System Administration Guide: Naming and Directory Services (FNS and NIS+)

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Preface

Solaris Administration Guide: Naming and Directory Services describes the set up, configuation, and administration of the Solaris 9 operating environment naming and directory services: NIS+ and FNS. This manual is part of the Solaris 9 Release System and Network Administration manual set.

Who Should Use This Book

This manual is written for experienced system and network administrators. Identify the audience.

Although this book introduces networking concepts relevant to Solaris naming and directory services, it explains neither the networking fundamentals nor the administration tools in the Solaris operating environment.

How This Book Is Organized

This manual is divided into parts according to the respective naming and directory services:

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Related Books

- *DNS and Bind*, by Cricket Liu and Paul Albitz, (O' Reilly, 1992)
- *Managing FNS and NFS*, by Hal Stern, (O' Reilly, 1993)

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What Typographic Conventions Mean

The following table describes the typographic changes used in this book.

TABLE P–1 Typographic Conventions

Typeface or Symbol	Meaning	Example
AaBbCc123	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `machine_name% you have mail.`
`AaBbCc123`	What you type, contrasted with on-screen computer output	`machine_name%` **`su`** `Password:`
AaBbCc123	Command-line placeholder: replace with a real name or value	To delete a file, type **`rm`** *filename*.
AaBbCc123	Book titles, new words, or terms, or words to be emphasized.	Read Chapter 6 in *User's Guide*. These are called *class* options. You must be *root* to do this.

Shell Prompts in Command Examples

The following table shows the default system prompt and superuser prompt for the C shell, Bourne shell, and Korn shell.

TABLE P–2 Shell Prompts

Shell	Prompt
C shell prompt	`machine_name%`
C shell superuser prompt	`machine_name#`
Bourne shell and Korn shell prompt	`$`
Bourne shell and Korn shell superuser prompt	`#`

PART I About Naming and Directory Services

For an overall introduction to the naming and directory services for the Solaris Operating Environment, see "Overview of Naming and Directory Services" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*. The following chapter describes the `nsswitch.conf` file, which you use to cooridinate the use of the different services.

CHAPTER 1

The Name Service Switch

This chapter describes the name service switch, what it does, and how clients use it to obtain naming information from one or more sources. You use the name service switch to coordinate usage of different naming services. For an overview of Solaris naming and directory services, please see "Overview of Naming and Directory Services" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

About the Name Service Switch

The name service switch is a file named `nsswitch.conf`. It controls how a client machine or application obtains network information. It is used by client applications that call any of the `getXbyY()` interfaces such as:

- `gethostbyname()`
- `getpwuid()`
- `getpwnam()`
- `getipnodebyname()`

Each machine has a switch file in its `/etc` directory. Each line of that file identifies a particular type of network information, such as host, password, and group, followed by one or more sources where the client is to look for that information.

A client can obtain naming information from one or more of the switch's sources. For example, an NIS+ client could obtain its hosts information from an NIS+ table and its password information from a local `/etc` file. In addition, it could specify the conditions under which the switch must use each source (see)Table 1–1.

The Solaris operating environment automatically loads an `nsswitch.conf` file into every machine's `/etc` directory as part of the installation process. Four alternate

(template) versions of the switch file are also loaded into `/etc` for LDAP, NIS, NIS+, or files. See "The `nsswitch.conf` Template Files" on page 40.

These four files are alternate default switch files. Each one is designed for a different primary naming service: `/etc` files, NIS, NIS+, or LDAP. When the Solaris software is first installed on a machine, the installer selects the machine's default naming service: NIS+, NIS, local files, or LDAP. During installation, the corresponding template file is copied to `nsswitch.conf`. For example, for a machine client using LDAP, the installation process copies `nsswitch.ldap` to `nsswitch.conf`. Unless you have an unusual namespace, the default template file as copied to `nsswitch.conf` should be sufficient for normal operation.

If you later change a machine's primary naming service, you copy the appropriate alternate switch file to `nsswitch.conf`. (See "The `nsswitch.conf` Template Files" on page 40.) You can also change the sources of particular types of network information used by the client by editing the appropriate lines of the `/etc/nsswitch.conf` file. The syntax for doing this is described below, and additional instructions are provided in "Modifying the name service switch" on page 44 .

Format of the `nsswitch.conf` File

The `nsswitch.conf` file is essentially a list of 16 types of information and the sources that `getXXbyYY()` routines search for that information. The 16 types of information, not necessarily in this order, are:

- `aliases`
- `bootparams`
- `ethers`
- `group`
- `hosts`
- `ipnodes`
- `netgroup`
- `netmasks`
- `networks`
- `passwd` (includes shadow information)
- `protocols`
- `publickey`
- `rpc`
- `services`
- `automount`
- `sendmailvars`

The following table provides a description of the kind of sources that can be listed in the switch file for the information types above.

TABLE 1–1 Switch File Information Sources

Information Sources	Description
`files`	A file stored in the client's `/etc` directory. For example, `/etc/passwd`
`nisplus`	An NIS+ table. For example, the `hosts` table.
`nis`	An NIS map. For example, the `hosts` map.
`compat`	Compat can be used for password and group information to support old-style + or - syntax in `/etc/passwd`, `/etc/shadow`, and `/etc/group` files.
`dns`	Can be used to specify that host information be obtained from DNS.
`ldap`	Can be used to specify entries be obtained from the LDAP directory.

Search Criteria

Single Source. If an information type has only one source, such as `nisplus` a routine using the switch searches for the information in that source *only*. If it finds the information, it returns a `success` status message. If it does not find the information, it stops searching and returns a different status message. What the routine does with the status message varies from routine to routine.

Multiple Sources. If a table has more than one source for a given information type, the switch directs the routine to start searching for the information in the first source that is listed. If it finds the information, it returns a `success` status message. If it does not find the information in the first source, it tries the next source. The routine will search through all of the sources until it has found the information it needs, or it is halted by encountering a `return` specification. If all of the listed sources are searched without finding the information, the routine stops searching and returns a `non-success` status message.

Switch Status Messages

If a routine finds the information, it returns a `success` status message. If it does not find the information for which it is looking, it returns one of three unsuccessful status messages, depending on the reason for not finding the information. Possible status messages are listed in the following table.

TABLE 1–2 Switch Search Status Messages

Status Message	Meaning of Message
`SUCCESS`	The requested entry was found in the specified source.

TABLE 1–2 Switch Search Status Messages *(Continued)*

Status Message	Meaning of Message
`UNAVAIL`	The source is not responding or is unavailable. That is, the NIS+ table, or NIS map, or `/etc` file could not be found or accessed.
`NOTFOUND`	The source responded with "No such entry." In other words, the table, map, or file was accessed but it did not contain the needed information.
`TRYAGAIN`	The source is busy; it might respond next time. In other words, the table, map, or file was found, but it could not respond to the query.

Switch Action Options

You can instruct the switch to respond to status messages with either of these two *actions* shown in the following table.

TABLE 1–3 Responses to Switch Status Messages

Action	Meaning
`return`	Stop looking for the information.
`continue`	Try the next source, if there is one.

Default Search Criteria

The combination of `nsswitch.conf` file status message and action option determines what the routine does at each step. This combination of status and action is called the search *criteria*.

The switch's default search criteria are the same for every source. Described in terms of the status messages listed above, they are:

- `SUCCESS=return`. Stop looking for the information and proceed using the information that has been found.
- `UNAVAIL=continue`. Go to the next `nsswitch.conf` file source and continue searching. If this is the last (or only) source, return with a `NOTFOUND` status.
- `NOTFOUND=continue`. Go to the next `nsswitch.conf` file source and continue searching. If this is the last (or only) source, return with a `NOTFOUND` status.
- `TRYAGAIN=continue`. Go to the next `nsswitch.conf` file source and continue searching. If this is the last (or only) source, return with a `NOTFOUND` status.

Because these are the default search criteria, they are assumed. That is, you do not have to explicitly specify them in the switch file. You can change these default search criteria by explicitly specifying some other criteria using the *STATUS=action* syntax show above. For example, the default action for a `NOTFOUND` condition is to continue

the search to the next source. To specify that for a particular type of information, such as networks, the search is to halt on a NOTFOUND condition, you would edit the networks line of the switch file to read:

```
networks: nis [NOTFOUND=return] files
```

The networks: nis [NOTFOUND=return] files line specifies a non-default criterion for the NOTFOUND status. Non-default criteria are delimited by square brackets.

In this example, the search routine behaves as follows:

- If the networks map is available and contains the needed information, the routine returns with a SUCCESS status message.
- If the networks map is not available, the routine returns with an UNAVAIL status message and by default continues on to search the appropriate /etc file.
- If the networks map is available and found, but it does not contain the needed information, the routine returns with a NOTFOUND message. But, instead of continuing on to search the appropriate /etc file, which would be the default behavior, the routine stops searching.
- If the networks map is busy, the routine returns with an TRYAGAIN status message and by default continues on to search the appropriate /etc file.

What if the Syntax is Wrong?

Client library routines contain compiled-in default entries that are used if an entry in the nsswitch.conf file is either missing or syntactically incorrect. These entries are the same as the switch file's defaults.

The name service switch assumes that the spelling of table and source names is correct. If you misspell a table or source name, the switch uses default values.

Auto_home and Auto_master

The switch search criteria for the auto_home and auto_master tables and maps is combined into one category called automount.

Timezone and the Switch File

The timezone table does not use the switch, so it is not included in the switch file's list.

Comments in `nsswitch.conf` Files

Any `nsswitch.conf` file line beginning with a comment character (#) is interpreted as a comment line and is ignored by routines that search the file.

When a comment character (#) is included in the middle of the line, characters preceding the comment mark *are* interpreted by routines that search the `nsswitch.conf` file. Characters to the right of the comment mark are interpreted as comments and ignored.

TABLE 1–4 Switch File Comment Examples

Type of Line	Example
Comment line (not interpreted).	# hosts: nisplus [NOTFOUND=return] files
Fully interpreted line.	hosts: nisplus [NOTFOUND=return] file
Partially interpreted line (the `files` element not interpreted)	hosts: nisplus [NOTFOUND=return] # files

Keyserver and `publickey` Entry in the Switch File

Caution – You must restart the keyserver after you make a change to `nsswitch.conf`

The keyserver reads the `publickey` entry in the name service switch configuration file only when the keyserver is started. As a result, if you change the switch configuration file, the keyserver does not become aware of changes to the `publickey` entry until it is restarted.

The `nsswitch.conf` Template Files

Four `nsswitch.conf` template files are provided with the Solaris operating environment to accommodate different naming services. Each of them provides a different default set of primary and subsequent information sources.

The four template files are:

- *NIS+ template file*. The `nsswitch.nisplus` configuration file specifies NIS+ as the primary source for all information except passwd, group, automount, and aliases. For those four files, the primary source is local `/etc` files and the secondary source is an NIS+ table. The `[NOTFOUND=return]` search criterion instructs the switch to stop searching the NIS+ tables if it receives a "No such entry" message from them. It searches through local files only if the NIS+ server is unavailable.
- *NIS template file*. The `nsswitch.nis` configuration file is almost identical to the NIS+ configuration file, except that it specifies NIS maps in place of NIS+ tables. Because the search order for passwd and group is `files nis`, you don't need to place the + entry in the `/etc/passwd` and `/etc/group` files.
- *Files template file*. The `nsswitch.files` configuration file specifies local `/etc` files as the only source of information for the machine. There is no "files" source for `netgroup`, so the client will not use that entry in the switch file.

Copy the template file that most closely meets your requirements to then`sswitch.conf` configuration file and then modify the file as needed.

For example, to use the LDAP template file, you would type the following command:

```
mymachine# cp nsswitch.ldap nsswitch.conf
```

The Default Switch Template Files

Here are the four switch files supplied with Solaris operating environment:

EXAMPLE 1–1 NIS+ Switch File Template (`nsswitch.nisplus`)

```
#
#
# /etc/nsswitch.nisplus:
#
#
# An example file that could be copied over to /etc/nsswitch.conf;
# it uses NIS+ (NIS Version 3) in conjunction with files.
#
# "hosts:" and "services:" in this file are used only if the
# /etc/netconfig file has a "-" for nametoaddr_libs of "inet"
# transports.

# the following two lines obviate the "+" entry in /etc/passwd
# and /etc/group.
passwd: files nisplus
group: files nisplus
# consult /etc "files" only if nisplus is down.
hosts: nisplus [NOTFOUND=return] files
# Uncomment the following line, and comment out the above, to use
# both DNS and NIS+. You must also set up the /etc/resolv.conf
# file for DNS name server lookup. See resolv.conf(4).
# hosts: nisplus dns [NOTFOUND=return] files
```

EXAMPLE 1–1 NIS+ Switch File Template (`nsswitch.nisplus`) *(Continued)*

```
services: nisplus [NOTFOUND=return] files
networks: nisplus [NOTFOUND=return] files
protocols: nisplus [NOTFOUND=return] files
rpc: nisplus [NOTFOUND=return] files
ethers: nisplus [NOTFOUND=return] files
netmasks: nisplus [NOTFOUND=return] files
bootparams: nisplus [NOTFOUND=return] files
publickey: nisplus
netgroup: nisplus
automount: files nisplus
aliases: files nisplus
sendmailvars: files nisplus
```

EXAMPLE 1–2 NIS Switch File Template

```
#
# /etc/nsswitch.nis:
#
# An example file that could be copied over to /etc/nsswitch.conf;
# it uses NIS (YP) in conjunction with files.
#
# "hosts:" and "services:" in this file are used only if the
# /etc/netconfig file has a "-" for nametoaddr_libs of "inet"
# transports.
#
# the following two lines obviate the "+" entry in /etc/passwd
# and /etc/group.
passwd: files nis
group: files nis
# consult /etc "files" only if nis is down.
hosts: nis [NOTFOUND=return] files
networks: nis [NOTFOUND=return] files
protocols: nis [NOTFOUND=return] files
rpc: nis [NOTFOUND=return] files
ethers: nis [NOTFOUND=return] files
netmasks: nis [NOTFOUND=return] files
bootparams: nis [NOTFOUND=return] files
publickey: nis [NOTFOUND=return] files
netgroup: nis
automount: files nis
aliases: files nis
# for efficient getservbyname() avoid nis
services: files nis
sendmailvars: files
```

EXAMPLE 1–3 Files Switch File Template

```
#
# /etc/nsswitch.files:
#
# An example file that could be copied over to /etc/nsswitch.conf;
```

EXAMPLE 1–3 Files Switch File Template *(Continued)*

```
# it does not use any naming service.
#
# "hosts:" and "services:" in this file are used only if the
# /etc/netconfig file has a "-" for nametoaddr_libs of "inet"
# transports.
passwd: files
group: files
hosts: files
networks: files
protocols: files
rpc: files
ethers: files
netmasks: files
bootparams: files
publickey: files
# At present there isn't a 'files' backend for netgroup;
# the system will figure it out pretty quickly, and will notuse
# netgroups at all.
netgroup: files
automount: files
aliases: files
services: files
sendmailvars: files
```

The `nsswitch.conf` File

The default `nsswitch.conf` file that is installed when you install the Solaris operating environment for the first time is determined by which naming service you select during the Solaris software installation process. Each line of that file identifies a particular type of network information, such as host, password, and group, followed by one or more sources, such as NIS+ tables, NIS maps, the DNS hosts table, or local `/etc`, where the client is to look for that information. When you chose a naming service, the switch template file for that service is copied to create the new `nsswitch.conf` file. For example, if you choose NIS+, the `nsswitch.nisplus` file is copied to create a new `nsswitch.conf` file.

An `/etc/nsswitch.conf` file is automatically loaded into every machine's `/etc` directory by the Solaris 9release software, along with the following alternate (template) versions:

- `/etc/nsswitch.nisplus`
- `/etc/nsswitch.nis`
- `/etc/nsswitch.files`

These alternate template files contain the default switch configurations used by the NIS+ and NIS services, local files, and LDAP. When the Solaris operating environment is first installed on a machine, the installer selects the machine's default naming

service: NIS+, NIS, local files, or LDAP. During installation, the corresponding template file is copied to `/etc/nsswitch.conf`. For example, for a machine client using NIS+, the installation process copies `nsswitch.nisplus` to `nsswitch.conf`.

Unless you have an unusual namespace, the default template file as copied to `nsswitch.conf`should be sufficient for normal operation.

Selecting a Different Configuration File

When you change a machine's naming service, you need to modify that machine's switch file accordingly. For example, if you change a machine's naming service from NIS to NIS+, you need to install a switch file appropriate for NIS+. You change switch files by copying the appropriate template file to `nsswitch.conf`.

If you are installing NIS+ on a machine using the NIS+ installation scripts, the NIS+ template script is copied to `nsswitch.conf` for you. In this case, you do not have to configure the switch file unless you want to customize it.

Before proceeding to change switch files, make sure the sources listed in the file are properly set up. In other words, if you are going to select the NIS+ version, the client must eventually have access to NIS+ service; if you are going to select the local files version, those files must be properly set up on the client.

▼ Modifying the name service switch

To change to a switch file, follow these steps:

1. **Log in to the client as superuser.**
2. **Copy the alternate file appropriate for the machine's naming service over the `nsswitch.conf` file.**

   NIS+ Version (done automatically for you by NIS+ scripts)

   ```
   client1# cd /etc
   client1# cp nsswitch.nisplus nsswitch.conf
   ```

   NIS Version

   ```
   client1# cd /etc
   client1# cp nsswitch.nis nsswitch.conf
   ```

   Local `/etc` Files Version

   ```
   client1# cd /etc
   client1# cp nsswitch.files nsswitch.conf
   ```

3. **Reboot the machine.**

   The `nscd` naming service cache daemon caches switch information. Some library routines do not periodically check the `nsswitch.conf` file to see whether it has been changed. You must reboot the machine to make sure that the daemon and those routines have the latest information in the file.

How to Enable an NIS+ Client to Use IPv6

1. **Log in as superuser.**
2. **Edit the `/etc/nsswitch.conf` file.**
3. **Add the new `ipnodes` source and specify the naming service (such as ldap).**

   ```
   ipnodes: ldap [NOTFOUND=return] files
   ```

   `ipnodes` defaults to `files`. During the transition from IPv4 to IPv6, where all naming services are not aware of IPv6 addresses, you should accept the `files` default. Otherwise, unnecessary delays might result during the resolution of addresses.
4. **Save the file and reboot the machine.**

   Because the `nscd` daemon caches this information, which it reads at start up, you must reboot the machine now.

Ensuring Compatibility With +/- Syntax

If +/- is used in `/etc/passwd`, `/etc/shadow`, and `/etc/group` files, you will need to modify the `nsswitch.conf`file to insure compatibility.

- *NIS+*. To provide +/- semantics with NIS+, change the `passwd` and `groups` sources to `compat` and add a `passwd_compat: nisplus` entry to the `nsswitch.conf` file after the `passwd` or `group` entry as shown below:

  ```
  passwd: compat
  passwd_compat: nisplus
  group: compat
  group_compat: nisplus
  ```

The above specifies that client routines obtain their network information from `/etc` files and NIS+ tables as indicated by the `+/-` entries in the files.

- *NIS*. To provide the same syntax as in the Sun Operating Environment 4.x release, change the `passwd` and `groups` sources to `compat`.

```
passwd: compat
group: compat
```

This specifies that /etc files and NIS maps as indicated by the +/- entries in the files.

Note – Users working on a client machine being served by an NIS+ server running in NIS compatibility mode cannot run `ypcat` on the netgroup table. Doing so will give you results as if the table were empty even if it has entries.

The Switch File and Password Information

Caution – `files` should be the first source in the `nsswitch.conf` file for `passwd` information. If `files` is not the first source, network security could be weakened and users could encounter log in difficulty.

For example, in an NIS+ environment, the `passwd` line of the `nsswitch.conf` file should look like this:

```
passwd: files nisplus
```

In an NIS environment, the `passwd` line of the `nsswitch.conf` file should look like this:

```
passwd: files nis
```

PART II NIS+ Setup and Configuration

This part describes the setup and configuration of the NIS+ naming service in the Solaris operating environment.

CHAPTER 2

NIS+: An Introduction

This chapter provides an overview of the *Network Information Service Plus* (NIS+)

About NIS+

NIS+ is a network name service similar to NIS but with more features. NIS+ is not an extension of NIS. It is a new software program.

The NIS+ name service is designed to conform to the shape of the organization that installs it, wrapping itself around the bulges and corners of almost any network configuration.

NIS+ enables one to store information about machine addresses, security information, mail information, Ethernet interfaces, and network services in central locations where all machines on a network can have access to it. This configuration of network information is referred to as the NIS+ *namespace*.

The NIS+ namespace is hierarchical, and is similar in structure to the UNIX directory file system. The hierarchical structure allows an NIS+ namespace to be configured to conform to the logical hierarchy of an organization. An NIS+ namespace can be divided into multiple domains that can be administered autonomously. Clients may have access to information in other domains in addition to their own if they have the appropriate permissions.

NIS+ uses a client-server model to store and have access to the information contained in an NIS+ namespace. Each domain is supported by a set of servers. The principal server is called the *master* server and the backup servers are called *replicas*. The network information is stored in 16 standard NIS+ tables in an internal NIS+ database. Both master and replica servers run NIS+ server software and both maintain copies of

NIS+ tables. Changes made to the NIS+ data on the master server are incrementally propagated automatically to the replicas.

NIS+ includes a sophisticated security system to protect the structure of the namespace and its information. It uses authentication and authorization to verify whether a client's request for information should be fulfilled. *Authentication* determines whether the information requester is a valid user on the network. *Authorization* determines whether a particular user is allowed to have or modify the information requested.

Solaris clients use the name service switch (`/etc/nsswitch.conf` file) to determine from where a machine will retrieve network information. Such information may be stored in local `/etc` files, NIS, DNS, or NIS+. one can specify different sources for different types of information in the name service switch. A complete description of the switch software and its associated files is provided in Chapter 1

What NIS+ Can Do for You

NIS+ has some major advantages over NIS:

- Secure data access
- Hierarchical and decentralized network administration
- Very large namespace administration
- Access to resources across domains
- Incremental updates

Within the security system described in "NIS+ Security" on page 54, one can control a particular user's access to an individual entry in a particular table. This approach to security helps to keep the system secure and administration tasks to be more broadly distributed without risking damage to the entire NIS+ namespace or even to an entire table.

The NIS+ hierarchical structure allows for multiple domains in one namespace. Division into domains makes administration easier to manage. Individual domains can be administered completely independently, thereby relieving the burden on system administrators who would otherwise each be responsible for very large namespaces. As mentioned above, the security system in combination with decentralized network administration allows for a sharing of administrative work load.

Even though domains may be administered independently, all clients can be granted permission to access information across all domains in a namespace. Since a client can only see the tables in its own domain, the client can only have access to tables in other domains by explicitly addressing them.

Incremental updates mean faster updates of information in the namespace. Since domains are administered independently, changes to master server tables only have to be propagated to that master's replicas and not to the entire namespace. Once propagated, these updates are visible to the entire namespace immediately.

How NIS+ Differs From NIS

The *Network Information Service Plus* (NIS+) differs from the *Network Information Service* (NIS) in several ways. NIS+ has many new features, and the terminology it uses for concepts similar to NIS is different. Look in the Glossary if one see a term one don't recognize. The following table gives an overview of the major differences between NIS and NIS+.

TABLE 2–1 Differences Between NIS and NIS+

NIS	NIS+
Flat domains—no hierarchy	Hierarchical laonet—data stored in different levels in the namespace
Data stored in two column maps	Data stored in multi-column tables
Uses no authentication	Uses DES authentication
Single choice of network information source	Name service switch—lets client choose information source: NIS, NIS+, DNS, or local `/etc` files
Updates delayed for batch propagation	Incremental updates propagated immediately

NIS+ was designed to replace NIS. NIS addresses the administration requirements of client-server computing networks prevalent in the 1980s. At that time client-server networks did not usually have more than a few hundred clients and a few multipurpose servers. They were spread across only a few remote sites, and since users were sophisticated and trusted, they did not require security.

However, client-server networks have grown tremendously since the mid-1980s. They now range from 100-10,000 multi-vendor clients supported by 10-100 specialized servers located in sites throughout the world, and they are connected to several "untrusted" public networks. In addition, the information client-server networks store changes much more rapidly than it did during the time of NIS. The size and complexity of these networks required new, autonomous administration practices. NIS+ was designed to address these requirements.

The NIS namespace, being flat, centralizes administration. Because networks in the 1990s require scalability and decentralized administration, the NIS+ namespace was designed with hierarchical domains, like those of DNS.

For example,Figure 2–1 shows a sample company with a parent domain named `doc`, and two subdomains named `sales` and `manf`.

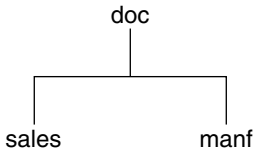


FIGURE 2–1 Example of Hierarchical Domains

This design enables NIS+ to be used in a range of networks, from small to very large. It also allows the NIS+ service to adapt to the growth of an organization. For example, if a corporation splits itself into two divisions, its NIS+ namespace could be divided into two domains that could be administered autonomously. Just as the Internet delegates administration of domains downward, NIS+ domains can be administered more or less independently of each other.

Although NIS+ uses a domain hierarchy similar to that of DNS, an NIS+ domain is much more than a DNS domain. A DNS domain only stores name and address information about its clients. An NIS+ domain, on the other hand, is a collection of *information* about the machines, users, and network services in a portion of an organization.

Although this division into domains makes administration more autonomous and growth easier to manage, it does not make information harder to access. Clients have the same access to information in other domains as they would have had under one umbrella domain. A domain can even be administered from within another domain.

The principal NIS+ server is called the *master* server, and the backup servers are called *replicas*. Both master and replica servers run NIS+ server software and both maintain copies of NIS+ tables. Tables store information in NIS+ the way maps store information in NIS. The principal server stores the original tables, and the backup servers store copies.

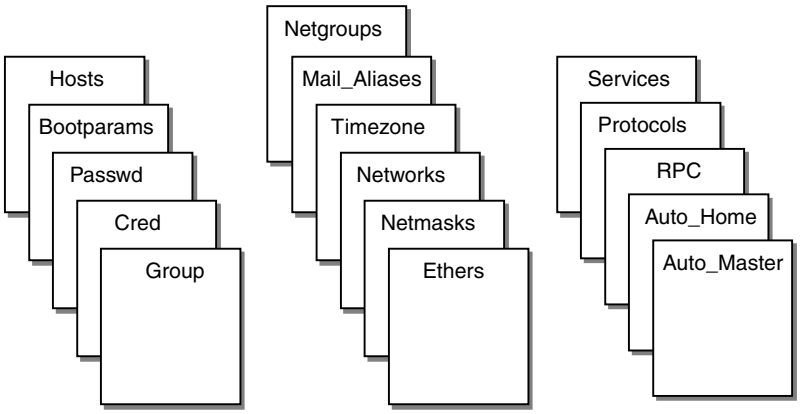
However, NIS+ uses an updating model that is completely different from the one used by NIS. Since at the time NIS was developed, the type of information it would store changed infrequently, NIS was developed with an update model that focused on stability. Its updates are handled manually and, in large organizations, can take more than a day to propagate to all the replicas. Part of the reason for this is the need to remake and propagate an entire map every time any information in the map changes.

NIS+, however, accepts *incremental* updates. Changes must still be made on the master server, but once made they are automatically propagated to the replica servers and immediately made available to the entire namespace. one don't have to "make" any maps or wait for propagation.

Details about NIS+ domain structure, servers, and clients, are provided in "Domains" on page 63, "Servers" on page 65, and "NIS+ Clients and Principals" on page 69, respectively.

An NIS+ domain can be connected to the Internet through its NIS+ clients, using the name service switch (see Example 1–1). The client, if it is also a DNS client, can set up its switch configuration file to search for information in either DNS zone files or NIS maps—in addition to NIS+ tables.

NIS+ stores information in *tables* instead of maps or zone files. NIS+ provides 16 types of predefined, or *system*, tables:



Each table stores a different type of information. For instance, the hosts table stores information about machine addresses, while the passwd table stores information about users of the network.

NIS+ tables provide two major improvements over the maps used by NIS. First, one can search an NIS+ table by any column, not just the first column (sometimes referred to as the "key"). This eliminates the need for duplicate maps, such as the `hosts.byname` and `hosts.byaddr` maps used by NIS. Second, one can access and manipulate the information in NIS+ tables at three levels of granularity: the table level, the entry level, and the column level. NIS+ tables—and the information stored in them—are described in Chapter 10.

one can use NIS in conjunction with NIS+ under the following principles and conditions:

- Servers within a domain. While one can have both NIS and NIS+ servers operating in the same domain, doing so is not recommended for long periods. As a general rule, using both services in the same domain should be limited to a relatively short transition period from NIS to NIS+.
- Subdomains. If the master server of oner root domain is running NIS+, one can set up subdomains whose servers are all running NIS. (If oner root domain master server is running NIS, one cannot have subdomains.)
- machines within a domain.
  - If a domain's servers are running NIS+, individual machines within that domain can be set up to use either NIS+, NIS, or `/etc` files for their name service information. In order for an NIS+ server to supply the needs of an NIS client, the NIS+ server must be running in NIS-Compatibility mode.
  - If a domain's servers are running NIS, individual machines within that domain can be set up to use either NIS or `/etc` files for name services (they cannot use NIS+).

  The service a machine uses for various name services is controlled by the machine's `nsswitch.conf` file. This file is called the *switch* file. See Chapter 1 for further information.

NIS+ Security

NIS+ protects the structure of the namespace, and the information it stores, by the complementary processes of *authorization* and *authentication*.

- *Authorization*. Every component in the namespace specifies the type of operation it will accept and from whom. This is authorization.
- *Authentication*. NIS+ attempts to *authenticate* every request for access to the namespace. Requests come from NIS+ *principals*. An NIS+ principal can be a process, machine, root, or a user. Valid NIS+ principals possess an NIS+ *credential*. NIS+ authenticates the originator of the request (principal) by checking the principal's credential.

If the principal possesses an authentic (valid) credential, and if the principal's request is one that the principal is authorized to perform, NIS+ carries out the request. If either the credential is missing or invalid, or the request is not one the principal is authorized to perform, NIS+ denies the request for access. An introductory description of the entire NIS+ security system is provided in Chapter 11.

Solaris 1.x Releases and NIS-Compatibility Mode

NIS+ can be used by machines running NIS with Solaris 1x or 2x Release software. In other words, machines within an NIS+ domain can have their `nsswitch.conf` files set to `nis` rather than `nisplus`. To access NIS+ service on machines running NIS, one must run the NIS+ servers in *NIS-compatibility mode*.

NIS-compatibility mode enables an NIS+ server running Solaris operating environment to answer requests from NIS clients while continuing to answer requests from NIS+ clients. NIS+ does this by providing two service interfaces. One responds to NIS+ client requests, while the other responds to NIS client requests.

This mode does not require any additional setup or changes to NIS clients. In fact, NIS clients are not even aware that the server that is responding isn't an NIS server—except that an NIS+ server running in NIS-compatibility mode does not support the `ypupdate` and `ypxfr` protocols and thus it cannot be used as a replica or master NIS server. For more information on NIS-compatibility mode, see Appendix B.

Two more differences need to be pointed out. First, instructions for setting up a server in NIS-compatibility mode are slightly different than those used to set up a standard NIS+ server. . Second, NIS-compatibility mode has security implications for tables in the NIS+ namespace. Since the NIS client software does not have the capability to provide the credentials that NIS+ servers expect from NIS+ clients, all their requests end up classified as *unauthenticated*. Therefore, to allow NIS clients to access information in NIS+ tables, those tables must provide access rights to unauthenticated requests. This is handled automatically by the utilities used to set up a server in NIS-compatibility mode, as described in Part 2. However, to understand more about the authentication process and NIS-compatibility mode, see Chapter 11.

NIS+ Administration Commands

NIS+ provides a full set of commands for administering a namespace. The table below, summarizes them.

TABLE 2–2 NIS+ Namespace Administration Commands

Command	Description
`nisaddcred`	Creates credentials for NIS+ principals and stores them in the cred table.
`nisaddent`	Adds information from `/etc` files or NIS maps into NIS+ tables.
`nisauthconf`	Optionally configure Diffie-Hellman key length.
`nisbackup`	Backs up NIS directories.
`nis_cachemgr`	Starts the NIS+ cache manager on an NIS+ client.
`niscat`	Displays the contents of NIS+ tables.
`nis_checkpoint`	Forces service to checkpoint data that has been entered in the log but not checkpointed to disk.
`nischgrp`	Changes the group owner of an NIS+ object.
`nischmod`	Changes an object's access rights.
`nischown`	Changes the owner of an NIS+ object.
`nischttl`	Changes an NIS+ object's time-to-live value.
`nisclient`	Initializes NIS+ principals.
`nisdefaults`	Lists an NIS+ object's default values: domain name, group name, machine name, NIS+ principal name, access rights, directory search path, and time-to-live
`nisgrep`	Searches for entries in an NIS+ table.
`nisgrpadm`	Creates or destroys an NIS+ group, or displays a list of its members. Also adds members to a group, removes them, or tests them for membership in the group.
`nisinit`	Initializes an NIS+ client or server.
`nisln`	Creates a symbolic link between two NIS+ tables.
`nislog`	Displays the contents of NIS+ transaction log.
`nisls`	Lists the contents of an NIS+ directory.
`nismatch`	Searches for entries in an NIS+ table.
`nismkdir`	Creates an NIS+ directory and specifies its master and replica servers.
`nispasswd`	Changes password information stored in the NIS+ passwd table. (Rather than using `nispasswd`, one should use `passwd` or `passwd -r nisplus`.)
`nis_ping`	Forces a replica to update its data from the master server.

TABLE 2–2 NIS+ Namespace Administration Commands *(Continued)*

Command	Description
`nispopulate`	Populates the NIS+ tables in a new NIS+ domain.
`nisprefadm`	Specifies the order in which clients are to seek NIS+ information from NIS+ servers.
`nisrestore`	Restores previously backed up NIS+ directories and can also be used to quickly bring online new NIS+ replica servers.
`nisrm`	Removes NIS+ objects (except directories) from the namespace.
`nisrmdir`	Removes NIS+ directories and replicas from the namespace.
`nisserver`	Shell script used to set up a new NIS+ server.
`nissetup`	Creates `org_dir` and `groups_dir` directories and a complete set of (unpopulated) NIS+ tables for an NIS+ domain.
`nisshowcache`	Lists the contents of the NIS+ shared cache maintained by the NIS+ cache manager.
`nisstat`	Reports statistics and other information about an NIS+ server.
`nistbladm`	Creates or deletes NIS+ tables, and adds, modifies or deletes entries in an NIS+ table.
`nistest`	Reports the current state of the NIS+ namespace.
`nisupdkeys`	Updates the public keys stored in an NIS+ object.
`passwd`	Changes password information stored in the NIS+ Passwd table. Also administers password aging and other password-related parameters.

NIS+ API

The NIS+ application programmer's interface (API) is a group of functions that can be called by an application to access and modify NIS+ objects. The NIS+ API has 54 functions that fall into nine categories:

- Object manipulation functions (`nis_names()`)
- Table access functions (`nis_tables()`)
- Local name functions (`nis_local_names()`)
- Group manipulation functions (`nis_groups()`)
- Application subroutine functions (`nis_subr()`)
- Miscellaneous functions (`nis_misc()`)
- Database access functions (`nis_db()`)

- Error message display functions (`nis_error()`)
- Transaction log functions (`nis_admin()`)

Setup and Configuration Preparation

Before configuring oner NIS+ namespace, one must:

- Install properly configured `nsswitch.conf` files on all the machines that use NIS+. See Chapter 2 for details.
- Plan oner NIS+ laonet. This includes:
  - Planning oner namespace. What will oner domain name be? Will one have subdomains, and if so how will they be organized? Which machines will be in which domain? Will oner domain be connected to a higher domain or to the Internet?
  - Determining oner server requirements. How many replica servers will be needed for each domain? What type of server, processor speed, and memory is required? How much server disk space is needed?

    See the Appendix Bfor a detailed description of these and other planning issues, and recommended guidelines.
- Prepare oner existing namespace (if any). See “Preparing the Existing Namespace” on page 82.
- Choose a root server machine.
- Make sure that one have at least one system already running at oner site that can be used as oner root master server. This machine must contain at least one user (root) in the system information files, such as `/etc/passwd`. (Machines usually come with root in the system files, so this should not be a problem.)

NIS and NIS+

Both NIS and NIS+ perform some of the same tasks. NIS+, however, allows for hierarchical domains, namespace security, and other features that NIS does not provide. For a more detailed comparison between NIS and NIS+, see “Differences Between NIS and NIS+” on page 593.

one can use NIS in conjunction with NIS+ under the following principles and conditions:

- Servers within a domain. While one can have both NIS and NIS+ servers operating in the same domain, doing so is not recommended for long periods. As a general

rule, using both services in the same domain should be limited to a relatively short transition period from NIS to NIS+. If some clients need NIS service, one can run NIS+ in NIS compatibility mode as explained inAppendix B .

- Subdomains. If the master server of oner root domain is running NIS+, one can set up subdomains whose servers are all running NIS. (If oner root domain master server is running NIS, one cannot have subdomains.) This might be useful in situations where one are moving from NIS to NIS+. For example, suppose oner enterprise had separate, multiple NIS domains, possibly at different sites. Now one need to link them all together into a single, hierarchical multi-domain namespace under NIS+. By first setting up the root domain under NIS+, one can then designate the legacy NIS domains as sub-domains that continue to run NIS until it is convenient to switch them over to NIS+.
- Machines within a domain.
  - If a domain's servers are running NIS+, individual machines within that domain can be set up to use either NIS+, NIS, or `/etc` files for their name service information. In order for an NIS+ server to supply the needs of an NIS client, the NIS+ server must be running in NIS-Compatibility mode as described in "USING NIS COMPATABILITY MODE: An Introduction" on page 631.
  - If a domain's servers are running NIS, individual machines within that domain can be set up to use either NIS or `/etc` files for name services (they cannot use NIS+).

NIS+ Files and Directories

Table 2–3 lists the UNIX directories used to store NIS+ files.

TABLE 2–3 Where NIS+ Files are Stored

Directory	Where	Contains
`/usr/bin`	All machines	NIS+ user commands
`/usr/lib/nis`	All machines	NIS+ administrator commands
`/usr/sbin`	All machines	NIS+ daemons
`/usr/lib/`	All machines	NIS+ shared libraries
`/var/nis/data`	NIS+ server	Data files used by NIS+ server
`/var/nis`	NIS+ server	NIS+ working files
`/var/nis`	NIS+ client machines	Machine-specific data files used by NIS+

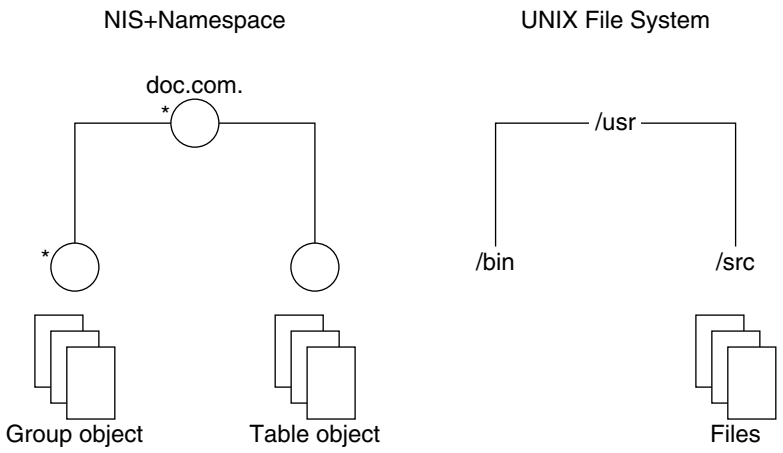
Caution – Do not rename the `/var/nis` or `/var/nis/data` directories or any of the files in these directories that were created by `nisinit` or any of the other NIS+ setup procedures. In Solaris Release 2.4 and earlier versions, the `/var/nis` directory contained two files named *hostname*`.dict` and *hostname*`.log`. It also contained a subdirectory named `/var/nis/`*hostname*. Starting with Solaris Release 2.5, the two files were named `trans.log` and `data.dict`, and the subdirectory was named `/var/nis/data`. The *content* of the files was also changed and they are not backward compatible with Solaris Release 2.4 or earlier. Thus, if one rename either the directories or the files to match the Solaris Release 2.4 patterns, the files will not work with *either* the Solaris 2.4 Release or the current version of `rpc.nisd`. Therefore, one should not rename either the directories or the files.

Note – With the Solaris operating environment, the NIS+ data dictionary (`/var/nis/data.dict`) is now machine independent. This allows one to easily change the name of an NIS+ server. one can also now use the NIS+ backup and restore capabilities to transfer NIS+ data from one server to another. See Chapter 16, NIS+ Backup and Restore.

Structure of the NIS+ Namespace

The NIS+ namespace is the arrangement of information stored by NIS+. The namespace can be arranged in a variety of ways to suit the needs of an organization. For example, if an organization had three divisions, its NIS+ namespace would likely be divided into three parts, one for each division. Each part would store information about the users, machines, and network services in its division, but the parts could easily communicate with each other. Such an arrangement would make information easier for the users to access and for the administrators to maintain.

Although the arrangement of an NIS+ namespace can vary from site to site, all sites use the same structural components: directories, tables, and groups. These components are called NIS+ *objects*. NIS+ objects can be arranged into a hierarchy that resembles a UNIX file system. For example, the illustration below shows, on the left, a namespace that consists of three directory objects, three group objects, and three table objects; on the right it shows a UNIX file system that consists of three directories and three files:



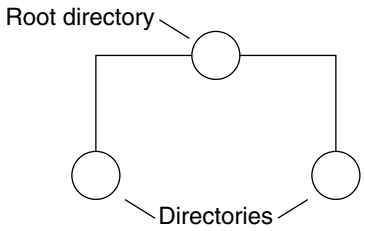
* Directory objects.

Although an NIS+ namespace resembles a UNIX file system, it has five important differences:

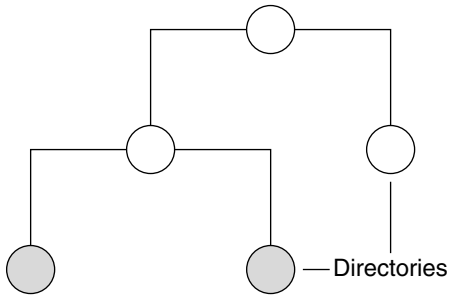
- Although both use directories, the other objects in an NIS+ namespace are tables and groups, not files.
- The NIS+ namespace is administered only through NIS+ administration commands or graphical user interfaces designed for that purpose, such as the Solstice AdminSuite tools; it cannot be administered with standard UNIX file system commands or GUIs.
- The names of UNIX file system components are separated by slashes (`/usr/bin`), but the names of NIS+ namespace objects are separated by dots (`doc.com.`).
- The "root" of a UNIX file system is reached by stepping through directories from right to *left* (`/usr/src/file1`), while the root of the NIS+ namespace is reached by stepping from left to *right* (`sales.doc.com.`).
- Because NIS+ object names are structured from left to right, a fully qualified name always ends in a dot. Any NIS+ object ending in a dot is assumed to be a fully qualified name. NIS+ object names that do not end in a dot are assumed to be relative names.

Directories

Directory objects are the skeleton of the namespace. When arranged into a tree- like structure, they divide the namespace into separate parts. one may want to visualize a directory hierarchy as an upside-down tree, with the root of the tree at the top and the leaves toward the bottom. The topmost directory in a namespace is the *root* directory. If a namespace is flat, it has only one directory, but that directory is nevertheless the root directory. The directory objects beneath the root directory are simply called "directories":



A namespace can have several levels of directories:

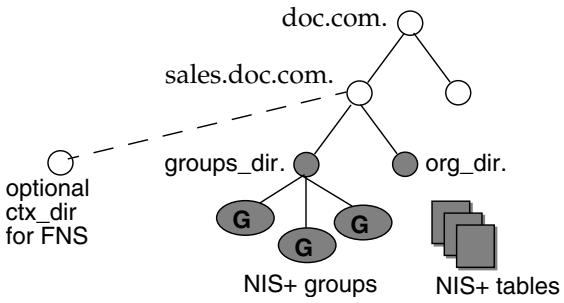


When identifying the relation of one directory to another, the directory beneath is called the *child* directory and the directory above is called the *parent* directory.

Whereas UNIX directories are designed to hold UNIX files, NIS+ directories are designed to hold NIS+ objects: other directories, tables and groups. Each NIS+ domain-level directory contains the following sub-directories:

- `groups_dir`. Stores NIS+ group information.
- `org_dir`. Stores NIS+ system tables.

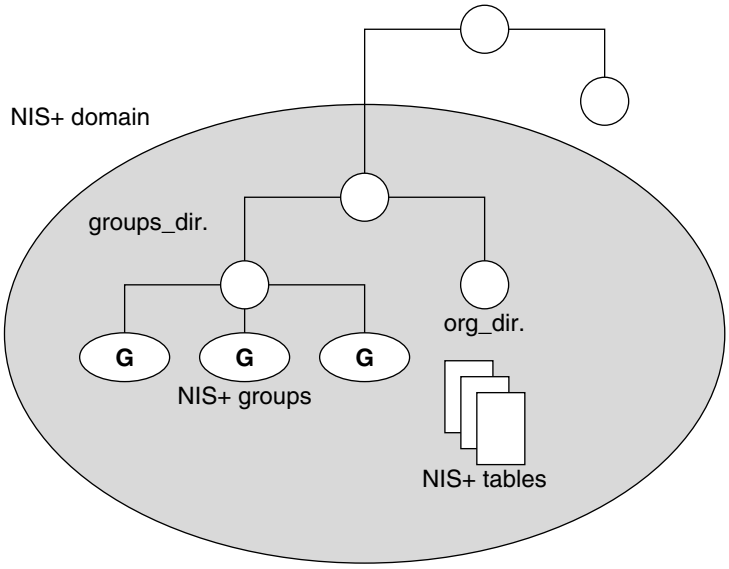
- `ctx_dir`. This directory is only present if one are using FNS.



Technically, one can arrange directories, tables, and groups into any structure that one like. However, NIS+ directories, tables, and groups in a namespace are normally arranged into configurations called *domains*. Domains are designed to support separate portions of the namespace. For instance, one domain may support the Sales Division of a company, while another may support the Manufacturing Division.

Domains

An NIS+ domain consists of a directory object, its `org_dir` directory, its `groups_dir` directory, and a set of NIS+ tables.



NIS+ domains are not *tangible* components of the namespace. They are simply a convenient way to *refer* to sections of the namespace that are used to support real-world organizations.

For example, suppose the DOC company has Sales and Manufacturing divisions. To support those divisions, its NIS+ namespace would most likely be arranged into three major directory groups, with a structure that looked like this:

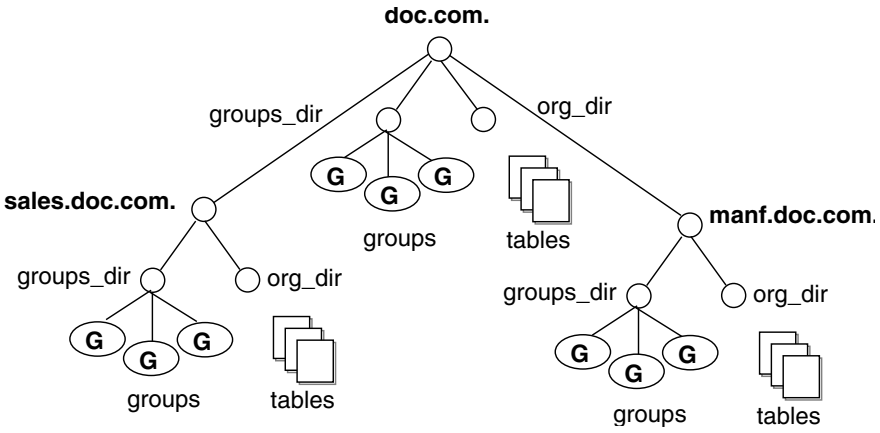


FIGURE 2–2 Example NIS+ Directory Structure

Instead of referring to such a structure as three directories, six subdirectories, and several additional objects, referring to it as three NIS+ domains is more convenient:

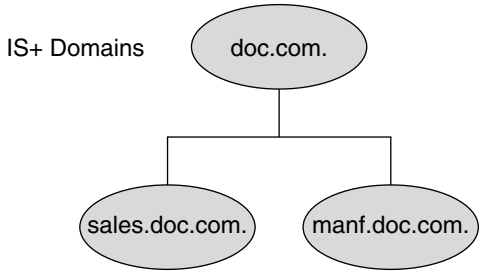
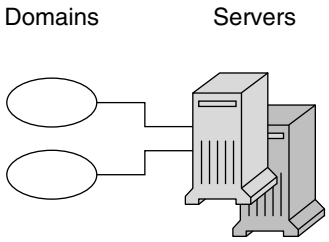


FIGURE 2–3 Example NIS+ Domains

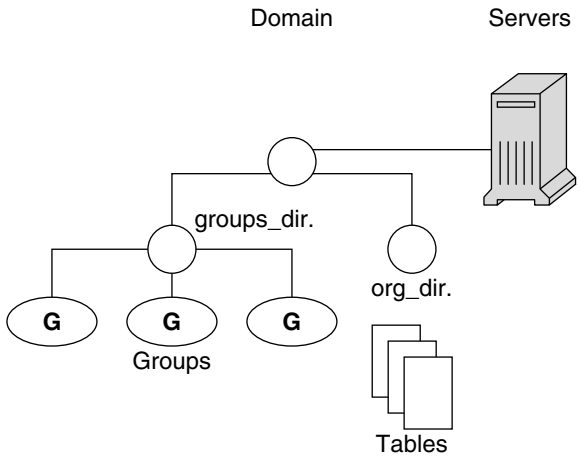
Servers

Every NIS+ domain is supported by a set of NIS+ *servers*. The servers store the domain's directories, groups, and tables, and answer requests for access from users,

administrators, and applications. Each domain is supported by only one set of servers. However, a single set of servers can support more than one domain:



Remember that a domain is not an object but only refers to a collection of objects. Therefore, a server that supports a domain is not actually associated with the domain, but with the domain's main *directory*:

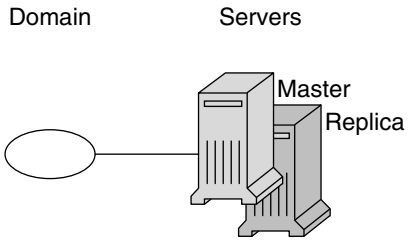


This connection between the server and the directory object is established during the process of setting up a domain. Although instructions are provided in Part 2, one thing is important to mention now: when that connection is established, the directory object stores the name and IP address of its server. This information is used by clients to send requests for service, as described later in this section.

Any Solaris operating environment based machine can be an NIS+ server. The software for both NIS+ servers and clients is bundled together into the release. Therefore, any machine that has the Solaris Release 2 software installed can become a server or a client, or both. What distinguishes a client from a server is the *role* it is playing. If a machine is providing NIS+ service, it is acting as an NIS+ server. If it is requesting NIS+ service, it is acting as an NIS+ client.

Because of the need to service many client requests, a machine that will act as an NIS+ server might be configured with more computing power and more memory than the average client. And, because it needs to store NIS+ data, it might also have a larger disk. However, other than hardware to improve its performance, a server is not inherently different from an NIS+ client.

Two types of servers support an NIS+ domain: a master and its replicas:



The master server of the root domain is called the *root master* server. A namespace has only one root master server. The master servers of other domains are simply called master servers. Likewise, there are root replica servers and regular replica servers.

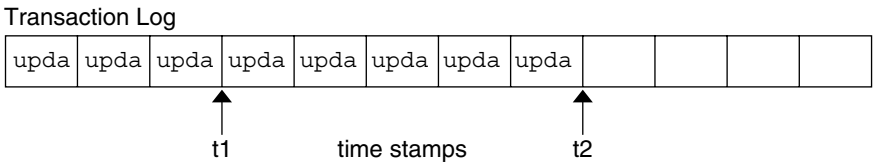
Both master and replica servers store NIS+ tables and answer client requests. The master, however, stores the master copy of a domain's tables. The replicas store only duplicates. The administrator loads information into the tables in the master server, and the master server propagates it to the replica servers.

This arrangement has two benefits. First, it avoids conflicts between tables because only one set of master tables exists; the tables stored by the replicas are only copies of the masters. Second, it makes the NIS+ service much more *available*. If either the master or a replica is down, another server can act as a backup and handle the requests for service.

How Servers Propagate Changes

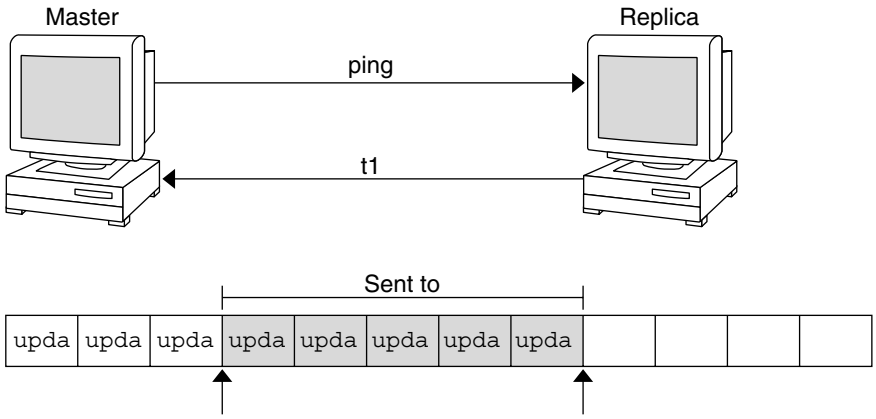
An NIS+ master server implements updates to its objects immediately; however, it tries to "batch" several updates together before it propagates them to its replicas. When a master server receives an update to an object, whether a directory, group, link, or table, it waits about two minutes for any other updates that may arrive. Once it is finished waiting, it stores the updates in two locations: on disk and in a *transaction log* (it has already stored the updates in memory).

The transaction log is used by a master server to store changes to the namespace until they can be propagated to replicas. A transaction log has two primary components: updates and time stamps.



An update is an actual copy of a changed object. For instance, if a directory has been changed, the update is a complete copy of the directory object. If a table entry has been changed, the update is a copy of the actual table entry. The time stamp indicates the time at which an update was made by the master server.

After recording the change in the transaction log, the master sends a message to its replicas, telling them that it has updates to send them. Each replica replies with the time stamp of the last update it received from the master. The master then sends each replica the updates it has recorded in the log since the replica's time stamp:



When the master server updates *all* its replicas, it clears the transaction log. In some cases, such as when a new replica is added to a domain, the master receives a time stamp from a replica that is before its earliest time stamp still recorded in the transaction log. If that happens, the master server performs a full *resynchronization*, or *resync*. A resync downloads all the objects and information stored in the master down to the replica. During a resync, both the master and replica are busy. The replica cannot answer requests for information; the master can answer read requests but

cannot accept update requests. Both respond to requests with a `Server Busy - Try Again` or similar message.

NIS+ Clients and Principals

NIS+ principals are the entities (clients) that submit requests for NIS+ services.

Principal

An NIS+ principal may be someone who is logged in to a client machine as a regular user or someone who is logged in as superuser (root). In the first instance, the request actually comes from the client user; in the second instance, the request comes from the client machine. Therefore, an NIS+ principal can be a client user or a client machine.

(An NIS+ principal can also be the entity that supplies an NIS+ service from an NIS+ server. Since all NIS+ servers are also NIS+ clients, much of this discussion also applies to servers.)

Client

An NIS+ client is a machine that has been set up to receive NIS+ service. Setting up an NIS+ client consists of establishing security credentials, making it a member of the proper NIS+ groups, verifying its home domain, verifying its switch configuration file and, finally, running the NIS+ initialization script. (Complete instructions are provided in Part 2.)

An NIS+ client can access any part of the namespace, subject to security constraints. In other words, if it has been authenticated and has been granted the proper permissions, it can access information or objects in any domain in the namespace.

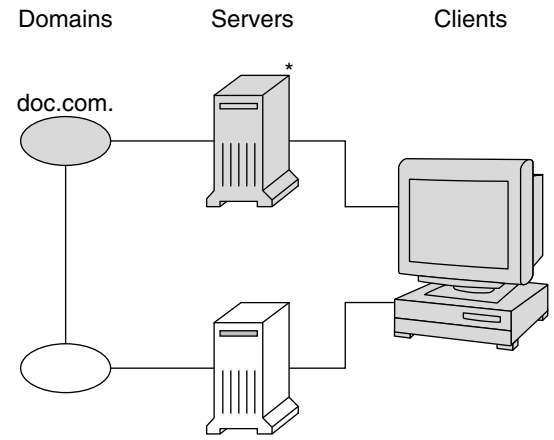
Although a client can access the entire namespace, a client *belongs* to only one domain, which is referred to as its *home* domain. A client's home domain is usually specified during installation, but it can be changed or specified later. All the information about a client, such as its IP address and its credentials, is stored in the NIS+ tables of its home domain.

There is a subtle difference between being an NIS+ client and being listed in an NIS+ table. Entering information about a machine into an NIS+ table does not automatically make that machine an NIS+ client. It simply makes information about that machine

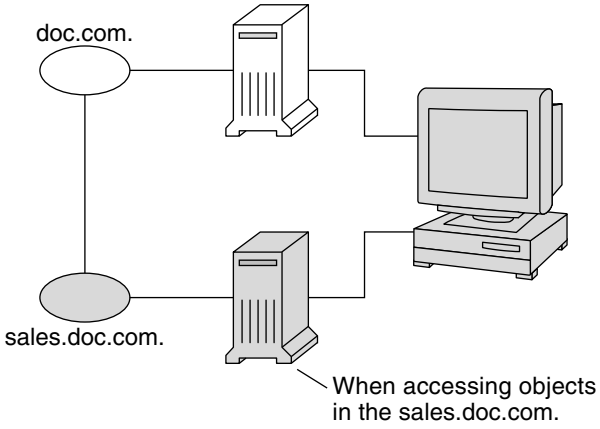
available to all NIS+ clients. That machine cannot request NIS+ service unless it is actually set up as an NIS+ client.

Conversely, making a machine an NIS+ client does not enter information about that machine into an NIS+ table. It simply allows that machine to receive NIS+ service. If information about that machine is not explicitly entered into the NIS+ tables by an administrator, other NIS+ clients will not be able to get it.

When a client requests access to the namespace, it is actually requesting access to a particular domain in the namespace. Therefore, it sends its request to the server that supports the domain it is trying to access. Here is a simplified representation:



* When accessing objects in the doc.com domain, the client is supported by this server.

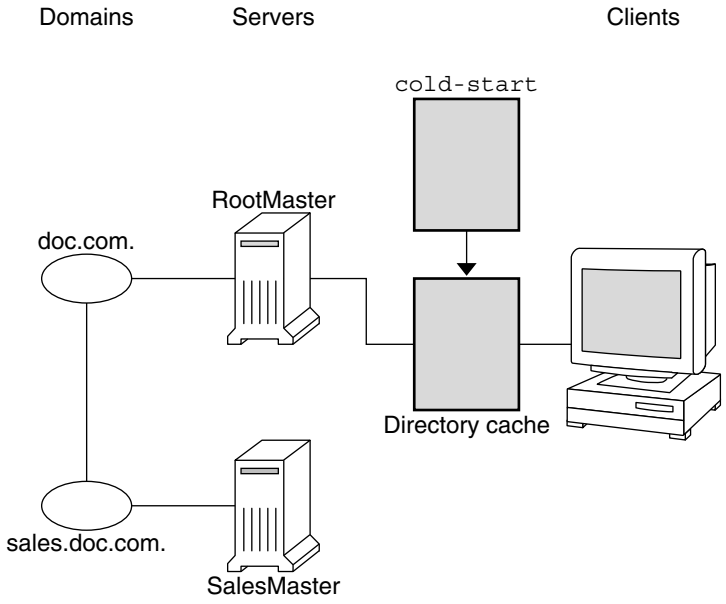


How does the client know which server that is? By trial and error. Beginning with its home server, the client tries first one server, then another, until it finds the right one. When a server cannot answer the client's request, it sends the client information to help locate the right server. Over time, the client builds up its own cache of information and becomes more efficient at locating the right server. The next section describes this process.

The Cold-Start File and Directory Cache

When a client is initialized, it is given a *cold-start file*. The cold-start file gives a client a copy of a directory object that it can use as a starting point for contacting servers in the namespace. The directory object contains the address, public keys, and other information about the master and replica servers that support the directory. Normally, the cold-start file contains the directory object of the client's home domain.

A cold-start file is used only to initialize a client's *directory cache*. The directory cache, managed by an NIS+ facility called the *cache manager*, stores the directory objects that enable a client to send its requests to the proper servers.



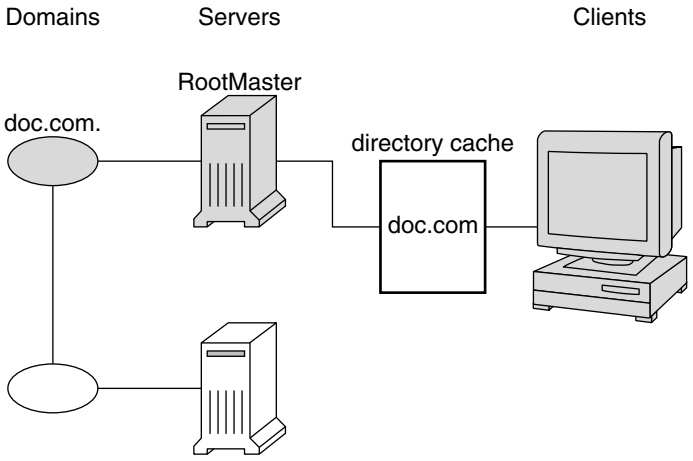
By storing a copy of the namespace's directory objects in its directory cache, a client can know which servers support which domains. (To view the contents of a client's cache, use the `nisshowcache` command, described in "The `nisshowcache` Command" on page 344.) Here is a simplified example:

Domain Name and Directory Name are the same	Supporting Server	IP Address
`doc.com.`	rootmaster	123.45.6.77
`sales.doc.com.`	salesmaster	123.45.6.66
`manf.doc.com.`	manfmaster	123.45.6.37

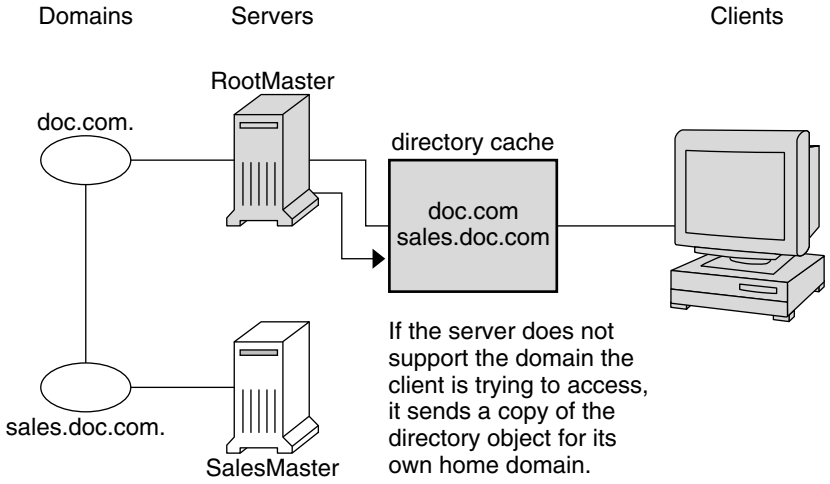
Domain Name and Directory Name are the same	Supporting Server	IP Address
`int.sales.doc.com.`	Intlsalesmaster	111.22.3.7

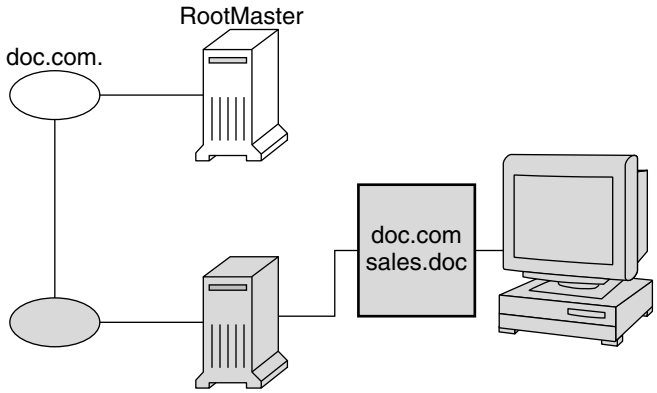
To keep these copies up-to-date, each directory object has a *time-to-live* (TTL) field. Its default value is 12 hours. If a client looks in its directory cache for a directory object and finds that it has not been updated in the last 12 hours, the cache manager obtains a new copy of the object. one can change a directory object's time-to-live value with the `nischttl` command, as described in "The `nischttl` Command" on page 349. However, keep in mind that the longer the time-to-live, the higher the likelihood that the copy of the object will be out of date; and the shorter the time to live, the greater the network traffic and server load.

How does the directory cache accumulate these directory objects? As mentioned above, the cold-start file provides the first entry in the cache. Therefore, when the client sends its first request, the request goes to the server specified by the cold-start file. If the request is for access to the domain supported by that server, the server answers the request.



If the request is for access to another domain (for example, `sales.doc.com.`), the server tries to help the client locate the proper server. If the server has an entry for that domain in its own directory cache, it sends a copy of the domain's directory object to the client. The client loads that information into its directory cache for future reference and sends its request to that server.





In the unlikely event that the server does not have a copy of the directory object the client is trying to access, it sends the client a copy of the directory object for its own home domain, which lists the address of the server's parent. The client repeats the process with the parent server, and keeps trying until it finds the proper server or until it has tried all the servers in the namespace. What the client does after trying all the servers in the domain is determined by the instructions in its name service switch configuration file. See Chapter 2, The Name Service Switch.

Over time, the client accumulates in its cache a copy of all the directory objects in the namespace and thus the IP addresses of the servers that support them. When it needs to send a request for access to another domain, it can usually find the name of its server in its directory cache and send the request directly to that server.

An NIS+ Server Is Also a Client

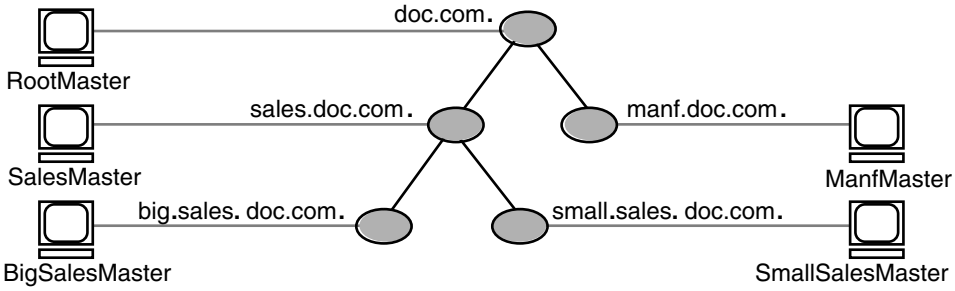
An NIS+ server is also an NIS+ client. In fact, before one can set up a machine as a server (as described in Part 2), one must initialize it as a client. The only exception is the root master server, which has its own unique setup process.

This means that in addition to *supporting* a domain, a server also *belongs* to a domain. In other words, by virtue of being a client, a server has a home domain. Its host information is stored in the Hosts table of its home domain, and its DES credentials are stored in the cred table of its home domain. Like other clients, it sends its requests for service to the servers listed in its directory cache.

An important point to remember is that—except for the root domain—a server's home domain is the *parent* of the domain the server supports:

In other words, a server supports clients in one domain, but is a *client* of another domain. A server cannot be a client of a domain that it supports, with the exception of the root domain. Because they have no parent domain, the servers that support the root domain belong to the root domain itself.

For example, consider the following namespace:



The chart lists which domain each server supports and which domain it belongs to:

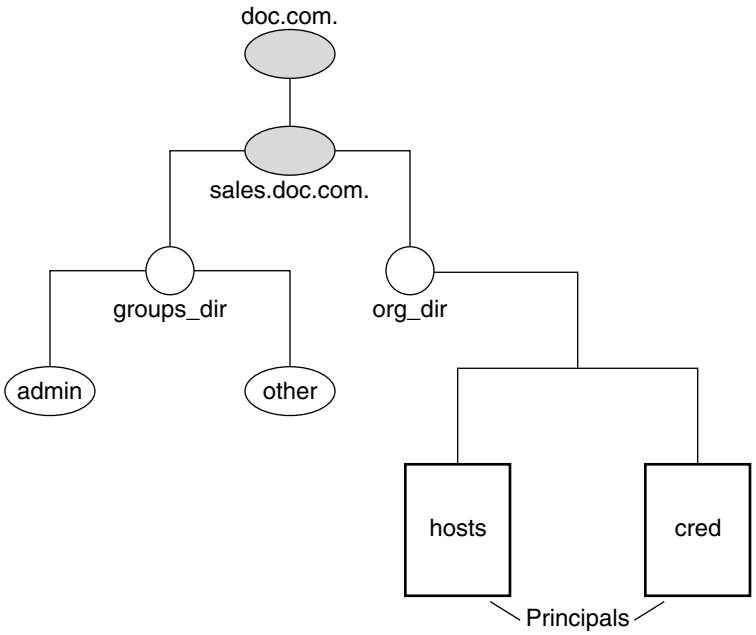
Server	Supports	Belongs to
RootMaster	doc.com.	doc.com.
SalesMaster	sales.doc.com.	doc.com.
IntlSalesMaster	intl.sales.doc.com.	sales.doc.com.
ManfMaster	manf.doc.com.	doc.com.

Naming Conventions

Objects in an NIS+ namespace can be identified with two types of names: *partially-qualified* and *fully qualified*. A partially qualified name, also called a *simple* name, is simply the name of the object or any portion of the fully qualified name. If during any administration operation one type the partially qualified name of an object or principal, NIS+ will attempt to expand the name into its fully qualified version. For details, see "Naming Conventions" on page 76.

A fully qualified name is the complete name of the object, including all the information necessary to locate it in the namespace, such as its parent directory, if it has one, and its complete domain name, including a trailing dot.

This varies among different types of objects, so the conventions for each type, as well as for NIS+ principals, is described separately. This namespace will be used as an example:



The fully qualified names for all the objects in this namespace, including NIS+ principals, are summarized below.

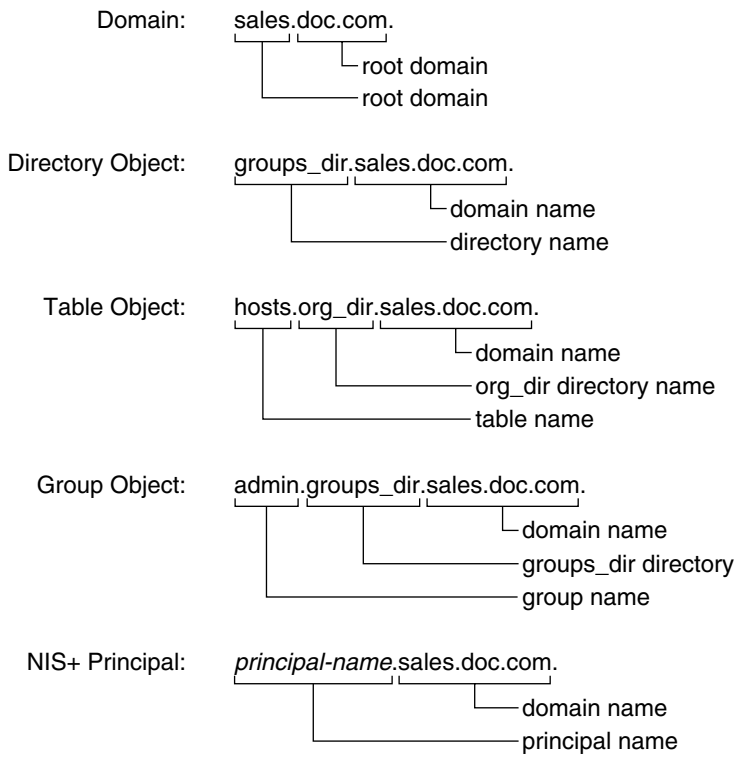


FIGURE 2–4 Fully qualified Names of Namespace Components

NIS+ Domain Names

A fully qualified NIS+ domain name is formed from left to right, starting with the local domain and ending with the root domain:

`doc.com.` (root domain)

`sales.doc.com.` (subdomain)

`intl.sales.doc.com.` (a third level subdomain)

The first line above shows the name of the root domain. The root domain must always have at least two elements (labels) and must end in a dot. The last (right most) label may be anything one want, but in order to maintain Internet compatibility, the last element must be either an Internet organizational name (as shown below), or a two or three character geographic identifier such as `.jp`. for Japan.

TABLE 2–4 Internet Organizational Domains

Domain	Purpose
`com`	Commercial organizations
`edu`	Educational institutions
`gov`	Government institutions
`mil`	Military groups
`net`	Major network support centers
`org`	Nonprofit organizations and others
`int`	International organizations

The second and third lines above show the names of lower-level domains.

Directory Object Names

A directory's simple name is simply the name of the directory object. Its fully qualified name consists of its simple name plus the fully qualified name of its domain (which always includes a trailing dot):

`groups_dir` (simple name)

`groups_dir.manf.doc.com.` (fully qualified name)

If one set up an unusual hierarchy in which several layers of directories do not form a domain, be sure to include the names of the intermediate directories. For example:

```
lowest_dir.lower_dir.low_dir.mydomain.com.
```

The simple name is normally used from within the same domain, and the fully qualified name is normally used from a remote domain. However, by specifying search paths in a domain's NIS_PATH environment variable, one can use the simple name from remote domains (see "`NIS_PATH` Environment Variable" on page 81).

Tables and Group Names

Fully qualified table and group names are formed by starting with the object name and appending the directory name, followed by the fully qualified domain name. Remember that all system table objects are stored in an `org_dir` directory and all

group objects are stored in a `groups_dir` directory. (If one create oner own NIS+ tables, one can store them anywhere one like.) Here are some examples of group and table names:

```
admin.groups_dir.doc.com.
admin.groups_dir.doc.com.
admin.groups_dir.sales.doc.com.
admin.groups_dir.sales.doc.com.
hosts.org_dir.doc.com.
hosts.org_dir.doc.com.
hosts.org_dir.sales.doc.com.
hosts.org_dir.sales.doc.com.
```

Table Entry Names

To identify an entry in an NIS+ table, one need to identify the table object and the entry within it. This type of name is called an *indexed* name. It has the following syntax:

[*column*=value,column=value,...],*tablename*

Column is the name of the table column. *Value* is the actual value of that column. *Tablename* is the fully qualified name of the table object. Here are a few examples of entries in the hosts table:

```
[addr=129.44.2.1,name=pine],hosts.org_dir.sales.doc.com.
[addr=129.44.2.2,name=elm],hosts.org_dir.sales.doc.com.
[addr=129.44.2.3,name=oak],hosts.org_dir.sales.doc.com.
```

one can use as few column-value pairs inside the brackets as required to uniquely identify the table entry.

Some NIS+ administrative commands accept variations on this syntax. For details, see the `nistbladm`, `nismatch`, and `nisgrep` commands in Part 2.

Host Names

Host names may contain up to 24 characters. Letters, numbers, the dash (-) and underscore (_) characters are allowed in host names. Host names are not case sensitive (that is, upper and lower case letters are treated as the same). The first character of a host name must be a letter of the alphabet. Blank spaces are not permitted in host names.

Note – Dots (`.`) are not permitted in host names. For example, a host name such as `myco.2` is not permitted. Dots are not allowed in host names even if they are enclosed in quotes. For example, `'myco.2'` is not permitted. Dots are only used as part of a fully qualified host name to identify the domain components. For example, `myco-2.sales.doc.com.` is a correct fully qualified host name.

Domains and hosts should not have the same name. For example, if one have a sales domain one should not have a machine named `sales`. Similarly, if one have a machine named `home`, one do not want to create a domain named home. This caution applies to subdomains, for example if one have a machine named `west` one don't want to create a `sales.west.myco.com` subdomain.

NIS+ Principal Names

NIS+ principal names are sometimes confused with Secure RPC netnames. Both types of names are described in the security chapters of Part—2. However, one difference is worth pointing out now because it can cause confusion: NIS+ principal names *always* end in a dot and Secure RPC netnames *never* do:

TABLE 2–5 NIS+ Principal Names

`olivia.sales.doc.com.`	NIS+ principal name
`unix.olivia@sales.doc.com`	Secure RPC netname

Also, even though credentials for principals are stored in a cred table, neither the name of the cred table nor the name of the `org_dir` directory is included in the principal name.

Accepted Name Symbols

one can form namespace names from any printable character in the ISO Latin 1 set. However, the names cannot start with these characters: `@ < > + [ ] - / = . , : ;`

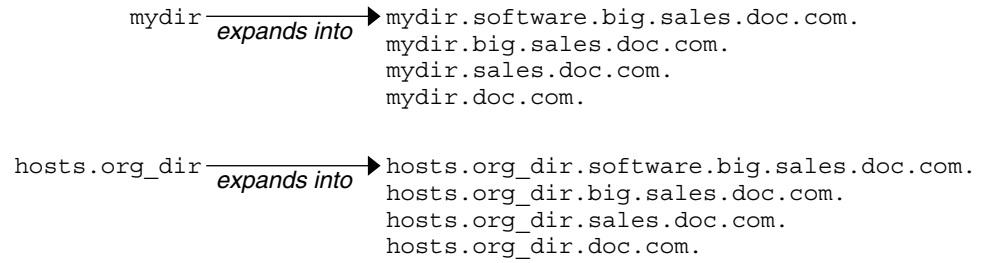
To use a string, enclose it in double quotes. To use a quote sign in the name, quote the sign too (for example, to use `o'henry`, type `o"'"henry`). To include white space (as in John Smith), use double quotes within single quotes, like this:

```
'"John Smith"'
```

See "Host Names" on page 79for restrictions that apply to host names.

NIS+ Name Expansion

Entering fully qualified names with oner NIS+ commands can quickly become tedious. To ease the task, NIS+ provides a name-expansion facility. When one enter a partially qualified name, NIS+ attempts to find the object by looking for it under different directories. It starts by looking in the default domain. This is the home domain of the client from which one type the command. If it does not find the object in the default domain, NIS+ searches through each of the default domain's parent directories in ascending order until it finds the object. It stops after reaching a name with only two labels. Here are some examples (assume one are logged onto a client that belongs to the `software.big.sales.doc.com.` domain).



`NIS_PATH` Environment Variable

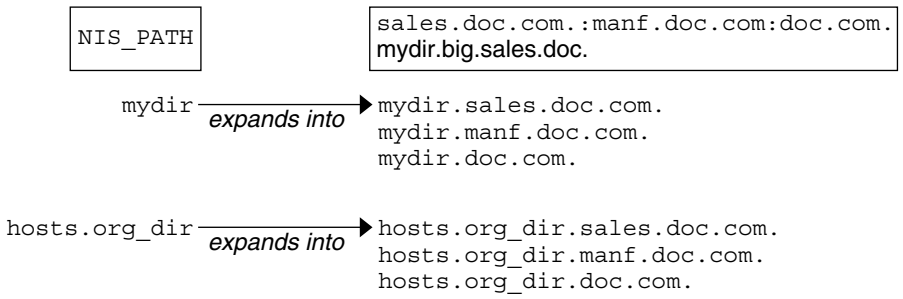
one can change or augment the list of directories NIS+ searches through by changing the value of the environment variable `NIS_PATH`. `NIS_PATH` accepts a list of directory names separated by colons:

`setenv NIS_PATH` *directory1*`:` *directory2*`:` *directory3* `...`

or

`NIS_PATH=`*directory1*`:` *directory2*`:` *directory3* `...;export NIS_PATH`

NIS+ searches through these directories from left to right. For example:



Like $PATH and $MANPATH, the NIS_PATH variable accepts the special symbol, $. one can append the $ symbol to a directory name or add it by itself. If one append it to a directory name, NIS+ appends the default directory to that name. For example:

NIS_PATH	$:org_dir.$:groups_dir.$ mydir.big.sales.doc.
If default directory is:	NIS_PATH is effectively:
sales.doc.com.	sales.doc.com.:org_dir.sales.doc.com.:groups_dir.sales.doc.com.
manf.doc.com.	manf.doc.com.:org_dir.manf.doc.com.:groups_dir.manf.doc.com.
doc.com.	doc.com.:org_dir.doc.com.:groups_dir.doc.com.

If one use the $ sign by itself (for example, org_dir.$:$), NIS+ performs the standard name expansion described earlier: it starts looking in the default directory and proceeds through the parent directories. In other words, the default value of NIS_PATH is $,

---

Note – Keep in mind that additions and changes to oner NIS_PATH may increase the number of lookups that NIS+ has to perform and thus slow down performance.

Preparing the Existing Namespace

If an NIS domain already exists at oner site, one can use the same flat domain structure for oner NIS+ namespace. (one can change it later to a hierarchical structure.)

Read the Appendix B before one start oner transition from NIS to NIS+ for important planning and preparation information. The NIS+ scripts enable one to start NIS+ with data from NIS maps. Chapter 4 shows one how to use the NIS+ scripts to create an NIS+ namespace from either system files or NIS maps.

In order for the scripts to run smoothly, however, one must prepare oner existing namespace (if one have one) for conversion to NIS+. These preparations are described fully in Appendix B.

For oner reference, key preparations are summarized below:

- *Domain and host names*. Domains and hosts must not have the same name. For example, if one have a `sales` domain one cannot have a machine named `sales`. Similarly, if one have a machine named `home`, do not create a domain named `home`. This caution also applies to subdomains; for example, if one have a machine named `west`, one don't want to create a `sales.west.myco.com` subdirectory.
- *No dots in host names*. Because NIS+ uses dots (periods) to delimit between machine names and domains and between parent and subdomains, one cannot have a machine name containing a dot. Before converting to NIS+ (before running the scripts) one must eliminate any dots in oner host names. one should convert host name dots to hyphens. For example, one cannot have a machine named `sales.alpha`. one can convert that name to `sales-alpha`.
- *Root server must be running*. The machine that is designated to be the root server must be up and running and one must have superuser access to it.
- View any existing local `/etc` files or NIS maps that one will load data from. Make sure that there are no spurious or incorrect entries. Make sure that the right data is in the correct place and format. Remove any outdated, invalid, or corrupt entries. one should also remove any incomplete or partial entries. one can always add individual entries after configuration is completed. That is easier than trying to load incomplete or damaged entries.

Caution – In Solaris 2.4 and earlier, the `/var/nis` directory contained two files named *hostname*`.dict` and *hostname*`.log`. It also contained a subdirectory named `/var/nis/`*hostname*. When one install NIS+ for Solaris 2.5, the two files are named `trans.log` and `data.dict`, and the subdirectory is named `/var/nis/data`. In Solaris 2.5, the *content* of the files has also been changed and they are not backward compatible with Solaris 2.4 or earlier. Thus, if one rename either the directories or the files to match the Solaris 2.4 patterns, the files will not work with either the Solaris 2.4 or the Solaris 2.5 version of `rpc.nisd`. Therefore, one should rename neither the directories nor the files.

Two Configuration Methods

The rest of this part of the manual describes two different methods of configuring an NIS+ namespace:

- *With the setup (configuration) scripts*. Chapters 2 and 3 describe how to configure NIS+ using the three NIS+ scripts: `nisserver`, `nispopulate`, and `nisclient`. This is the easiest, as well as recommended, method.
- *With the NIS+ command set*. Chapters 4 through 9 describe how to configure NIS+ using the NIS+ command set. While this method gives one more flexibility than the scripts method, it is more difficult. This method should be used only by experienced NIS+ administrators who need to configure a namespace with characteristics significantly different than those provided by the configuration scripts.

Note – If one use the NIS+ command set, one must also make sure that each machine using NIS+ for its name service has the correct `nsswitch.conf` file in its `/etc` directory as described in Chapter 1. If one use the NIS+ configuration scripts on a given machine, this step is performed for one.

See Chapter 22for information on how to remove an NIS+ directory or domain, an NIS+ server, or the NIS+ namespace.

CHAPTER 3

NIS+ Setup Scripts

This chapter describes the NIS+ scripts and their functionalities.

About the NIS+ Scripts

Caution – Before running the NIS+ setup scripts, make sure you have performed the steps described in "NIS+ Configuration Overview" on page 87.

The three NIS+ scripts—`nisserver`, `nispopulate`, and `nisclient`—enable you to set up an NIS+ namespace. The NIS+ scripts are Bourne shell scripts that execute groups of NIS+ commands so you do not have to type the NIS+ commands individually. The following table describes what each script does.

TABLE 3–1 NIS+ Scripts

NIS+ Script	What It Does
`nisserver`	Sets up the root master, non-root master and replica servers with level 2 security (DES)
`nispopulate`	Populates NIS+ tables in a specified domain from their corresponding system files or NIS maps
`nisclient`	Creates NIS+ credentials for hosts and users; initializes NIS+ hosts and users

What the NIS+ Scripts Will Do

In combination with a few NIS+ commands, you can use the NIS+ scripts to perform all the tasks necessary for setting up an NIS+ namespace. See the `nisserver`, `nispopulate`, and `nisclient` man pages for complete descriptions of these commands and their options. Chapter 4 shows you how to use the NIS+ scripts to set up an NIS+ namespace.

You can run each of the scripts without having the commands execute by using the `-x` option. This option lets you see what commands the scripts call and their approximate output without the scripts actually changing anything on your systems. Running the scripts with `-x` can minimize unexpected surprises.

What the NIS+ Scripts Will Not Do

While the NIS+ scripts reduce the effort required to create an NIS+ namespace, the scripts do not completely replace the individual NIS+ commands. The scripts only implement a subset of NIS+ features. If you are unfamiliar with NIS+, you may want to refer back to this section after you have created the sample NIS+ namespace.

The `nisserver` script only sets up an NIS+ server with the standard default tables and permissions (authorizations). This script does *not*:

- Set special permissions for tables and directories
- Add extra NIS+ principals to the NIS+ admin group

  See Chapter 4 for how to use the `nisgrpadm` command instead of one of the NIS+ scripts to add extra NIS+ principals to the NIS+ admin group.
- Create private tables
- Run an NIS+ server at any security level other than level 2
- Start the `rpc.nisd` daemon on remote servers, which is required to complete server installation

See Chapter 4 for how to use the `rpc.nisd` command instead of one of the NIS+ scripts to change NIS+ client machines into non-root servers.

The `nisclient` script does not set up an NIS+ client to resolve host names using DNS. You need to explicitly set DNS for clients that require this option.

CHAPTER 4

Configuring NIS+ With Scripts

This chapter describes how to configure a basic NIS+ namespace using the `nisserver`, `nispopulate`, and `nisclient` scripts in combination with a few NIS+ commands.

NIS+ Configuration Overview

Using the configuration scripts is the recommended method of setting up and configuring an NIS+ namespace. Using these scripts is easier than to trying to set up an NIS+ namespace with the NIS+ command set, as described in the subsequent chapters of this Part.

(See the `nisserver`, `nispopulate`, and `nisclient` man pages for complete descriptions of the scripts. See the glossary Glossaryfor definitions of terms and acronyms you do not recognize.)

You should *not* use the small sample NIS+ namespace referred to in this tutorial manual as a basis for your actual NIS+ namespace. You should destroy the sample namespace after you finish exploring it, instead of adding on to it. It is better to begin again and carefully plan your NIS+ hierarchy before you create your actual namespace.

Table 4–1 summarizes the recommended generic configuration procedure. The left column lists the major configuration activities, such as configuring the root domain or creating a client. The text in the middle describes the activities. The third column lists which script or NIS+ commands accomplish each step.

TABLE 4–1 Recommended NIS+ Configuration Procedure Overview

Activity	Description	Script/NIS+ Commands
Plan your new NIS+ namespace	Plan your new NIS+ namespace. See "PLANNING THE NIS+ NAMESPACE: Identifying the Goals of Your Administrative Model" on page 601for a full discussion of planning requirements and steps. (If you are just following the NIS+ tutorial in a test-bed network, this step has been done for you.)	
Prepare your existing namespace	In order for the scripts to work best, your current namespace (if any) must be properly prepared. See and the "PLANNING THE NIS+ NAMESPACE: Identifying the Goals of Your Administrative Model" on page 601for a description of necessary preparations. (If you are just following the NIS+ tutorial in a test-bed network, this step has been done for you.)	
Configure the Diffie-Hellman key length	If you intend to use DES authentication, consider using Diffie-Hellman keys longer than the 192-bit default. The extended key length must be the same on all machines in the domain. Specify the desired key length before running the respective initialization scripts.	`nisauthconf`
Configure root Domain	Create the root domain. Configure and initialize the root master server. Create the root domain admin group.	`nisserver`

Populate tables	Populate the NIS+ tables of the root domain from text files or NIS maps. Create credentials for root domain clients. Create administrator credentials.	`nispopulate`
		`nisgrpadm`
		`nisping`

Configure root domain clients	Configure the client machines. (Some of them will subsequently be converted into servers.) Initialize users as NIS+ clients.	`nisclient`
Enable servers	Enable some clients of the root domain to become servers. Some servers will later become root replicas; others will support lower-level domains.	`rpc.nisd`
Configure root replicas	Designate one or more of the servers you just configured as replicas of the root domain.	`rpc.nisd` `nisserver`
Configure non-root domains	Create a new domain. Designate a previously enabled server as its master. Create its admin group and admin credentials.	`rpc.nisd` `nisserver`
Populate tables	Create credentials for clients of the new domain. Populate the NIS+ tables of the new domain from text files or NIS maps.	`nispopulate`

TABLE 4–1 Recommended NIS+ Configuration Procedure Overview *(Continued)*

Activity	Description	Script/NIS+ Commands
Configure non-root domain clients	Configure the clients of the new domain. (Some may subsequently be converted into servers for lower-level domains.) Initialize users as NIS+ clients.	`nisclient`

The NIS+ scripts enable to you to skip most of the individual procedures included in the above activities.

Creating a Sample NIS+ Namespace

The procedures in this chapter show you how to create a sample NIS+ namespace. The sample NIS+ namespace will be created from `/etc` files and NIS maps. This sample shows you how to use the scripts both when your site is not running NIS and when NIS is running at your site. You can set your servers to NIS-compatibility mode if they will be serving NIS clients. See the Appendix Bfor more information on NIS-compatibility mode.

Note – Your site's actual NIS+ namespace and its domain hierarchy probably differs from the sample namespace's, and yours probably contains a different *number* of servers, clients, and domains. Do not expect any resemblance between your final domain configuration or hierarchy and the sample one. The sample namespace is only an illustration of how to use the NIS+ scripts. After you have created this sample namespace, you should have a clear idea about how to create domains, servers, and clients at your site.

The sample namespace contains the following components:

- A root master server named `master` for the `doc.com.` domain
- Four clients of the root domain, `doc.com.`:
  - The first client, `client1`, will become a root replica (for the `doc.com.` domain).
  - The second client, `client2`, will become a master server for a new subdomain (for the `sub.doc.com.` domain).
  - The third client, `client3`, will become a non-root replica server of the new subdomain (for the `sub.doc.com.`) domain.
  - The fourth client, `client4`, will remain solely a client of the root domain (`doc.com.`).

- Two clients, `subclient1` and `subclient2`, of the subdomain (`sub.doc.com.`).

This scenario shows the scripts being used to configure NIS+ at a site that uses both system information files, such as `/etc/hosts`, and NIS maps to store network service information. The sample NIS+ namespace uses such a mixed site purely for example purposes.

Summary of NIS+ Scripts Command Lines

Table 4–2 contains the generic sequence of NIS+ scripts and commands you will use to create a ample NIS+ domain. Subsequent sections describe these command lines in detail. After you are familiar with the tasks required to create NIS+ domains, servers, and clients, use Table 4–2 as a quick-reference guide to the appropriate command lines. Table 4–2 is a summary of the actual commands with the appropriate variables that you type to create the sample NIS+ namespace.

TABLE 4–2 NIS+ Domains Configuration Command Lines Summary

Action	Machine	Command

Include `/usr/lib/nis` in root's path; C shell or Bourne shell.	Root master server and client machines as superuser	`setenv PATH $PATH:/usr/lib/nis`
		or
		`PATH=$PATH:/usr/lib/nis; export PATH`

Optionally, if using DES authentication, select the Diffie-Hellman key length	Server and client machines as superuser	`nisauthconf -dh`*key-length-alg-type* `des`
Create a root master server without or with NIS (YP) compatibility.	Root master server as superuser	`nisserver -r -d` *newdomain*. or `nisserver -Y -r -d` *newdomain*.
Populate the root master server tables from files or from NIS maps.	Root master server as superuser	`nispopulate -F -p` */files* `-d` *newdomain*. or `nispopulate -Y -d` *newdomain*. `-h` *NISservername*`\ -a` *NIS_server_ipaddress* `-y` *NIS_domain*
Add additional users to the NIS+ admin group.	Root master server as superuser	`nisgrpadm-aadmin.`*domain.name.domain*.
Make a checkpoint of the NIS+ database.	Root master server as superuser	`nisping- C` *domain*.
Initialize a new client machine.	Client machine as superuser	`nisclient- i -d` *domain* `. -h` *master1*

TABLE 4–2 NIS+ Domains Configuration Command Lines Summary *(Continued)*

Action	Machine	Command
Initialize user as an NIS+ client.	Client machine as user	`nisclient -u`

Start the `rpc.nisd` daemon—required to convert a client to a server without or with NIS (and DNS) compatibility.	Client machine as superuser	`rpc.nisd`
		or
		`rpc.nisd -Y`
		or
		`rpc.nisd -Y -B`

Convert a server to a root replica.	Root master server as superuser	`nisserver -R -d` *domain*. `-h` *clientname*
Convert a server to a non-root master server.	Root master server as superuser	`nisserver -M -d` *newsubdomain.domain* . `-h\`*clientmachine*
Populate the new master server tables from files or from NIS maps.	New subdomain master server as superuser	`nispopulate -F -p` */subdomaindirectory* `-d \` *newsubdomain .domain* . or `nispopulate -Y -d` *newsubdomain .domain* `.-h` *NISservername* `-a`*NIS_server_ipaddress* `-y` *NIS_domain*
Convert a client to a master server replica.	Subdomain master server as superuser	`nisserver -R -d` *subdomain .domain* `. - h` *clientname*
Initialize a new client of the subdomain. Clients can be converted to subdomain replicas or to another server.	New subdomain client machine as superuser	`nisclient -i -d` *newsubdomain.domain* `. - h \` *subdomainmaster*
Initialize user as an NIS+ client.	Client machine as user	`nisclient -u`

Note – To see what commands an NIS+ script calls, without actually executing the commands, use the `-x` option. The `-x` option causes the command names and their approximate output to echo to the screen as if you were actually running the script. Running the scripts for the first time with `-x` can minimize unexpected results. For more information, see the man pages for the scripts.

Setting Up NIS+ Root Servers

Setting up the root master server is the first activity towards establishing NIS+ domain. This section shows you how to configure a root master server using the `nisserver` script with default settings. The root master server uses the following defaults:

- Security level 2 (DES)—the highest level of NIS+ security
- NIS compatibility set to OFF (instructions for setting NIS compatibility are included)
- System information files (`/etc`) or NIS maps as the source of name services information
- `admin`. *domainname* as the NIS+ group

Note – The `nisserver` script modifies the name service switch file for NIS+ when it sets up a root master server. The `/etc/nsswitch.conf` file can be changed later. See Chapter 2 for information on the name service switch.

Prerequisites to Running `nisserver`

Check to see that the `/etc/passwd` file on the machine you want to be root master server contains an entry for root.

Information You Need

You need the following:

- The superuser password of the machine that will become the root master server
- The name of the new root domain. The root domain name must have at least two elements (labels) and end in a dot (for example, *something* `.com.`). The last element

may be anything you want, but in order to maintain Internet compatibility, the last element must be either an Internet organizational name (as shown in Table 4–3), or a two or three character geographic identifier such as `.jp`. for Japan.

TABLE 4–3 Internet Organizational Domains

Domain	Purpose
com	Commercial organizations
edu	Educational institutions
gov	Government institutions
mil	Military groups
net	Major network support centers
org	Nonprofit organizations and others
int	International organizations

In the following example, the machine that is designated as the root master server is called `master1`, and `doc.com.` becomes the new root domain.

Note – Domains and hosts should not have the same name. For example, if you have `doc.com.` as a root domain, you should not have a machine named `doc` in any of your domains. Similarly, if you have a machine named `home`, you do not want to create a domain named `home`. This caution also applies to subdomains; for example, if you have a machine named `west`, you do not want to create a `sales.west.myco.com` subdomain.

▼ How to Create a Root Master Server

1. **Set the superuser's `PATH` variable to include `/usr/lib/nis`.**
   Either add this path to root's `.cshrc` or `.profile` file or set the variable directly.
2. **Optionally, if using DES authentication, specify the Diffie-Hellman key length.**
   To use 640–bit Diffie-Hellman keys as well as the default 192–bit keys, type:

   ```
   nisauthconf dh640-0 des
   ```

   To allow only 640–bit keys (rejects 192–bit keys), type:

   ```
   nisauthconf dh640-0
   ```

3. **Type the following command as superuser (root) to configure a root master server.**

   The `-r` option indicates that a root master server should be configure. The `-d` option specifies the NIS+ domain name.

```
master1# nisserver -r -d doc.com.
This script sets up this machine “master1” as a NIS+ root master
server for domain doc.com.
Domain name : doc.com.
NIS+ group : admin.doc.com.
NIS (YP) compatibility : OFF
Security level : 2=DES
Is this information correct? (type ’y’ to accept, ’n’ to change)
```

   “NIS+ group” refers to the group of users who are authorized to modify the information in the `doc.com.` domain. (Domain names always end with a period.) Modification includes deletion. `admin.`*domainname* is the default name of the group. See “How to Change Incorrect Information” on page 95for instructions on how to change this name.

   “NIS compatibility” refers to whether an NIS+ server accepts information requests from NIS clients. When set to `OFF`, the default setting, the NIS+ server does not fulfill requests from NIS clients. When set to `ON`, an NIS+ server fulfills such requests. You can change the NIS-compatibility setting with this script. See “How to Change Incorrect Information” on page 95.

Note – This script sets machines up only at security level 2, the highest level of NIS+ security. You cannot change the security level when using this script. After the script has completed, you can change the security level with the appropriate NIS+ command. See the `rpc.nisd` man page for more information on changing security levels.

---

4. **Type `y` (if the information shown on the screen is correct).**

   Typing `n` causes the script to prompt you for the correct information. (See “How to Change Incorrect Information” on page 95 for what you need to do if you type `n`.)

```
Is this information correct? (type ’y’ to accept, ’n’’ to change)
y
This script will set up your machine as a root master server for
domain doc.com. without NIS compatibility at security level 2.
Use "nisclient -r" to restore your current network service environment.
Do you want to continue? (type ‘y’ to continue, ‘n’ to exit the script)
```

5. **Type y to continue NIS+ configuration.**

   (Typing `n` safely stops the script.) If you interrupt the script after you have chosen `y` and while the script is running, the script stops running and leaves configured whatever it has created so far. The script does not do any automatic recovery or cleaning up. You can always rerun this script.

```
Do you want to continue? (type ’y’ to continue, ’n’ to exit the script
y
```

```
setting up domain information "doc.com." ...
setting up switch information ...
running nisinit ...
This machine is in the doc.com. NIS+ domain.
Setting up root server ...
All done.
starting root server at security level 0 to create credentials...
running nissetup ...
(creating standard directories & tables)
org_dir.doc.com. created
Enter login password:
```

The `nissetup` command creates the directories for each NIS+ table.

6. **Type your machine's root password at the prompt and press Return.**

   In this case, the user typed the `master1` machine's root password.

```
Wrote secret key into /etc/.rootkey
setting NIS+ group to admin.doc.com. ...
restarting root server at security level 2 ...
This system is now configured as a root server for domain doc.com.
You can now populate the standard NIS+ tables by using the
nispopulate or /usr/lib/nis/nisaddent commands.
```

   Your root master server is now configured and ready for you to populate the NIS+ standard tables. To continue with populating tables, skip to "Populating NIS+ Tables" on page 97.

▼ How to Change Incorrect Information

If you typed `n` because some or all of the information returned to you was wrong in step 4 in the above procedure, you will see the following:

```
Is this information correct? (type 'y' to accept, 'n' to change)
 n
Domain name: [doc.com.]
```

1. **Press Return if the domain name is correct; otherwise, type the correct domain name and press Return.**

   In this example, Return was pressed, confirming that the desired domain name is `doc.com.`. The script then prompts for the NIS+ group name.

```
Is this information correct? (type 'y' to accept, 'n' to change)
 n
Domain name: [doc.com.]
NIS+ group: [admin.doc.com.]
```

2. **Press Return if NIS+ group is correct; otherwise, type the correct NIS+ group name and press Return.**

   In this example, the name was changed. The script then prompts for NIS compatibility.

```
NIS+ group: [admin.doc.com.] netadmin.doc.com.
NIS (YP) compatibility (0=off, 1=on): [0]
```

3. **Press Return if you do not want NIS compatibility; otherwise, type `1` and press Return.**

   In this example, Return was pressed, confirming that NIS compatibility status is correct. Once again, the script asks you if the information is correct.

Note – If you choose to make this server NIS compatible, you also need to edit a file and restart the `rpc.nisd` daemon before it will work. See "Configuring a Client as an NIS+ Server" on page 110 for more information.

```
NIS (YP) compatibility (0=off, 1=on): [0]
Domain name : doc.com.
NIS+ group : netadmin.doc.com.
NIS (YP) compatibility : OFF
Security level : 2=DES
Is this information correct? (type 'y' to accept, 'n' to change)
```

When the information is correct, continue with Step 3 in "How to Create a Root Master Server" on page 93. You can keep choosing `-n` until the information is correct.

▼ How to Set Up a Multihomed NIS+ Root Master Server

The procedure for setting up a multihomed NIS+ server is the same as setting up a single interface server. The only difference is that there are more interfaces that need to be defined in the hosts database (`/etc/hosts` and `/etc/inet/ipnodes` files, and NIS+ `hosts` and `ipnodes` tables). Once the host information is defined, use the `nisclient` and `nisserver` scripts to set up the multihomed NIS+ server. For information about setting up a multihomed replica server, see "How to Set Up Multihomed NIS+ Replica Servers" on page 114

Caution – When setting up a multihomed NIS+ server, the server's primary name must be the same as the nodename for the system. This is a requirement of both Secured RPC and `nisclient`.

- Secured RPC relies on the nodename to create the netname for authentication.
- `nisclient` relies on the primary name to create the credential for the client.

If these names are different, Secure RPC authentication will fail to work properly causing NIS+ problems.

The following procedure shows how to set up an NIS+ root master server:

1. **On the root master, add the server host information into the `/etc/hosts` or `/etc/inet/ipnodes` file.**

   For example, the `/etc/hosts` file for the *hostA* system with three ethernet interfaces looks like:

   ```
   127.0.0.1 localhost loghost
   192.168.10.x hostA hostA-10 hostA-le0
   192.168.11.y hostA hostA-11 hostA-le1
   192.168.12.z hostA hostA-12
   ```

2. **Set up the server as a multihome NIS+ root server with `nisserver`.**

   ```
   hostA# nisserver -r -d sun.com
   ```

   where our example shows *sun.com* as the root domain name. Issue the `nisserver` command using the name of your root domain name.

   After completing the steps for setting up a multihome NIS+ root server, the remainder of the setup is exactly the same as for a single interface server.

Populating NIS+ Tables

After the root master server has been configured, you can populate its standard NIS+ tables with name services information. This section shows you how to populate the root master server's tables with data from files or NIS maps using the `nispopulate` script with default settings. The script uses:

- The domain created in the previous example (`doc.com.`)
- System information files or NIS maps as the source of name services
- The standard NIS+ tables: `auto_master`, `auto_home`, `ethers`, `group`, `hosts`, `networks`, `passwd`, `protocols`, `services`, `rpc`, `netmasks`, `bootparams`,

`netgroup`, and `aliases`

Note – The `shadow` file's contents are merged with the `passwd` file's to create the `passwd` table when files are the tables' information source. No `shadow` table is created.

Prerequisites to Running `nispopulate`

Before you can run the `nispopulate` script:

- View each local `/etc` file or NIS map from which you will load data. Make sure there are no spurious or incorrect entries. Make sure that the right data is in the correct place and format. Remove any outdated, invalid, or corrupt entries. You should also remove any incomplete or partial entries. You can always add individual entries after configuration is completed. That is easier than trying to load incomplete or damaged entries.
- The information in the files must be formatted appropriately for the table into which it will be loaded. Chapter 9 describes the format required for a text file to be transferred into its corresponding NIS+ table.
- Make sure that domain and host names are different. Domains and hosts cannot have the same name. For example, if you have a `sales` domain you cannot have a machine named `sales`. Similarly, if you have a machine named `home`, do not create a domain named `home`. This caution also applies to subdomains; for example, if you have a machine named `west`, do not create a `sales.west.myco.com` subdomain.
- Remove all dots and underscores in host names. NIS+ uses dots (periods) to delimit between machine names and domains and between parent and subdomains, so you cannot have a machine name containing a dot. You also cannot use underscores in hostnames, since DNS does not allow it. Before running the `nispopulate` script, you must eliminate any dots in your host names. You can convert host name dots to hyphens. For example, you cannot have a machine named `sales.alpha`. You can convert that name to `sales-alpha`.
- If you are setting up a network for the first time, you may not have much network information stored anywhere. In that case, you first need to collect the information, then type it into the *input file*—which is essentially the same as an `/etc` file.
- For safety's sake, you should make copies of the `/etc` files and use the copies to populate the tables instead of the actual ones. (This example uses files in a directory called `/nisplusfiles`, for instance.)
- Edit four of the copied NIS table files, `passwd`, `shadow`, `aliases`, and `hosts`, for security problems, particularly items that you do not want distributed across the namespace. For example, you might want to remove the following lines from the copy of your local `passwd` file so that they are not made available across the

namespace:

```
root:x:0:1:0000-Admin(0000):/:/sbin/sh
daemon:x:1:3:0000-Admin(0000):/:
bin:x:3:5:0000-Admin(0000):/usr/bin:
sys:x:3:3:0000-Admin(0000):/:
adm:x:4:4:0000-Admin(0000):/var/adm:
lp:x:78:9:0000-lp(0000):/usr/spool/lp:
smtp:x:0:0:mail daemon user:/:
uucp:x:5:5:0000-uucp(0000):/usr/lib/uucp:
nuucp:x:7:8:0000-uucp (0000):/var/spool/uucppublic:/usr/lib/uucp/uucico
listen:x:22:6:Network Admin:/usr/net/nls
nobody:x:60000:60000:uid no body:/:
noaccess:x:60002:60002:uid no access:/:
```

- The domain must have already been configured and its master server must be running.
- The domain's server must have sufficient disk space to accommodate the new table information.
- You must be logged in as an NIS+ principal (a client with appropriate credentials) and have write permission to the NIS+ tables in the specified domain. In this example, you must be the user `root` on the machine `master1`.

Information You Need

If populating from files, you need:

- The new NIS+ domain name
- The path of the appropriately edited text files whose data will be transferred
- Your root password

If populating from NIS maps, you need:

- The new NIS+ domain name
- The NIS domain name
- The NIS server's name
- The IP address of the NIS server
- Your root password

Note – The NIS domain name is case-sensitive, while the NIS+ domain name is not.

▼ How to Populate the Root Master Server Tables

1. **Perform either substep *a* or *b* to populate the root master server tables, then continue with step 2.**

   Substep *a* shows you how to populate tables from files. Substep *b* shows you how to populate tables from NIS maps. Type these commands in a scrolling window; otherwise, the script's output might scroll off the screen.

   Note – The `nispopulate` script can fail if there is insufficient `/tmp` space on the system. To keep this from happening, you can set the environment variable `TMPDIR` to a different directory. If `TMPDIR` is not set to a valid directory, the script uses the `/tmp` directory.

   a. **Type the following command to populate the tables from files.**

   ```
   master1# nispopulate -F -p /nis+files -d doc.com.
   NIS+ domain name : doc.com.
   Directory Path : /nis+files
   Is this information correct? (type 'y' to accept, 'n' to change)
   ```

   The `-F` option indicates that the tables take their data from files. The `-p` option specifies the directory search path for the source files. (In this case, the path is `/nis+files`.) The `-d` option specifies the NIS+ domain name. (In this case, the domain name is `doc.com.`)

   The NIS+ principal user is root. You must perform this task as superuser in this instance because this is the first time that you are going to populate the root master server's tables. The `nispopulate` script adds credentials for all members of the NIS+ admin group

   b. **Type the following command to populate the tables from NIS maps.**

   ```
   master1# nispopulate -Y -d doc.com. -h salesmaster -a 130.48.58.111
   -y sales.doc.com.
   NIS+ domain name : doc.com.
   NIS (YP) domain : sales.doc.com.
   NIS (YP) server hostname : salesmaster
   Is this information correct? (type 'y' to accept, 'n' to change)
   ```

   The `-Y` option indicates that the tables take their data from NIS maps. The `-d` option specifies the NIS+ domain name. The `-h` option specifies the NIS server's machine name. (In this case, the NIS server's name is `salesmaster`. You have to insert the name of a real NIS server at your site to create the sample domain.) The `-a` option specifies the NIS server's IP address. (In this case, the address is

130.48.58.111. You have to insert the IP address of a real NIS server at your site to create the sample domain.) The -y option specifies the NIS domain name. (In this case, the domain's name is sales.doc.com.; you have to insert the NIS domain name of the real NIS domain at your site to create the sample domain.

The NIS+ principal user is root. You must perform this task as superuser in this instance because this is the first time that you are going to populate the root master server's tables. The nispopulate script also adds credentials for all members of the NIS+ admin group.

2. **Type** y **(if the information returned on the screen is correct).**

   Typing n causes the script to prompt you for the correct information. (See "How to Change Incorrect Information" on page 95for what you need to do if the information is incorrect.)

   - If you performed substep *a* of step a, you will see the following:

```
Is this information correct?
(type 'y' to accept, 'n' to change)
y

This script will populate the following NIS+ tables for domain doc.com. from
the files in /nis+files: auto_master auto_home ethers group hosts networks
passwd protocols services rpc netmasks bootparams netgroup aliases shadow
**WARNING: Interrupting this script after choosing to continue may leave
the tables only partially populated. This script does not do any automatic
recovery or cleanup.
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
```

   - If you performed substep *b* of step b, you will see the following:

```
Is this information correct? (type 'y' to accept, 'n' to change)
y
This script will populate the following NIS+ tables for domain doc.com. from the
NIS (YP) maps in domain sales: auto_master auto_home ethers group hosts networks
passwd protocols services rpc netmasks bootparams netgroup aliases
**WARNING: Interrupting this script after choosing to continue may leave the
 tables only partially populated. This script does not do any automatic recovery
or cleanup.
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
```

3. **Type** y **to continue populating the tables.**

   (Typing n safely stops the script.) If you interrupt the script after you have chosen y—while the script's running—the script stops running and can leave the tables only partially populated. The script does not do any automatic recovery or cleaning up. You can safely rerun the script, but the tables will be overwritten with the latest information.

   - If you are populating tables from files, you see messages like the following as the script uses hosts and passwd information to create the credentials for hosts and users:

```
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
y
populating auto_master table from file /nis+files/auto_master
... auto_master table done.
populating auto_home table from file /nis+files/auto_home
... auto_home table done.
Credentials have been added for the entries in the hosts and passwd table(s).
Each entry was given a default network password (also known as a Secure-
RPC password). This password is: nisplus
Use this password when the nisclient script requests the network password.
Done!
```

Note and remember the Secure RPC password (`nisplus`, in the above example). Use this password when prompted for your network or Secure RPC password.

The script continues until it has searched for all the files it expects and loads all the tables it can from the available files.

- If you are populating tables from NIS maps, you will see messages like the following as the script uses `hosts` and `passwd` information to create the credentials for hosts and users:

```
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
y
populating auto_master table from sales.doc.com. NIS(YP) domain...
auto_master table done.
populating auto_home table from file sales.doc.com. NIS(YP) domain...
auto_home table done.
....
Credentials have been added for the entries in the hosts and passwd table(s).
Each entry was given a default network password (also known as a Secure-RPC password).
This password is: nisplus
Use this password when the nisclient script requests the network password.
Done!
```

Note and remember the Secure RPC password (`nisplus`, in the above example). Use this password when prompted for your network or Secure RPC password.

All the tables are now populated. You can ignore any `parse error` warnings. Such errors indicate that NIS+ found empty or unexpected values in a field of a particular NIS map. You may want to verify the data later after the script completes.

4. **(Optional) Add yourself and others to the root domain's admin group.**

   For example, if your login ID is `topadm` and your co-worker's ID is `secondadmin`, you enter:

```
master1# nisgrpadm -a admin.doc.com. topadm.doc.com. secondadm.doc.com.
Added "topadm.doc.com." to group "admin.doc.com.".
Added "secondadm.doc.com." to group "admin.doc.com.".
```

The `admin.doc.com.` argument in the `nisgrpadm -a` command above is the group name, which must come first. The remaining two arguments are the names of the administrators.

Note – This step is necessary only if you want to add additional users to the admin group now, which is a good time to add administrators to the root server. You can also add users to the admin group after you have configured NIS+.

You do not have to wait for the other administrators to change their default passwords to perform this step; however, they must already be listed in the `passwd` table before you can add them to the admin group. Members of the admin group will be unable to act as NIS+ principals until they add themselves to the domain. See "How to Initialize an NIS+ User" on page 108for more information on initializing users. The group cache also has to expire before the new members become active.

5. **Type the following command to checkpoint the domain.**

```
master1# nisping -C doc.com.
Checkpointing replicas serving directory doc.com.
Master server is master1.doc.com.
 Last update occurred at date
Master server is master1.doc.com.
checkpoint scheduled on master1.doc.com.
```

This step ensures that all the servers supporting the domain transfer the new information from their initialization (`.log`) files to the disk-based copies of the tables. Since you have just configured the root domain, this step affects only the root master server, as the root domain does not yet have replicas.

Caution – If you do not have enough swap or disk space, the server will be unable to checkpoint properly, but it will not notify you. One way to make sure everything is correct is to list the contents of a table with the `niscat` command. For example, to check the contents of the `rpc` table, type:

```
master1# niscat rpc.org_dir
rpcbind rpcbind 100000
rpcbind portmap 100000
rpcbind sunrpc 100000
```

If you do not have enough swap space, you will see the following error message instead of the sort of output you see above.

```
can't list table: Server busy, Try Again.
```

Even though it does not say so, in this context this message indicates that you do not have enough swap space. Increase the swap space and checkpoint the domain again.

Setting Up NIS+ Client Machines

After the root master server's tables have been populated from files or NIS maps, you can initialize NIS+ client machines. (Because the root master server is an NIS+ client of its own domain, no further steps are required to initialize it.) This section shows you how to initialize an NIS+ client by using the `nisclient` script with default settings. The script will use:

- The domain used in previous examples, `doc.com`.
- The Secure RPC password (also known as the network password) created by the `nispopulate` script in the previous example (`nisplus`, the default password)

Note – The `-i` option used in "How to Initialize a New Client Machine" on page 105does not configure an NIS+ client to resolve host names requiring DNS. You need to explicitly include DNS for clients in their name service switch files. See the DNS section for more information on resolving host names through DNS.

Prerequisites to Running `nisclient`

Before you can use the `nisclient` script:

- The domain must have already been configured and its master server must be running.

- The master server of the domain's tables must be populated. (At a minimum, the hosts or ipnodes table must have an entry for the new client machine.)
- You must be logged in as superuser on the machine that is to become an NIS+ client. In this example, the new client machine is named `client1`.

Information You Need

You need:

- The domain name
- The default Secure RPC password (`nisplus`)
- The root password of the machine that will become the client
- The IP address of the NIS+ server (in the client's home domain)
- If DES authentication is used, note the Diffie-Hellman key length used on the master server. Use `nisauthconf` to ascertain the master server Diffie-Hellman key length.

▼ How to Initialize a New Client Machine

1. **Optionally, if using DES authentication, specify the Diffie-Hellman key length.**

   On the master server, type

   ```
   nisauthconf
   ```

   Use the output as the arguments when running the `nisauthconf` command on the client. For example, if `nisauthconf` on the master server produces

   ```
   dh640dh-0 des
   ```

   type the following command on the client machine

   ```
   nisauthconf dh640dh-0 des
   ```

2. **Type the following command to initialize the new client on the new client machine.**

   The `-i` option initializes a client. The `-d` option specifies the new NIS+ domain name. (If the domain name is not specified, the default is the current domain name.) The `-h` option specifies the NIS+ server's host name.

```
client1# nisclient -i -d doc.com. -h master1
Initializing client client1 for domain "doc.com.".
Once initialization is done, you will need to reboot your machine.
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
```

3. **Type** `y`**.**

   Typing `n` exits the script. The script prompts you only for the root server's IP address if there is no entry for it in the client's `/etc/hosts` or `/etc/inet/ipnodes` file.

```
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
y
Type server master1's IP address:
```

4. **Type the correct IP address, and press Return.**

   This example uses the hypothetical address `123.123.123.123`.

```
Type server master1's IP address: 123.123.123.123
setting up the domain information...
setting up the name service switch information...
At the prompt below, type the network password (also known as the
Secure-RPC password) that you obtained either from your administrator or
from running the nispopulate script.
 Please enter the Secure-RPC password for root:
```

5. **Type the Secure RPC password (also known as the network password) only if the Secure RPC password differs from the root login password.**

   In this case, use the default, `nisplus` .

   The password does not echo on the screen. If you mistype it, you are prompted for the correct one. If you mistype it twice, the script exits and restores your previous network service. If this happens, try running the script again.

```
Please enter the login password for root:
```

6. **Type the root password for this client machine.**

   The password does not echo on the screen. (If the Secure RPC password and the root login password happen to be the same, you will not be prompted for the root login password.)

   Typing the root password changes the credentials for this machine. The RPC password and the root password are now the same for this machine.

```
Please enter the login password for root:
Wrote secret key into /etc/.rootkey
Your network password has been changed to your login one.
Your network and login passwords are now the same.
Client initialization completed!!
Please reboot your machine for changes to take effect.
```

7. **Reboot your new client machine.**

   Your changes do not take effect until you reboot the machine.

   You can now have the users of this NIS+ client machine add themselves to the NIS+ domain.

Creating Additional Client Machines

Repeat the preceding client-initiation procedure on as many machines as you like. To initiate clients for another domain, repeat the procedure but change the domain and master server names appropriately.

The sample NIS+ domain described in this chapter assumes that you will initialize four clients in the `doc.com.` domain. You are then going to configure two of the clients as non-root NIS+ servers and a third client as a root replica of the root master server of the `doc.com.` domain.

Note – You always have to make a system into a client of the parent domain before you can make the same system a server of any type.

Initializing NIS+ Client Users

After a machine has become an NIS+ client, the users of that machine must add themselves to the NIS+ domain. Adding a user to the domain means changing the Secure RPC password to that user's login password. What actually happens is that the user's password and the Secure RPC password are bound together. This procedure uses the `nisclient` script.

Prerequisites to Running `nisclient`

Before you can use the `nisclient` script to initialize a user:

- The domain must have already been configured and its master server must be running.
- The master server of the domain's tables must be populated. (At a minimum, the hosts table must have an entry for the new client machine.)
- You must have initialized a client machine in the domain.
- You must be logged in as a *user* on the client machine. In this example, the user is named `user1`.
- Optionally, if using DES authentication, the client machine must use the same Diffie-Hellman key configuration as that used on the master server.

Information You Need

You need:

- A user's login name (`user1` in this example)
- The default Secure RPC password (`nisplus` in this example)
- The login password of the user who will become the NIS+ client

▼ How to Initialize an NIS+ User

1. **To become an NIS+ client, enter the following `nisclient` command while logged in as the user.**

```
user1prompt% nisclient -u
At the prompt below, type the network password (also known as the
Secure-RPC password) that you obtained either from your administrator
or from running the nispopulate script.
Please enter the Secure-RPC password for user1:
```

2. **Enter the Secure RPC password, which is `nisplus` in this case.**

   The password does not echo on the screen.

```
Please enter the login password for user1:
```

3. **Type the user's login password and press Return.**

   The password does not echo on the screen.

```
Your network password has been changed to your login one.
Your network and login passwords are now the same
```

   This user is now an NIS+ client. You need to have all users make themselves NIS+ clients.

Setting Up NIS+ Servers

Now that the client machines have been initialized, you can change any of them to NIS+ servers of the following types:

- To be root replicas—to contain copies of the NIS+ tables that reside on the root master server
- To be master servers of subdomains of the root domain
- To be replicas of master servers of subdomains of the root domain

Note – You can have only one NIS+ master root server. Root NIS+ servers are a special type of NIS+ server. This section does not describe how to configure a root master server; see "Setting Up NIS+ Root Servers" on page 92 for more information.

You can configure servers any of these different ways:

- Without NIS compatibility
- With NIS compatibility
- With NIS compatibility and DNS forwarding—you only need to set DNS forwarding if you are going to have SunOS 4.x clients in your NIS+ namespace.

Servers and their replicas should have the same NIS-compatibility settings. If they do not have the same settings, a client that needs NIS compatibility set to receive network information may not be able to receive it if either the server or replica it needs is unavailable.

This example shows the machine `client1` being changed to a server. This procedure uses the NIS+ `rpc.nisd` command instead of an NIS+ script.

Prerequisites to Running `rpc.nisd`

Before you can run `rpc.nisd`:

- The domain must have already been configured and its master server must be running.
- The master server of the domain's tables must be populated. (At a minimum, the hosts table must have an entry for the new client machine.)
- You must have initialized the client machine in the domain.
- You must be logged in as root on the client machine. In this example, the client machine is named `client1`.
- Optionally, if using DES authentication, the client machine must use the same Diffie-Hellman key configuration as that used on the master server.

Information You Need

You need the superuser password of the client that you will convert into a server.

Configuring a Client as an NIS+ Server

Perform any of the following to alternate procedures to configure a client as a server. These procedures create a directory with the same name as the server and create the server's initialization files which are placed in `/var/nis`.

Note – All servers in the same domain must have the same NIS-compatibility setting. For example, if the master server is NIS compatible, then its replicas should also be NIS compatible.

▼ How to Configure a Server Without NIS Compatibility

- **To configure a server without NIS compatibility, enter the following command:**

```
client1# rpc.nisd
```

▼ How to Configure a Server With NIS Compatibility

1. **Edit the `/etc/init.d/rpc` file on the server to uncomment the whole line containing the string `-EMULYP="-Y"`.**

   To do this, remove the # character from the beginning of the line.

2. **Type the following as superuser.**

```
client1# rpc.nisd -Y
```

▼ How to Configure a Server With DNS and NIS Compatibility

This procedure configures an NIS+ server with both DNS forwarding and NIS+ compatibility. Both of these features are needed to support SunOS 4.x clients.

1. **Edit the `/etc/init.d/rpc` file on the server to uncomment the whole line containing the string `EMULYP="-Y"`.**

   To do this, remove the # character from the beginning of the line.

2. **Add `-B` to the above line inside the quotes.**

   The line should read:

```
-EMULYP="-Y -B"
```

3. **Type the following command as superuser.**

```
client1# rpc.nisd -Y -B
```

Now this server is ready to be designated a master or replica of a domain.

Creating Additional Servers

Repeat the preceding client-to-server conversion procedure on as many client machines as you like.

The sample NIS+ domain described in this chapter assumes that you will convert three clients to servers. You will then configure one of the servers as a root replica, another as a master of a new subdomain, and the third as a replica of the master of the new subdomain.

Creating a Root Replica Server

To have regularly available NIS+ service, you should always create one or more root replica servers. Having replicas can also speed network-request resolution because multiple servers are available to handle requests.

For performance reasons, you should have no more than a few replicas per domain. If your network includes multiple subnets or different sites connected by a Wide Area Network (WAN), you may need additional replicas:

- *Subnets*. If you have a domain that spans multiple subnets, it is a good idea to have at least one replica server within each subnet so that if the connection between nets is temporarily out of service, each subnet can continue to function until the connection is restored.
- *Remote sites*. If you have a domain spanning multiple sites linked over a WAN, it is a good idea to have at least one replica server on each side of the WAN link. For example, it may make sense from an organizational point of view to have two physically distant sites in the same NIS+ domain. If the domain's master server and all of its replicas are at the first site, there will be much NIS+ network traffic between the first and second sites. Creating an additional replica at the second site should reduce network traffic.

See "Creating a Root Replica Server" on page 111for additional information on how to determine the optimum number of replicas.

"How to Create a Root Replica" on page 112 shows the machine `client1` being configured as a root replica for the `doc.com.` domain. This procedure uses the NIS+

`nisserver` script. (You can also use the NIS+ command set to configure a replica server as described in "Using NIS+ Commands to Configure a Replica Server" on page 166.)

Prerequisites to Running `nisserver`

Before you can run `nisserver` to create a replica:

- The domain must already have been configured and its master server must be running.
- The tables of the master server must be populated. (At a minimum, the hosts table must have an entry for the new client machine.)
- You must have initialized the new server as a client machine in the domain, as described in "Setting Up NIS+ Client Machines" on page 104.
- You must have started `rpc.nisd` on the new replica server, as described in "Setting Up NIS+ Servers" on page 108.
- You must be logged in as root on the root master server. In this example, the root master machine is named `master1`.

Information You Need

You need:

- The domain name
- The client machine name; (`client1,` in this example)
- The superuser password for the root master server

▼ How to Create a Root Replica

1. **To create a root replica, type the following command as superuser (root) on the NIS+ domain's root master server.**

```
master1# nisserver -R -d doc.com. -h client1
This script sets up a NIS+ replica server for domain doc.com.
Domain name: :doc.com.
NIS+ server    : :client1
Is this information correct? (type 'y' to accept, 'n' to change)
```

The `-R` option indicates that a replica should be configured. The `-d` option specifies the NIS+ domain name (`doc.com.`, in this example). The `-h` option specifies the client machine (`client1,` in this example) that will become the root replica.

2. **Type** `y` **to continue.**

   Typing `n` causes the script to prompt you for the correct information. (See "How to Change Incorrect Information" on page 95 for what you need to do if you type `n`.)

```
Is this information correct? (type 'y' to accept, 'n' to change)
y
This script will set up machine "client1" as an NIS+ replica server for domain
doc.com. without NIS compatibility. The NIS+ server daemon, rpc.nisd, must
be running on client1 with the proper options to serve this domain.
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
```

3. **Type** `y` **to continue.**

   Typing `n` safely stops the script. The script will exit on its own if `rpc.nisd` is *not* running on the client machine.

```
Is this information correct? (type 'y' to continue, 'n' to exit this script)
y
The system client1 is now configured as a replica server for domain doc.com..
The NIS+ server daemon, rpc.nisd, must be running on client1 with the proper
options to serve this domain. If you want to run this replica in NIS (YP)
compatibility mode, edit the /etc/init.d/rpc file on the replica server '
to uncomment the line which sets EMULYP to "-Y". This will ensure that
rpc.nisd will boot in NIS-compatibility mode. Then, restart rpc.nisd with
the "-Y" option. These actions should be taken after this script completes.
```

Note – The above notice refers to an optional step. You need to modify only the `/etc/init.d/rpc` file if you want the root replica to be NIS compatible and it is not now NIS compatible. That is, the file needs modification only if you want the root replica to fulfill NIS client requests and it was not already configured as an NIS-compatible server. See "Configuring a Client as an NIS+ Server" on page 110 for more information on creating NIS-compatible servers.

---

4. **[Optional] Configure the replica to run in NIS (YP) compatibility mode.**

   If you want this replica to run in NIS compatibility mode, follow these steps:

   a. **Kill** `rpc.nisd`

   b. **Edit the server's** `/etc/init.d/rpc` **file to uncomment the line that sets** `EMULYP` **to** `-Y`**.**

      In other words, delete the # character from the start of the `EMULYP` line.

   c. **Restart** `rpc.nisd`**.**

5. **Load your namespace data on to the new replica server.**

   You can do this in two ways:

   - The preferred method of loading data on to a new replica server is to use the NIS+ backup and restore capabilities to back up the master server, then "restore" that

data on to the new replica server. This step is described in detail in "How to Load Namespace Data—nisrestore Method" on page 169.

- Run `nisping`. Running `nisping` initiates a full resynch of all NIS+ data from the master server to this new replica. If your namespace is large, this can take a long time, during which your master server is very busy and slow to respond and your new replica is unable to answer NIS+ requests. This step is described in detail in "How to Load Namespace Data—nisping Method" on page 171.

When you have finished loading your namespace data, the machine `client1` is now an NIS+ root replica. The new root replica can handle requests from the clients of the root domain. Because there are now two servers available to the domain, information requests can be fulfilled faster.

Using these procedures, you can create as many root replicas as you need. You can also use these procedures to create replica servers for subdomains.

▼ How to Set Up Multihomed NIS+ Replica Servers

The procedure for setting up a multihomed NIS+ server is the same as setting up a single interface server. The only difference is that there are more interfaces that need to be defined in the hosts database (`/etc/hosts` and `/etc/inet/ipnodes` files, and NIS+ `hosts` and `ipnodes` tables). Once the host information is defined, use the `nisclient` and `nisserver` scripts to set up the multihomed NIS+ server.

Caution – When setting up a multihomed NIS+ server, the server's primary name must be the same as the nodename for the system. This is a requirement of both Secured RPC and `nisclient`.

- Secured RPC relies on the nodename to create the netname for authentication.
- `nisclient` relies on the primary name to create the credential for the client.

If these names are different, Secure RPC authentication will fail to work properly causing NIS+ problems.

This procedure shows how to set up any NIS+ non-root master servers. The following example creates a replica for the root domain. For information about setting up a multihomed root server, see "How to Set Up a Multihomed NIS+ Root Master Server" on page 96.

1. **Add the server host information into the `hosts` or `ipnodes` file.**

   For example, for the *hostB* system with three interfaces:

```
192.168.11.y hostB hostB-11
192.168.12.x hostB hostB-12
192.168.14.z hostB hostB-14
```

2. **On the root master server, use either** `nispopulate` **or** `nisaddent` **to load the new host information into the** `hosts` **or** `ipnodes` **table.**

   For example:

   ```
   hostA# nispopulate -F -d sun.com hosts
   ```

   where the example shows *sun.com* as the NIS+ root domain name. Issue the `nispopulate` command specifying the name of your NIS+ root domain name.

3. **On the root master server, use the** `nisclient` **script to create the credential for the new client.**

   For example:

   ```
   hostA# nisclient -c -d sun.com hostB
   ```

   where the example shows *sun.com* as the root domain name. Issue the `nisclient` command specifying the name of your root domain name.

4. **On the non-root master server, use** `nisclient` **to start the new server if it is not already running and initialize the machine as an NIS+ client.**

   For example:

   ```
   hostB# nisclient -i -d sun.com
   ```

   where the example shows *sun.com* as the root domain name. Issue the `nisclient` command specifying the name of your root domain name.

5. **On the root master server, use** `nisserver` **to create a non-root master.**

   For example:

   ```
   hostA# nisserver -M -d eng.sun.com -h hostB.sun.com.
   ```

   where the example shows *eng.sun.com* as the NIS+ domain name and *hostB.sun.com* as the fully-qualified hostname for the NIS+ server. Issue the `nisserver` command specifying the name of your NIS+ domain and the fully-qualified hostname for the NIS+ server.

6. **On the root master server, use** `nisserver` **to set up a replica server.**

   For example:

   ```
   hostA# nisserver -R -d sun.com -h hostB.sun.com.
   ```

   where the example shows *sun.com* as the replica server and *hostB.sun.com* as the fully-qualified hostname for the NIS+ server. Issue the `nisserver` command specifying the name of your replica server and NIS+ domain.

   After completing the steps for setting up a multihome NIS+ replica server, the remainder of the setup is exactly the same as for a single interface server.

Creating a Subdomain

This section shows you how to create the master server of a new non-root domain. The new domain will be a subdomain of the `doc.com.` domain. The hierarchical structure of NIS+ allows you to create a domain structure that parallels your organizational structure.

This example shows the machine `client2` being converted to the master server of a new domain called `sub.doc.com.`. This procedure uses the NIS+ script `nisserver`.

Prerequisites to Running `nisserver`

Before you can run `nisserver` to create a master server for a new non-root domain:

- The parent domain must already have been configured and its master server must be running.
- The parent domain's tables must be populated. (At a minimum, the hosts table must have an entry for the new client machine.)
- You must have initialized the new client machine in the parent domain.
- You must have started `rpc.nisd` on the client.
- You must have adequate permissions to add the new domain. In this case, you must be logged in as root on the parent master server. In this example, the parent master machine is named `master1`.

Information You Need

You need:

- A name for the new non-root domain—the name of the new domain includes the name of the parent domain with this syntax: *newdomain.rootdomain*.
- The client machine name (`client2,` in this example)
- The superuser password for the parent master server

In "How to Create a New Non-Root Domain" on page 117, the new non-root domain is called `sub.doc.com.`.

Note – In Solaris release 2.6 and earlier, any NIS+ client can be converted to an NIS+ master server as long as it is itself in a domain above the domain it is serving. For example, an NIS+ client in domain `sales.doc.com.` can serve domains below it in the hierarchy, such as `west.sales.doc.com.` or even `alameda.west.sales.doc.com.`. This client cannot, however, serve the domain `doc.com.`, because `doc.com.` is above the domain `sales.doc.com.` in the hierarchy. Root replicas are the only exception to this rule. They are clients of the domain that they serve.

Note – In Solaris release 7, the domainname of any non-root NIS+ server can be set to the domain it serves. The non-root server behaves as if it lives in its own domain. This allows you to configure applications on the non-root server to use the information provided by the domain above it in the hierarchy.

The non-root server's credentials must still be in the domain above it in the hierarchy. Configure the non-root servers as described in "How to Create a New Non-Root Domain" on page 117. Only after the servers are properly configured, can you change the domainname to that of the domain it serves. See the `-k` option of `nisinit` and the `-d` option of `nisserver`.

▼ How to Create a New Non-Root Domain

1. **Type the following command as superuser (root) on the NIS+ domain's root master server to create a new non-root domain master server.**

   The `-M` option indicates that a master server for a new non-root domain should be created. The `-d` option specifies the *new* domain name, `sales.doc.com.` in this instance. The `-h` option specifies the client machine, (`client2`, in this example), that will become the master server of the new domain.

```
master1# nisserver -M -d sales.doc.com. -h client2
This script sets up a non-root NIS+ master server for domain sales.doc.com.
Domain name : sales.doc.com.
NIS+ server : client2
NIS+ group : admin.sales.doc.com.
NIS (YP) compatibility : OFF
Security level : 2=DES
Is this information correct? (type 'y' to accept, 'n' to change)
```

   Master servers of new non-root domains are created with the same set of default values as root servers. See "How to Create a Root Master Server" on page 93 for more information on NIS+ group, NIS compatibility, and security level.

2. **Type `y` to continue.**

   Typing `n` causes the script to prompt you for the correct information. (See "How to Change Incorrect Information" on page 95 for what you need to do if you type `n`.)

```
Is this information correct?
(type 'y' to accept, 'n' to change) y
This script sets up machine "client2" as an NIS+ non-root master
server for domain sales.doc.com.
Do you want to continue? (type 'y' to continue, 'n' to exit this script)
```

3. **Type `y` to continue.**

   Typing `n` safely exits the script. The script exits on its own if `rpc.nisd` is *not* running on the client machine.

```
Do you want to continue? (type 'y' to continue, 'n'
to exit this script)
y
running nissetup ...
org_dir.sales.doc.com. created
groups_dir.sales.doc.com. created
...
...
setting NIS+ group admin.sales.doc.com. ...
The system client2 is now configured as a non-root server for
domain sales.doc.com.
You can now populate the standard NIS+ tables by using the
nispopulate or /usr/lib/nis/nisaddent commands.
```

The machine `client2` is now the master server of the `sales.doc.com.` domain. The `sales.doc.com.` domain is a subdomain of the `doc.com.` domain. The machine `client2` is simultaneously still a client of the root domain `doc.com.`, and the master server of the `sales.doc.com.` domain.

You can now populate the standard NIS+ tables on the new master server of the `sales.doc.com.` domain.

Creating Additional Domains

Repeat the preceding procedure for changing servers to master servers of new non-root domains on as many server machines as you like. Every new master server is a new domain. Plan your domain structure before you start creating an NIS+ namespace. See "Structure of the NIS+ Namespace" on page 60for more information on planning an NIS+ hierarchy.

Populating the New Subdomain's Tables

After you have created a new domain, you need to populate its master server's standard NIS+ tables. You use the same procedure to populate the new master server's tables as you used to populate the root master server's tables. The major difference is that the `nispopulate` script is run on the new master server instead of on the root master server. The domain names and file paths or NIS servers' names may change as well.

This example shows the tables of the new domain, `sales.doc.com.`, being populated.

Prerequisites to Running `nispopulate`

Before you can run the `nispopulate` script to populate the new master server's tables:

- The information in the files must be formatted appropriately for the table into which it will be loaded.
  - Before proceeding, view each local `/etc` file or NIS map that you will be loading data from. Make sure that there are no spurious or incorrect entries. Make sure that the right data is in the correct place and format. Remove any outdated, invalid, or corrupt entries. You should also remove any incomplete or partial entries. You can always add individual entries after configuration is completed. That is easier than trying to load incomplete or damaged entries.
  - If you are setting up a network for the first time, you may not have much network information stored anywhere. In that case, you'll need to first get the information and then enter it manually into the *input file*—which is essentially the same as an `/etc` file.
- You should make copies of the `/etc` files and use the copies to populate the tables instead of the actual ones for safety reasons. (This example uses files in a directory called `/nis+files`, for instance.)
- Edit four of the copied NIS table files, `passwd`, `shadow`, `aliases`, and `hosts`, for security reasons. For example, you might want to remove the following lines from the copy of your local `passwd` file so they are not distributed across the namespace:

```
root:x:0:1:0000-Admin(0000):/:/sbin/sh
daemon:x:1:3:0000-Admin(0000):/:
bin:x:3:5:0000-Admin(0000):/usr/bin:
sys:x:3:3:0000-Admin(0000):/:
adm:x:4:4:0000-Admin(0000):/var/adm:
```

```
lp:x:78:9:0000-lp(0000):/usr/spool/lp:
smtp:x:0:0:mail daemon user:/:
uucp:x:5:5:0000-uucp(0000):/usr/lib/uucp:
nuucp:x:7:8:0000-
uucp (0000):/var/spool/uucppublic:/usr/lib/uucp/uucico
listen:x:22:6:Network Admin:/usr/net/nls:
nobody:x:60000:60000:uid no body:/:
noaccess:x:60002:60002:uid no access:/:
```

- The domain must have already been configured and its master server must be running.
- The domain's servers must have sufficient disk space to accommodate the new table information.
- You must be logged in as an NIS+ principal and have write permission to the NIS+ tables in the specified domain. In this example, you would have to be the user root on the machine `client2`.

Note – The `nispopulate` script can fail if there is insufficient `/tmp` space on the system. To keep this from happening, you can set the environment variable `TMPDIR` to a different directory. If `TMPDIR` is not set to a valid directory, the script uses the `/tmp` directory instead.

Information You Need

If populating from files, you need:

- The new NIS+ domain name
- The path of the appropriately edited text files whose data will be transferred
- The root password of the NIS+ master server

If populating from NIS maps, you need:

- The new NIS+ domain name
- The NIS domain name
- The NIS server's name
- The IP address of the NIS server
- The root password of the NIS+ master server

Note – The NIS domain name is case-sensitive, while the NIS+ domain name is not.

Populating the Master Server Tables

Since this procedure is essentially the same as the procedure shown in "How to Populate the Root Master Server Tables" on page 100, this example shows you only what you would type to populate the tables of the new domain, `sales.doc.com.`. For more information about this procedure, see "How to Populate the Root Master Server Tables" on page 100.

Note – This script should be run on the new domain's master server, not the root master server.

The alternate methods of populating the master server tables on the new master server are:

- You can populate master server tables from files.
- You can populate master server tables from NIS maps.

Whichever method you choose should be executed in a scrolling window as the script's output might otherwise scroll off the screen.

▼ How to Populate the Tables From Files

To populate master server tables from files, type the following commands.

```
client2# nispopulate -F -p /nis+files -d sales.doc.com.
NIS+ domain name : sales.doc.com.
Directory Path : /nis+files
Is this information correct? (type 'y' to accept, 'n' to change
```

▼ How to Populate the Tables From NIS Maps

To populate master server tables from NIS maps, type the following commands.

```
client2# nispopulate -Y -d sales.doc.com. -h businessmachine -a
 IP_addr_of_NIS_server -y business.doc.com.
NIS+ Domain name : sales.doc.com.
NIS (YP) domain : business.doc.com.
NIS (YP) server hostname : businessmachine
Is this information correct? (type 'y' to accept, 'n' to change)
```

See “How to Populate the Root Master Server Tables” on page 100 for additional information.

Creating Subdomain Replicas

The same principles that apply to root domain replicas apply to subdomain replicas (see “Creating a Root Replica Server” on page 111).

You use the same procedure to create a subdomain replica as you do to create a root replica. The major difference between creating the root replica and a subdomain replica is that the machine you are going to convert to a subdomain replica remains a client of the domain above the one it serves as a replica. This example shows you only what you type to create a replica for the new domain. For the rest of the script’s output, see “How to Create a Root Replica” on page 112.

Prerequisites to Running `nisserver`

Before you can run `nisserver` to create a replica:

- The domain must have already been configured and its master server must be running.
- The domain’s tables must be populated. (At a minimum, the hosts table must have an entry for the new client machine.)
- You must have initialized the client machine in the parent domain.
- You must have started `rpc.nisd` on the client.
- You must be logged in as root on the master server. In this example, the master machine is named `client2`.

Information You Need

- The domain name
- The client machine name (`client3,` in this example)
- The superuser password for the root master server

▼ How to Create a Replica

- **Run the `nisserver -R` command as superuser (root) on the NIS+ domain's master server.**

```
client2# nisserver -R -d sales.doc.com. -h client3
This script sets up a NIS+ replica server for domain sales.doc.com.
Domain name     ::sales.doc.com.
NIS+ server :client
Is this information correct? (type 'y' to accept, 'n' to change)
```

In this example, `client2` is the master server. The `-R` option indicates that a replica should be configured. The `-d` option specifies the NIS+ domain name (`sales.doc.com.` in this example). The `-h` option specifies the client machine (`client3`, in this example) that will become the replica. Notice that this machine is still a client of the `doc.com.` domain and not a client of the `sales.doc.com.` domain.

See "How to Create a Root Replica" on page 112 for the rest of this script's output.

Initializing Subdomain NIS+ Client Machines

After the master server's tables have been populated from files or NIS maps, you can initialize an NIS+ client machine. This section shows you how to initialize an NIS+ client in the new domain using the `nisclient` script with default settings. The NIS+ client machine is a different machine from the NIS+ master server.

Note – The `-i` option used in "How to Initialize a New Subdomain Client Machine" on page 124does not configure an NIS+ client to resolve host names requiring DNS. You need to explicitly include DNS for clients in their name service switch files. See for more information on resolving host names through DNS.

You use the same procedure to initialize a client in the new domain as you do to initialize a client in the root domain. This example shows you only what you would type to initialize a client for the new domain. For the rest of the script's output, see "How to Initialize a New Client Machine" on page 105.

Prerequisites to Running `nisclient`

Before you can use the `nisclient` script to initialize a user:

- The domain must have already been configured and its master server must be running.
- The master server of the domain's tables must be populated. (At a minimum, the host's table must have an entry for the new client machine.)
- You must have initialized a client machine in the domain.
- You must be logged in as a *user* on the client machine. In this example, the user is named user1.

Information You Need

You need:

- The domain name (`sales.doc.com.`, in this example)
- The default Secure RPC password (`nisplus`)
- The root password of the machine that will become the client
- The IP address of the NIS+ server (in the client's home domain) (in this example, the address of the master server, `client2`)

▼ How to Initialize a New Subdomain Client Machine

- **Type the following command as superuser to initialize the new client on the new client machine.**

```
subclient1# nisclient -i -d sales.doc.com. -h client2
Initializing client subclient1 for domain "sales.doc.com.".
Once initialization is done, you will need to reboot your machine.
Do you want to continue? (type 'Y' to continue, 'N' to exit this script)
```

The `-i` option initializes a client. The `-d` option specifies the new NIS+ domain name. (If the domain name is not specified, the default becomes the current domain name.) The `-h` option specifies the NIS+ server's host name.

See "How to Initialize a New Client Machine" on page 105 for the rest of this script's output.

Initializing Subdomain NIS+ Client Users

You use the same procedure (`nisclient`) to initialize a user in the new domain as you do to initialize a user in the root domain. All users must make themselves NIS+ clients. This example shows you only what you would type to initialize a user for the new domain. For the rest of the script's output, see "How to Initialize an NIS+ User" on page 108.

Prerequisites to Running `nisclient`

Before you can use the `nisclient` script to initialize a user:

- The domain must have already been configured and its master server must be running.
- The master server of the domain's tables must be populated. (At a minimum, the hosts table must have an entry for the new client machine.)
- You must have initialized a client machine in the domain.
- You must be logged in as a *user* on the client machine. In this example, the user is named `user2`.

Information You Need

You need:

- The user's login name (`user2`, in this example)
- The default Secure RPC password (`nisplus`)
- The login password of the user that will become the NIS+ client

▼ How to Initialize an NIS+ Subdomain User

- **To become an NIS+ client, type the following command while logged in as the user.**

```
user2prompt% nisclient -u
At the prompt below, type the network password (also known as the
Secure-RPC password) that you obtained either from your administrator
or from running the nispopulate script.
Please enter the Secure-RPC password for user2:
```

See “How to Initialize an NIS+ User” on page 108 for the rest of this script’s output.

Summary of Commands for the Sample NIS+ Namespace

Table 4–4 summarizes the actual commands that you typed to create the sample namespace. The prompt preceding each command indicates on which machine the command should be typed.

TABLE 4–4 Creating the Sample Namespace: Command Summary

Tasks	Commands

Set environment path to include `/usr/lib/nis`—C shell or Bourne shell.	`# setenv PATH $PATH:/usr/lib/nis`
	or
	`# PATH=$PATH:/usr/lib/nis; export PATH`

Optionally configure Diffie-Hellman key length.	`master1# nisauthconf dh640-0 des`
Create root master server for `doc.com.` domain.	`master1# nisserver -r -d doc.com.`

Populate the root master server’s NIS+ tables—from files or from NIS maps.	`master1# nispopulate -F -p /nis+files -d doc.com.`
	or
	`master1# nispopulate -Y -d doc.com. -h salesmaster -a \`
	`130.48.58.111 -y sales.doc.com.`

Add additional members to the admin group (2).	`master1# nisgrpadm -a admin. doc.com. topadmin.doc.com. \` `secondadmin.doc.com.`
Make a checkpoint of the NIS+ database.	`master1# nisping -C org_dir. doc.com.`
Optionally configure Diffie-Hellman key length.	`client1# nisauthconf dh640-0 des`
Initialize an NIS+ client machine in the doc.com. domain.	`client1# nisclient -i -d doc.com. -h master1`
Initialize user as an NIS+ client.	`client1user1prompt% nisclient -u`

TABLE 4–4 Creating the Sample Namespace: Command Summary *(Continued)*

Tasks	Commands

Convert NIS+ client to NIS+ server, without or with NIS compatibility or with NIS and DNS.	`client1#rpc.nisd`
	or
	`client1# rpc.nisd -Y`
	or
	`client1# rpc.nisd -Y -B`

Create a root replica.	`master1# nisserver -R -d doc.com. -h client1`
Convert a server to a non-root master server of the `sales.doc.com.` domain.	`master1# nisserver -M -d sales.doc.com. -h client2`

Populate the new master server's NIS+ tables—from files or from NIS maps.	`client2# nispopulate -F -p /nis+files -d sales.doc.com.`
	or
	`client2# nispopulate -Y -d sales.doc.com. -h \`
	`businessmachine -a 130.48.58.242 -y business.doc.com.`

Create a master server replica.	`client2# nisserver -R -d sales.doc.com. -h client3`
Initialize an NIS+ client in the `sales.doc.com..` domain.	`subclient1# nisclient -i -d sales.doc.com. -h client2`
Initialize user as an NIS+ client.	`subclient1user2prompt% nisclient -u`

CHAPTER 5

Setting Up the Root Domain

This chapter provides step-by-step instructions for setting up the root domain and DES authentication using the NIS+ command set.

Introduction to Setting Up the Root Domain

This task describes how to configure the root domain with the root master server running at security level 2 (the normal level).

Note – It is much easier to perform this task with the NIS+ installation scripts as described in Part 1 than with the NIS+ command set as described here. The methods described in this chapter should be used only by those administrators who are very familiar with NIS+ and who require some nonstandard features or configurations not provided by the installation scripts.

Setting up the root domain involves three major tasks:

- Preparing the root master server
- Creating the root domain
- Creating credentials for the root domain

However, setting up the root domain is not as simple as performing these three tasks in order; they are intertwined with one another. For instance, you must specify some security parameters before you create the root directory, the rest, after. To make the root domain easier to configure, this chapter separates these tasks into individual steps and arranges them into their most efficient order.

Standard Versus NIS-Compatible Configuration Procedures

The steps in this chapter apply to both a standard NIS+ root domain and an NIS-compatible root domain. There are, however, some important differences. The NIS+ daemon for an NIS-compatible domain must be started with the `-Y` option, which allows the root master server to answer requests from NIS clients. This is described in step 11. The equivalent step for standard NIS+ domains is step 12.

An NIS-compatible domain also requires read rights to the `passwd` table for the nobody class, which allows NIS clients to access the information stored in the table's `passwd` column. This is accomplished with the `-Y` option to the `nissetup` command, in step 14. The standard NIS+ domain version uses the same command but without the `-Y` option.

Establishing the Root Domain

The procedure describes each step in detail and provides related information. For those who do not need detailed instructions, a summary listing of the necessary commands is provided on "Root Domain Configuration Summary" on page 143.

Summary of Steps

Here is a summary of the entire configuration process:

1. Log in as superuser to the root master server.
2. Check the root master server's domain name.
3. Check the root master server's switch-configuration file.
4. Optionally, configure the Diffie-Hellman key length.
5. Clean out leftover NIS+ material and processes.
6. Name the root domain's admin group.
7. Create the root directory and initialize the root master server.
8. [NIS-compatibility Only] Start the NIS+ daemon with `-Y`. [Standard NIS+ Only] Start the NIS+ daemon.
9. Verify that the daemon is running.

10. Create the root domain's subdirectories and tables.
11. Create DES credentials for the root master server.
12. Create the root domain's admin group.
13. Add the root master to the root domain's admin group.
14. Update the root domain's public keys.
15. Start the NIS+ cache manager.
16. Restart the NIS+ daemon with security level 2.
17. Add your LOCAL credentials to the root domain.
18. Add your DES credentials to the root domain.
19. Add credentials for other administrators.
20. Add yourself and other administrators to the root domain's admin group.

Establishing the Root Domain—Task Map

TABLE 5–1 Establishing the Root Domain

Task	Description	For Instructions, Go To
Establishing the Root Domain	Use the `domainname` command to establish the root domain. Optionally extend the Diffie-Hellman key length. Stop and start the `ncsd` daemon. Kill and restart `keyserv`. Clean out leftover NIS+ information.	"How to Configure a Root Domain" on page 132

Security Considerations

NIS+ provides preset security defaults for the root domain. The default security level is level 2. Operational networks with actual users should always be run at security level 2. Security levels 0 and 1 are for configuring and testing purposes only. Do not run an operational network at level 0 or 1.

Note – The NIS+ security system is complex. If you are not familiar with NIS+ security, you might want to review Chapter 11before starting to configure your NIS+ environment.

Prerequisites

Before proceeding, make sure that:

- The `/etc/passwd` file on the root master server contains an entry for you and every other administrator whose credentials will be added to the root domain in this configuration process.
- If the server will operate in NIS-compatibility mode and support DNS forwarding for Solaris 1.x release clients, it must have a properly configured `/etc/resolv.conf` file.
- The server must have a unique machine name that duplicates all user IDs.
- The server must have a machine name that does not contain any dots. For example, a machine named `sales.alpha` is not allowed. A machine named `sales-alpha` is allowed.

Information You Need

In order to complete this task you need to know:

- The superuser password of the machine that will become the root master server
- The name of the root domain
- The name of the root domain's admin group
- Your UID and password
- The UID of any administrator whose credentials you will add to the root domain

▼ How to Configure a Root Domain

1. **Log in as superuser on the machine designated to be the root master server.**

   The examples in these steps use `rootmaster` as the root master server and `doc.com.` as the root domain.

2. **Check the root master server's domain name.**

   Use the `domainname` command to make sure the root master server is using the correct domain name. The `domainname` command returns a machine's current domain name.

Caution – Domains and hosts should not have the same name. For example, if you have a `sales` domain you should not have a machine named `sales`. Similarly, if you have a machine named `home`, you do not want to create a domain named `home`. This caution applies to subdomains; for example, if you have a machine named `west`, you don't want to create a `sales.west.myco.com` subdirectory.

If the name is not correct, change it.

```
rootmaster# domainname
strange.domain
rootmaster# domainname doc.com
rootmaster# domainname
rootmaster# doc.com
rootmaster# rm -f /etc/defaultdomain
rootmaster# domainname > /etc/defaultdomain
```

(Do not include a trailing dot with the `domainname` command. The `domainname` command is not an NIS+ command, so it does not follow the NIS+ conventions of a trailing dot.)

The above example changes the domain name of the root master server from `strange.domain` to `doc.com`. When changing or establishing a domain name, make sure that it has at least two elements; for example, `doc.com` instead of `doc`. The final element should end in either an Internet organizational name (such as `.com`) or a geographical identifier (such as `.jp` or `.uk`).

3. **Check the root master server's switch-configuration file.**

   Make sure the root master server is using the NIS+ version of the `nsswitch.conf` file, even if it will run in NIS-compatibility mode. This step ensures that the primary source of information for the root master are NIS+ tables.

   ```
   rootmaster# more /etc/nsswitch.conf
   ```

   This command displays the current `nsswitch.conf` file. The primary name service referenced by this file should be `nisplus`. If the root master server's configuration file does not use `nisplus` as the primary name service, exchange it for one that does, as explained in "Selecting a Different Configuration File" on page 44.

4. **Optionally, configure the Diffie-Hellman key length.**

   If you are using DES authentication, you can elect to increase the Diffie-Hellman key length from the default 192 bits. For example, to allow both 640 and 192–bit keys type the following:

   ```
   rootmaster# nisauthconf dh640-0 des
   ```

5. **If you made any changes at all to the `nsswitch.conf` file, stop and restart the `nscd` daemon.**

   Because `nscd` caches the contents of the `nsswitch.conf` file, it is necessary to stop and restart `nscd` after any change to the switch file.

   Complete instructions are provided in Chapter 1.

6. **Now kill and restart `keyserv`, as shown below.**

   ```
   rootmaster# cp /etc/nsswitch.nisplus /etc/nsswitch.conf
   rootmaster# sh /etc/init.d/nscd stop
   rootmaster# sh /etc/init.d/nscd start
   rootmaster# ps -e | grep keyserv
    root 145 1 67 16:34:44 ? keyserv
    .
    .
   ```

```
rootmaster# kill -9 145
rootmaster# rm -f /etc/.rootkey
rootmaster# keyserv
```

7. **Clean out leftover NIS+ material and processes.**

   If the machine you are working on was previously used as an NIS+ server or client, remove any files that might exist in `/var/nis` and kill the cache manager, if it is still running. In this example, a cold-start file and a directory cache file still exist in `/var/nis`:

```
rootmaster# ls /var/nis
NIS_COLD_START NIS_SHARED_CACHE
rootmaster# rm -rf /var/nis/*
rootmaster# ps -ef | grep nis_cachemgr
 root 295 260 10 15:26:58 pts/0 0:00 grep nis_cachemgr
 root 286 1 57 15:21:55 ? 0:01 /usr/sbin/nis_cachemgr
rootmaster# kill -9 286
```

   This step makes sure files left in `/var/nis` or directory objects stored by the cache manager are completely erased so they do not conflict with the new information generated during this configuration process. If you have stored any admin scripts in `/var/nis`, you might want to consider temporarily storing them elsewhere, until you finish setting up the root domain.

8. **Kill server daemons**

   If the machine you are working on was previously used as an NIS+ server, check to see if `rpc.nisd` or `rpc.nispasswdd` is running. If either of these daemons is running, kill them.

9. **Name the root domain's admin group.**

   Although you won't actually create the admin group until step 16, you must identify it now. Identifying it now ensures that the root domain's `org_dir` directory object, `groups_dir` directory object, and all its table objects are assigned the proper default group when they are created in step 14.

   To name the admin group, set the value of the environment variable `NIS_GROUP` to the name of the root domain's admin group. Here are two examples, one for `csh` users, and one for `sh/ksh` users. They both set `NIS_GROUP` to `admin.doc.com.`.

   For C Shell

```
rootmaster# setenv NIS_GROUP admin.doc.com.
```

   For Bourne or Korn Shell

```
rootmaster# NIS_GROUP=admin.doc.com.
rootmaster# export NIS_GROUP
```

10. **Create the root directory and initialize the root master server.**

    This step creates the first object in the namespace—the root directory—and converts the machine into the root master server. Use the `nisinit -r` command, as shown below. (This is the only instance in which you will create a domain's directory object

and initialize its master server in one step. In fact, `nisinit -r` performs an automatic `nismkdir` for the root directory. In any case, except the root master, these two processes are performed as separate tasks.)

```
rootmaster# nisinit -r
This machine is in the doc.com. NIS+ domain
Setting up root server ...
All done.
```

A UNIX directory with the name `/var/nis/data` is created.

Within the `/var/nis` directory is a file named `root.object`.

```
rootmaster# ls -l /var/nis/data
-rw-rw-rw- 1 root other 384 date root.object
```

This is not the root directory object; it is a file that NIS+ uses to describe the root of the namespace for internal purposes. The NIS+ root directory object is created in step 11 or step 12.

In subsequent steps, other files are added beneath the directory created in this step. Although you can verify the existence of these files by looking directly into the UNIX directory, NIS+ provides more appropriate commands. They are called out where applicable in the following steps.

Caution – Do not rename the `/var/nis` or `/var/nis/data` directories or any of the files in these directories that were created by `nisinit` or any of the other NIS+ configuration procedures. In Solaris Release 2.4 and earlier, the `/var/nis` directory contained two files named *hostname*. It also contained a subdirectory named `/var/nis/`*hostname*. In Solaris Release 2.5, the two files are named `trans.log` and `data.dict`, and the subdirectory is named `/var/nis/data`. In Solaris Release 2.5, the content of the files has also been changed and they are not backward compatible with Solaris Release 2.4 or earlier. Thus, if you rename either the directories or the files to match the Solaris Release 2.4 patterns, the files will not work with either the Solaris Release 2.4 or the Solaris Release 2.5 version of `rpc.nisd`. Therefore, you should not rename either the directories or the files.

11. [NIS-Compatibility only] Start the NIS+ daemon with `-Y`.

Perform this step only if you are setting up the root domain in NIS-compatibility mode; if setting up a standard NIS+ domain, perform step 12 instead. This step includes instructions for supporting the DNS forwarding capabilities of NIS clients.

Substep *a* starts the NIS+ daemon in NIS-compatibility mode. Substep *b* makes sure that when the server is rebooted, the NIS+ daemon restarts in NIS-compatibility mode. After substep *b* of step b, go to step 14.

a. Use `rpc.nisd` with the `-Y`, `-B` , and `-S 0` options.

```
rootmaster# rpc.nisd -Y -B -S 0 options
```

The `-Y` option invokes an interface that answers NIS requests in addition to NIS+ requests. The `-B` option supports DNS forwarding. The `-S 0` flag sets the server's

security level to 0, which is required at this point for bootstrapping. Because no `cred` table exists yet, no NIS+ principals can have credentials; if you used a higher security level, you would be locked out of the server.

b. Edit the `/etc/init.d/rpc` file.

Search for the string `EMULYP="Y"` in the `/etc/init.d/rpc` file. Uncomment the line and, to retain DNS forwarding capabilities, add the `-B` flag.

An `rpc` file with DNS forwarding contains:

```
EMULYP="-Y -B"
```

An `rpc` file without DNS forwarding contains:

```
EMULYP="-Y"
```

If you do not need to retain DNS forwarding capabilities, uncomment the line but do not add the `-B` flag.

12. [Standard NIS+ only] Start the NIS+ daemon.

Use the `rpc.nisd` and be sure to add the `-S 0` flag.

```
rootmaster# rpc.nisd -S 0
```

The `-S 0` flag sets the server's security level to 0, which is required at this point for bootstrapping. Because no cred table exists yet, no NIS+ principals can have credentials, and if used with a higher security level, you would be locked out of the server.

13. Verify that the root objects have been properly created.

As a result of step 11 or step 12, your namespace should now have:

- A root directory object (`root.dir`)
- A root master server (`rootmaster`) running the NIS+ daemon (`rpc.nisd`)
- A cold start file for the master server (`NIS_COLD_START`)
- A transaction log file (`trans.log`)
- A table dictionary file (`data.dict`).

The root directory object is stored in the directory created in step 10. Use the `ls` command to verify that it is there.

```
rootmaster# ls -l /var/nis/data
-rw-rw-rw- 1 root other 384 date root.object
-rw-rw-rw- 1 root other 124 date root.dir
```

At this point, the root directory is empty; in other words, it has no subdirectories. You can verify this by using the `nisls` command.

```
rootmaster# nisls -l doc.com.
doc.com.:
```

However, it has several *object* properties, which you can examine using `niscat -o`:

```
rootmaster# niscat -o doc.com.
 Object Name : doc
Owner : rootmaster.doc.com.
```

```
Group : admin.doc.com.
Domain : Com.
Access Rights : r---rmcdrmcdr---
```

Notice that the root directory object provides full (read, modify, create, and destroy) rights to both the owner and the group, while providing only read access to the world and nobody classes. (If your directory object does not provide these rights, you can change them using the `nischmod` command.)

To verify that the NIS+ daemon is running, use the `ps` command.

```
rootmaster# ps -ef | grep rpc.nisd
root 1081 1 61 16:43:33 ? 0:01 rpc.nisd -S 0
root 1087 1004 11 16:44:09 pts/1 0:00 grep rpc.nisd
```

The root domain's `NIS_COLD_START` file, which contains the Internet address (and, eventually, public keys) of the root master server, is placed in `/var/nis`. Although there is no NIS+ command that you can use to examine its contents, its contents are loaded into the server's directory cache (`NIS_SHARED_DIRCACHE`). You can examine those contents with the `/usr/lib/nis/nisshowcache` command.

Also created are a transaction log file (`trans.log`) and a dictionary file (`data.dict`). The transaction log of a master server stores all the transactions performed by the master server and all its replicas since the last update. You can examine its contents by using the `nislog` command. The dictionary file is used by NIS+ for internal purposes; it is of no interest to an administrator.

14. Create the root domain's subdirectories and tables.

This step adds the `org_dir` and `groups_dir` directories, and the NIS+ tables, beneath the root directory object. Use the `nissetup` utility. For an NIS-compatible domain, be sure to include the `-Y` flag. Here are examples for both versions:

For standard NIS+ only

```
rootmaster# /usr/lib/nis/nissetup
```

NIS-compatible only

```
rootmaster# /usr/lib/nis/nissetup -Y
```

Each object added by the utility is listed in the output:

```
rootmaster# /usr/lib/nis/nissetup
org_dir.doc.com. created
groups_dir.doc.com. created
auto_master.org_dir.doc.com. created
auto_home.org_dir.doc.com. created
bootparams.org_dir.doc.com. created
cred.org_dir.doc.com. created
ethers.org_dir.doc.com. created
group.org_dir.doc.com. created
hosts.org_dir.doc.com. created
mail_aliases.org_dir.doc.com. created
sendmailvars.org_dir.doc.com. created
netmasks.org_dir.doc.com. created
netgroup.org_dir.doc.com. created
```

```
networks.org_dir.doc.com. created
passwd.org_dir.doc.com. created
protocols.org_dir.doc.com. created
rpc.org_dir.doc.com. created
services.org_dir.doc.com. created
timezone.org_dir.doc.com. created
```

The `-Y` option creates the same tables and subdirectories as for a standard NIS+ domain, but assigns read rights to the `passwd` table to the `nobody` class so that requests from NIS clients, which are unauthenticated, can access the encrypted password in that column.

Recall that when you examined the contents of the root directory with `nisls` (in step 12), it was empty. Now, however, it has two subdirectories.

```
rootmaster# nisls doc.com.
doc.com.:
org_dir
groups_dir
```

You can examine the object properties of the subdirectories and tables by using the `niscat -o` command. You can also use the `niscat` option without a flag to examine the information in the tables, although at this point they are empty.

15. Create DES credentials for the root master server.

The root master server requires DES credentials so that its own requests can be authenticated. To create those credentials, use the `nisaddcred` command, as shown below. When prompted, enter the server's root password.

```
rootmaster# nisaddcred des
DES principal name: unix.rootmaster@doc.com
Adding key pair for unix.rootmaster@doc.com
 (rootmaster.doc.com.).
Enter login password:
Wrote secret key into /etc/.rootkey
```

If you enter a password that is different from the server's root password, you receive a warning message and a prompt to repeat the password:

```
Enter login password:
nisaddcred: WARNING: password differs from login password.
Retype password:
```

If you persist and retype the same password, NIS+ will still create the credential. The new password will be stored in `/etc/.rootkey` and be used by the keyserver when it starts up. To give the keyserver the new password right away, run `keylogin -r`, as described in the credentials chapter of *Solaris Naming Administration Guide*.

If you decide to use your login password after all, press Control-c and start the sequence over. If you were to retype your login password as encouraged by the server, you would get an error message designed for another purpose, but which in this instance could be confusing.

```
nisaddcred: WARNING: password differs from login password.
Retype password:
nisaddcred: password incorrect.
```

```
nisaddcred: unable to create credential.
```

As a result of this step, the root server's private and public keys are stored in the root domain's `cred` table (`cred.org_dir.doc.com.`) and its secret key is stored in `/etc/.rootkey`. You can verify the existence of its credentials in the `cred` table by using the `niscat` command. Since the default domain name is `doc.com.`, you don't have to enter the cred table's fully qualified name; the `org_dir` suffix is enough. You can locate the root master's credential by looking for its secure RPC netname.

16. Create the root domain's admin group.

This step creates the admin group named in step 9. Use the `nisgrpadm` command with the `-c` option. The example below creates the `admin.doc.com.` group.

```
rootmaster# nisgrpadm -c admin.doc.com.
 Group admin.doc.com. created.
```

This step only creates the group—it does not identify its members. That is done in step 17. To observe the object properties of the group, use `niscat -o`, but be sure to append `groups_dir` in the group's name.

```
doc.com.
Object Name : admin
Directory : groups_dir.doc.com
Owner : rootmaster.doc.com.
Group : admin.doc.com.
Domain : groups_dir.doc.com.
Access Rights : ----rmcdr---r---
Time to Live : 1:0:0
Object Type : GROUP
Group Flags :
Group Members :
```

17. Add the root master to the root domain's admin group.

Since at this point the root master server is the only NIS+ principal that has DES credentials, it is the only member you should add to the admin group. Use the `nisgrpadm` command again, but with the `-a` option. The first argument is the group name, the second is the name of the root master server. This example adds `rootmaster. doc.com.` to the `doc.com` domain.

```
rootmaster# nisgrpadm -a admin.doc.com.
 rootmaster.doc.com.
Added rootmaster.doc.com. to group admin.doc.com.
```

To verify that the root master is indeed a member of the group, use the `nisgrpadm` command with the `-l` option (see the groups chapter of *Solaris Naming Administration Guide*).

Note – With group-related commands such as `nisgrpadm`, you don't have to include the `groups_dir` subdirectory in the name. You need to include that directory with commands like `niscat` because they are designed to work on NIS+ objects in general. The group-related commands are "targeted" at the `groups_dir` subdirectory.

```
rootmaster# nisgrpadm -l admin.doc.com.
 Group entry for admin.doc.com. group:
 Explicit members:
 rootmaster.doc.com.
 No implicit members
 No recursive members
 No explicit nonmembers
 No implicit nonmembers
 No recursive nonmembers
```

18. Update the root domain's public keys.

Normally, directory objects are created by an NIS+ principal that already has DES credentials. In this case, however, the root master server could not acquire DES credentials until *after* it created the `cred` table (since there was no parent domain in which to store its credentials). As a result, three directory objects—`root`, `org_dir`, and `groups_dir`—do not have a copy of the root master server's public key. (You can verify this by using the `niscat -o` command with any of the directory objects. Look for the public key field. Instructions are provided in the directories chapter of *Solaris Naming Administration Guide*.)

To propagate the root master server's public key from the root domain's cred table to those three directory objects, use the `/usr/lib/nis/nisupdkeys` utility for each directory object.

```
rootmaster# /usr/lib/nis/nisupdkeys doc.com.
rootmaster# /usr/lib/nis/nisupdkeys org_dir.doc.com.
rootmaster# /usr/lib/nis/nisupdkeys groups_dir.doc.com.
```

After each instance, you will receive a confirmation message such as this one:

```
Fetch Public key for server rootmaster.doc.com.
 netname = 'unix.rootmaster@doc.com.'
Updating rootmaster.doc.com.'s public key.
 Public key:
```

If you look in any of those directories (use `niscat -o`), you can find one or more entries like the following in the public key field:

```
Public key: Diffie-Hellman (192 bits)
```

19. Start the NIS+ cache manager.

The cache manager maintains a local cache of location information for an NIS+ client (in this case, the root master server). It obtains its initial set of information from the client's cold-start file (created in step 11 or step 12), and downloads it into a file named `NIS_SHARED_DIRCACHE` in `/var/nis`.

To start the cache manager, enter the `nis_cachemgr` command as shown below.

```
rootmaster# nis_cachemgr
```

After the cache manager has been started, you have to restart it only if you have explicitly killed it. You don't have to restart it if you reboot, since the `NIS_COLD_START` file in `/var/nis` starts it automatically when the client is rebooted.

20. Restart the NIS+ daemon with security level 2.

Now that the root master server has DES credentials and the root directory object has a copy of the root master's public key, you can restart the root master with security level 2. First kill the existing daemon, then restart with security level 2.

For a standard NIS+ domain only:

```
rootmaster# ps -e | grep rpc.nisd
1081 ? 0:03 rpc.nisd -s 0
rootmaster# kill 1081
rootmaster# rpc.nisd
```

For an NIS-compatible root domain, be sure to use the `-Y` (and `-B`) flags:

For an NIS-compatible NIS+ domain:

```
rootmaster# ps -e | grep rpc.nisd
1081 ? 0:03 rpc.nisd -Y -B -s 0
rootmaster# kill 1081
rootmaster# rpc.nisd -Y -B
```

Since security level 2 is the default, you don't need to use an `-S 2` flag.

Note – Operational networks with actual users should always be run at security level 2. Security levels 0 and 1 are for configuration and testing purposes only. Do not run an operational network at level 0 or 1.

---

21. Add your LOCAL credentials to the root domain.

Because you don't have access rights to the root domain's cred table, you must perform this operation as superuser. In addition, the root master's `/etc/passwd` file must contain an entry for you. Use the `nisaddcred` command with the `-p` and `-P` flags as shown below.

`nisaddcred -p` *uid* `-P` *principal-name* `local`

The *principal-name* consists of the administrator's login name and domain name. This example adds a LOCAL credential for an administrator with a UID of 11177 and an NIS+ principal name of `topadmin.doc.com.`

```
rootmaster# nisaddcred -p 11177 -P topadmin.doc.com. local
```

For more information about the `nisaddcred` command, see the credentials chapter of *Solaris Naming Administration Guide*.

22. Add your DES credentials to the root domain.

Use the `nisaddcred` command again, but with the following syntax:

`nisaddcred -p` *secure-RPC-netname*`- P` *principal-name* `des`

The *secure-RPC-netname* consists of the prefix `unix` followed by your UID, the symbol `@`, and your domain name, but *without* a trailing dot. The *principal-name* is the same as for LOCAL credentials: your login name followed by your domain name, *with* a trailing dot.

```
rootmaster# nisaddcred -p unix.11177@doc.com -P topadmin.doc.com. des
Adding key pair for unix.11177@doc.com (topadmin.doc.com.).
Enter login password:
```

If, after entering your login password, you get a password that differs from the login password warning, yet the password you entered is your correct login password, ignore the error message. The message appears because NIS+ cannot read the protected `/etc/shadow` file that stores the password, as expected. The message would not have appeared if you had no user password information stored in the `/etc/passwd` file.

23. Add credentials for the other administrators.

Add the credentials, both LOCAL and DES, of the other administrators who will work in the root domain. You can do this in the following ways.

- An easy way to create temporary credentials for the other administrators is to use Solstice AdminSuite (if you have it available) running in NIS+ mode.
- A second way is to ask them to add their own credentials. However, they will have to do this as superuser. Here is an example that adds credentials for an administrator with a UID of `33355` and a principal name of `miyoko.doc.com.`

  ```
  rootmaster# nisaddcred -p 33355 -P miyoko.doc.com. local
  rootmaster# nisaddcred -p unix.33355@doc.com -P miyoko.doc.com. des
  Adding key pair for unix.33355@doc.com (miyoko.doc.com.).
   Enter login password:
  ```

- A third way is for you to create temporary credentials for the other administrators, using dummy passwords. (Note that the other administrator, in this example `miyoko`, must have an entry in the NIS+ `passwd` table. If no such entry exists, you must first create one with `nistbladm`. The example below includes that step.)

```
rootmaster# nistbladm -D owner=miyoko.doc.com. name=miyoko uid=33355 gcos=miyoko
home=/home/miyoko shell=/bin/tcsh passwd.org_dir
rootmaster# nisaddent -a -f /etc/passwd.xfr passwd
rootmaster# nisaddent -a -f /etc/shadow.xfr shadow
rootmaster# nisaddcred -p 33355 -P miyoko.doc.com. local
rootmaster# nisaddcred -p unix.33355@doc.com -P miyoko.doc.com. des
Adding key pair for unix.33355@doc.com (miyoko.doc.com.).
Enter miyoko's login password:
nisaddcred: WARNING: password differs from login passwd.
Retype password:
rootmaster# nischown miyoko.doc.com. '[name=miyoko],passwd.org_dir'
```

In this case, the first instance of `nisaddent` populates the `passwd` table—except for the password column. The second instance populates the shadow column. Each administrator can later change his or her network password using the `chkey` command. The credentials chapter, Chapter 12describes how to do this.

24. **Add yourself and other administrators to the root domain's admin group.**

    You don't have to wait for the other administrators to change their dummy passwords to perform this step. Use the `nisgrpadm` command with the `-a` option. The first argument is the group name, the remaining arguments are the names of the administrators. This example adds two administrators, `topadmin` and `miyoko`, to the `admin.doc.com.` group:

    ```
    rootmaster# nisgrpadm -a admin.doc.com. topadmin.doc.com. miyoko.doc.com.
    Added topadmin.doc.com. to group admin.doc.com.
    Added miyoko.doc.com. to group admin.doc.com.
    ```

25. **Allocate sufficient swap space to accommodate NIS+ tables.**

    Swap space should be double the size of the maximum size of `rpc.nisd`. To determine how much memory `rpc.nisd` is using, issue the following command:

    ```
    rootmaster# /usr/lib/nis/nisstat
    ```

    `rpc.nisd` will under certain circumstances fork a copy of itself. If there is not enough memory, `rpc.nisd` fails.

    You can also calculate the memory and swap space requirements for NIS+ tables. For example, if you have 180,000 users and 180,000 hosts in your NIS+ tables, those two tables occupy approximately 190 Mbytes of memory. When you add credentials for 180,000 users and 180,000 hosts, the `cred` table has 540,000 entries (one entry for each local user credential, one entry for each DES user credential, and one entry for each host). The `cred` table occupies approximately 285 Mbytes of memory. In this example, `rpc.nisd` occupies at least 190 Mbytes + 285 Mbytes = 475 Mbytes of memory. So, you will require at least 1 Gbyte swap space. You will also want at least 500 Mbytes of memory to hold `rpc.nisd` entirely in memory.

Root Domain Configuration Summary

Table 5–2 summarizes the steps required to configure a root domain. The summary assumes a simple case. Be sure you are familiar with the complete task descriptions before you use this summary as a reference. This summary does not show the server's responses to each command.

TABLE 5–2 Setting Up a Root Domain: Command Summary

Tasks	Commands
Log in as superuser to `rootmaster`.	`rootmaster% su` `Password:`
Check domain name	`# domainname`
Check Switch file.	`# more /etc/nsswitch.conf`
Remove leftover NIS+ material.	`# rm -rf /var/nis*`
Name the admin group.	`# NIS_GROUP=admin.doc.com.; export NIS_GROUP`
Initialize the root master.	`# nisinit -r`
[NIS-compat only]	`# rpc.nisd -Y -B -S 0`
Start daemon with `-Y -B, S 0`.	`# vi /etc/inet.d/rpc`
Change to `EMULYP=-Y -B`.	
[NIS+ Only] Start daemon with `-S 0`.	`# rpc.nisd -S 0`
Create `org_dir` and `groups_dir` tables.	`# /usr/lib/nis/nissetup [-Y]`
Create DES credentials for root master.	`#nisaddcred des` `Enter login password:`
Create `admin` group.	`# nisgrpadm -c admin.doc.com.`
Assign full group rights to root directory	`# nischmod g+rmcd doc.com.`
Add `rootmaster` to `admin` group.	`# nisgrpadm -a admin.doc.com. rootmaster.doc.com.`

Update root directory's keys. Update `org_dir`'s keys. Update `groups_dir`'s keys.	`# /usr/lib/nis/nisupdkeys doc.com.`
	`# /usr/lib/nis/nisupdkeys org_dir.doc.com.`
	`# /usr/lib/nis/nisupdkeys groups_dir.doc.com.`

Start NIS+ cache manager	`# nis_cachemgr`
Kill existing daemon.	`# ps -ef | grep rpc.nisd` `# kill -9` *process-id*
Restart the NIS+ daemon. (Use `-Y` for NIS compat and `-B` for DNS.)	`# rpc.nisd [-Y] [-B]`
Add your LOCAL credentials.	`# nisaddcred -p 11177 -P topadmin.doc.com. local`
Add your DES credentials.	`# nisaddcred -p unix.11177@doc.com -P topadmin.doc.com. des Enter login password:`

TABLE 5–2 Setting Up a Root Domain: Command Summary *(Continued)*

Tasks	Commands
Add credentials for other admins.	`# nisaddcred ... nisgrpadm -a admin.doc.com` *members*
Add other admins to `admin` group.	

CHAPTER 6

Configuring NIS+ Clients

This chapter gives step-by-step instructions for setting up NIS+ clients using the NIS+ command set and three different initialization methods. These instructions apply to clients in both the root domain and subdomains, whether all-NIS+ or NIS-compatible.

Introduction to Setting Up NIS+ Clients

This chapter describes how to configure clients in both standard NIS+ domains and NIS-compatible domains. The procedure describes each step in detail and provides related information. For those who do not need detailed instructions, a summary listing of the necessary commands is provided in Table 6–6.

Note – It is much easier to perform this task with the NIS+ installation scripts, as described in Part 1, than with the NIS+ command set as described here. The methods described in this chapter should only be used by those administrators who are very familiar with NIS+ and who require some non-standard features or configurations not provided by the installation scripts. If you have them available, the Solstice AdminSuite™ tools also provide easier methods of adding and setting up NIS+ client machines.

At step 10 in the client configuration instructions you must choose which of three methods to use: broadcast, host name, or cold-start file. Because each method is implemented differently, each has its own task description. After initializing a client by one of these methods, you can continue setting up the client by returning to step 11.

The last task in the chapter describes how to change a machine's domain.

Configuring the Client

This section describes how to configure a typical NIS+ client in either the root domain or a non-root domain. This procedure applies to regular NIS+ clients and to those clients that will later become NIS+ servers. It applies, as well, to clients in a standard NIS+ domain and those in an NIS-compatible domain.

Caution – Domains and hosts should not have the same name. For example, if you have a `sales` domain you should not have a machine named `sales`. Similarly, if you have a machine named `home`, you do not want to create a domain named home. This caution applies to subdomains; for example, if you have a machine named `west` you do not want to create a `sales.west.myco.com` subdomain.

Setting up an NIS+ client involves the following tasks:

- Creating credentials for the client
- Preparing the machine
- Initializing the machine as an NIS+ client.

However, as with setting up the root domain, setting up a client is not as simple as carrying out these three tasks in order. To make the configuration process easier to execute, these tasks have been broken down into individual steps, and the steps have been arranged in the most efficient order:

1. Logging in to the domain's master server
2. Creating DES credentials for the new client machine
3. Ascertaining the Diffie-Hellman key length used on the master server
4. Logging in as superuser to the client
5. Assigning the client its new domain name
6. Stopping and restarting `nscd`
7. Checking the client's `nsswitch.conf` file
8. Setting the client's Diffie-Hellman key
9. Cleaning out leftover NIS+ material and processes
10. Initializing the client
11. Killing and restarting the `keyserv` daemon
12. Running `keylogin`
13. Rebooting the client

Security Considerations

Setting up a client has two main security requirements: both the administrator and the client must have the proper credentials and access rights. Otherwise, the only way for

a client to obtain credentials in a domain running at security level 2 is for the credentials to be created by an administrator with valid DES credentials and modify rights to the `cred` table in the client's home domain. The administrator can either have DES credentials in the client's home domain or in the administrator's home domain.

After an administrator creates the client's credentials, the client can complete the configuration process. However, the client still needs read access to the directory object of its home domain. If you configured the client's home domain according to the instructions in either Chapter 5 or Chapter 8, read access was provided to the world class by the NIS+ commands used to create the directory objects (`nisinit` and `nismkdir`, respectively).

You can check the directory object's access rights by using the `niscat -o` command. This command displays the properties of the directory, including its access rights:

```
rootmaster# niscat -o doc.com.
ObjectName : Doc
Owner : rootmaster.doc.com.
Group : admin.doc.com.
Domain : Com.
Access Rights : r---rmcdr---r---
```

You can change the directory object's access rights, provided you have modify rights to it yourself, by using the `nischmod` command, described in the rights chapter,Chapter 15.

Prerequisites

The administrator setting up the client's credentials must have:

- A valid DES credential
- Modify rights to the `cred` table in the client's home domain

The client must have:

- Read rights to the directory object of its home domain
- The client's home domain must already be configured and running NIS+
- An entry in either the master server's `/etc/hosts` or `/etc/inet/ipnodes` file or in its domain's hosts or ipnodes table
- A unique machine name that does duplicate any user ID
- A machine name that does not contain any dots. (For example, a machine named `sales.alpha` is not allowed; a machine named `sales-alpha` is allowed.)

Information You Need

- The name of the client's home domain
- The superuser password of the machine that will become the client
- The IP address of an NIS+ server in the client's home domain

Configuring the Client—Task Map

TABLE 6–1 Configuring the Client

Task	Description	For Instructions, Go To
Configuring the Client"	Create credentials fpr the client. Prepare the client machine and initialize it as an NIS+ client.	"How to Configure an NIS+ Client" on page 150

▼ How to Configure an NIS+ Client

1. **Log into the domain's master server.**

   You can log in as superuser or as yourself, depending on which NIS+ principal has the proper access rights to add credentials to the domain's cred table.

2. **Create DES credentials for the new client machine.**

   Use the `nisaddcred` command with the `-p` and `-P` arguments. Here is the syntax:

   ```
   nisaddcred -p secure-RPC-netname  principal-name des [domain]
   ```

   The secure-RPC-netname consists of the prefix `unix` followed by the client's host name, the symbol `@` and the client's domain name, but without a trailing dot. The *principal-name* consists of the client's host name and domain name, with a trailing dot. If the client belongs to a different domain than the server from which you enter the command, append the client's domain name after the second argument.

   This example adds a DES credential for a client machine named `client1` in the `doc.com.` domain:

   ```
   rootmaster% nisaddcred -p unix.client1@doc.com -P client1.doc.com. des
   Adding key pair for unix.client1@doc.com (client1.doc.com.).
   Enter client1.doc.com.'s root login passwd:
   Retype password:
   ```

   For more information about the `nisaddcred` command, see the credentials chapter of the *Solaris Naming Administration Guide*.

3. **Ascertain the Diffie-Hellman key length used on the master server.**

   For example:

   ```
   rootmaster% nisauthconf dh640-0 des
   ```

4. **Log in as superuser to the client.**

   Now that the client machine has credentials, you can log out of the master server and begin working from the client itself. You can do this locally or remotely.

5. **Assign the client its new domain name.**

   See "Changing a machine's Domain Name" on page 153 for information on how to assign (or change) a client's domain name, then return to step 6.

6. **Check the client's `nsswitch.conf` file.**

   Make sure the client is using an NIS+ version of the `nsswitch.conf` file. This ensures that the primary source of information for the client will be NIS+ tables. See Example 1–1for a description of an NIS+ switch file.

7. **If you made any changes to the `nsswitch.conf` file (or copied over a new file), you must now stop and restart `nscd`, as shown below.**

   ```
   client1# cp /etc/nsswitch.nisplus /etc/nsswitch.conf
   client1# sh /etc/init.d/nscd stop
   client1# sh /etc/init.d/nscd start
   ```

   (You do not need to kill and restart the keyserver at this point, as you will do so in step 11.)

8. **Set the Diffie-Hellman key length on the client, using the information from step 3.**

   For example:

   ```
   client# nisauthconf dh640-0 des
   ```

9. **Clean out leftover NIS+ material and processes.**

   If the machine you are working on was previously used as an NIS+ server or client, remove any files that might exist in `/var/nis` and kill the cache manager, if it is still running. In this example, a cold-start file and a directory cache file still exist in `/var/nis`.

   ```
   client1# ls /var/nis
   NIS_COLD_START NIS_SHARED_CACHE
   client1# rm -rf /var/nis/*
   client1# ps -ef | grep nis_cachemgr
    root 295 260 10 15:26:58 pts/0 0:00 grep nis_cachemgr
    root 286 1 57 15:21:55 ? 0:01 /usr/sbin/nis_cachemgr
   client1# kill -9 286
   ```

   This step makes sure that files left in `/var/nis` or directory objects stored by the cache manager are completely erased so that they do not conflict with the new information generated during this configuration process. If you have stored any admin scripts in `/var/nis`, you might want to consider temporarily storing them elsewhere, until you finish setting up the root domain.

10. **Initialize the client.**

    You can initialize a client in three different ways: by host name, by cold-start file, or by broadcast. Choose and perform one of those methods. After initializing the client,

proceed with step 11.

11. **Kill and restart the** `keyserv` **daemon.**

    This step stores the client's secret key on the keyserver.

    a. **Kill the** `keyserv` **daemon.**

       This also has the side effect of updating the key server's switch information about the client.

    b. **Remove the** `/etc/.rootkey` **file.**

    c. **Restart the keyserver.**

       This example shows the complete procedure in step 11.

```
client1# ps -e | grep keyserv
 root 145 1 67 16:34:44 ? keyserv
client1# kill 145
client1# rm -f /etc/.rootkey
client1# keyserv
```

    d. **Run** `keylogin -r`**.**

       This step stores the client's secret key with the keyserver. It also saves a copy in `/etc/.rootkey`, so that the superuser on the client does not have to run `keylogin` to use NIS+. Use `keylogin` with the `-r` option. When prompted for a password, type the client's superuser password. It must be the same as the password supplied to create the client's DES credentials:

```
client1# keylogin -r
Password:
Wrote secret key into /etc/.rootkey
```

    e. **Reboot the client.**

Setting Up DNS Forwarding

▼ To enable DNS forwarding capabilities on an NIS+ client:

1. **Login as superuser.**
2. **Properly configure the** `hosts` **line in the** `/etc/resolve.conf` **file to read:** `hosts:nisplus dns files`**.**

   In this implementation of NIS, if a `/etc/resolve.conf` file exists on the server, `ypstart` *automatically* starts the `ypserv` daemon with the `-d` option to forward requests to DNS. (To stop forwarding to DNS, edit the

/usr/lib/netsvc/yp/ypstart script to remove the -d option from the ypserv command. You must then reboot the machine.)

Changing a machine's Domain Name

This task changes a machine's domain name. Since a machine's domain name is usually set during installation, you should check it (type domainname without an argument) before you decide to perform this task.

Security Considerations

You must perform this task as superuser on the machine whose domain name you are changing.

Information You Need

- The machine's superuser password
- The new domain name

Changing a machine's Domain—Task Map

TABLE 6–2 Configuring the Client

Task	Description	For Instructions, Go To
Changing a machine's Domain	Use the domainname command to change the client machine domain	"How to Change a Client's Domain Name" on page 153

▼ How to Change a Client's Domain Name

1. **Log in to the machine and become superuser.**

   The examples in this task use client1 as the machine and doc.com. as the new domain name.

   ```
   client1% su
   Password:
   ```

2. **Change the machine's domain name.**

   Type the new name after the `domainname` command. Do not use a trailing dot. For example, to change a machine's domain to the `doc.com` domain, you enter:

   ```
   client1# domainname doc.com
   ```

   If the machine had been an NIS client, it may no longer be able to get NIS service.

3. **Verify the result.**

   Run the `domainname` command again, this time without an argument, to display the server's current domain.

   ```
   client1# domainname
   doc.com
   ```

4. **Save the new domain name.**

   Redirect the output of the `domainname` command into the `/etc/defaultdomain` file.

   ```
   client1# domainname > /etc/defaultdomain
   ```

5. **At a convenient time, reboot the machine.**

   Even after entering the new domain name into the `/etc/defaultdomain` file, some processes may still operate with the old domain name. To ensure that all processes are using the new domain name, reboot the machine.

   Because you may be performing this task in a sequence of many other tasks, examine the work remaining to be done on the machine before rebooting. Otherwise, you might find yourself rebooting several times instead of just once.

   Although restarting individual daemons, such as `mountd` may solve an NFS problem, it is strongly recommended that you reboot to synchronize configuration changes across daemons. This minimizes application failures caused by unknown changes to the configuration.

Initializing an NIS+ Client

The three different ways to initialize an NIS+ client are:

- Broadcast method (see "Broadcast Initialization" on page 155)
- Host-name method (see "Initializing a Client by Host Name" on page 156)
- Cold-start file method (see "Initializing Client Using a Cold-Start File" on page 157)

Broadcast Initialization

This method *initializes* an NIS+ client by sending an IP broadcast on the client's subnet.

This is the simplest way to configure a client but is also the least secure. The NIS+ server that responds to the broadcast sends the client all the information that the client needs in its cold-start file, including the server's public key. Presumably, only an NIS+ server will respond to the broadcast. However, the client has no way of knowing whether the machine that responded to the broadcast is indeed a trusted server. As a result, this method is only recommended for sites with small, secure networks.

Security Considerations

You must perform this task as superuser on the client.

Prerequisites

At least one NIS+ server must exist on the same subnet as the client. The client must use the same Diffie-Hellman key lengths as those on the master server. See `nisauthconf`(1M).

Information You Need

You need the superuser password to the client.

Initializing an NIS+ Client—Task Map

TABLE 6–3 Initializing an NIS+ Client

Task	Description	For Instructions, Go To
Initializing an NIS+ Client	Use `nisclient` command to initialize an NIS+ client	"How to Configure an NIS+ Client" on page 150

How to Initialize a Client—Broadcast Method

- **Initialize the client.**

  This step initializes the client and creates a `NIS_COLD_START` file in its `/var/nis` directory. Use the `nisinit` command with the `-c` and `-B` options.

```
client1# nisinit -c -B
This machine is in the doc.com. NIS+ domain.
Setting up NIS+ client ...
All done.
```

An NIS+ server on the same subnet will reply to the broadcast and add its location information into the client's cold-start file.

Initializing a Client by Host Name

Initializing a client by host name consists of explicitly identifying the IP address of its trusted server. This server's name, location information, and public keys are then placed in the client's cold-start file.

This method is more secure than the broadcast method because it actually specifies the IP address of the trusted server, rather than relying on a server to identify itself. However, if a router exists between the client and the trusted server, it could intercept messages to the trusted IP address and route them to an untrusted server.

Security Considerations

You must perform this operation as superuser on the client.

Prerequisites

- The NIS+ service must be running in the client's domain.
- The client must have an entry in its `/etc/hosts` or `/etc/inet/ipnodes` file for the trusted server.
- The client must use the same Diffie-Hellman key lengths as those on the master server. See `nisauthconf`(1M).

Information You Need

You need the name and IP address of the trusted server.

Initializing an NIS+ Client—Task Map

TABLE 6–4 Initializing an NIS+ Client

Task	Description	For Instructions, Go To
Initializing a Client by Host Name	Use `nisinit` command to initialize an NIS+ client by host name.	"How to Initialize a Client—Host-name Method" on page 157

▼ How to Initialize a Client—Host-name Method

1. **Check the client's `/etc/hosts` or `/etc/inet/ipnodes` file.**

   Make sure the client has an entry for the trusted server.

2. **Initialize the client.**

   This step initializes the client and creates a `NIS_COLD_START` file in its `/var/nis` directory. Use the `nisinit` command with the `-c` and `-H` options. This example uses `rootmaster` as the trusted server.

   ```
   Client1# nisinit -c -H rootmaster
   This machine is in the doc.com. NIS+ domain.
   Setting up NIS+ client ...
   All done.
   ```

   The `nisinit` utility looks for the server's address in the client's `/etc/hosts` or `/etc/inet/ipnodes` file, so do not append a domain name to the server. If you do, the utility will not be able to find its address.

Initializing Client Using a Cold-Start File

This task initializes an NIS+ client by using the cold-start file of another NIS+ client, preferably one from the same domain. This is the most secure method of setting up an NIS+ client. It ensures that the client obtains its NIS+ information from a trusted server, something that cannot be guaranteed by the host-name or broadcast method.

Security Considerations

You must perform this task as superuser on the client.

Prerequisites

The servers specified in the cold-start file must already be configured and running NIS+.

The client must use the same Diffie-Hellman key lengths as those on the master server. See `nisauthconf`(1M).

Information You Need

You need the name and location of the cold-start file you will copy.

Initializing an NIS+ Client—Task Map

TABLE 6–5 Initializing an NIS+ Client

Task	Description	For Instructions, Go To
InitializingClient via Cold-Start File	Use `nisinit` command to initialize an NIS+ client via a cold-start file	"How to Initialize a Client—Cold-Start Method" on page 158

▼ How to Initialize a Client—Cold-Start Method

1. **Copy the other client's cold-start file.**

   Copy the other client's cold-start file into a directory in the new client. This may be easier to do while logged on as yourself rather than as superuser on the client. Be sure to switch back to superuser before initializing the client.

   Don't copy the `NIS_COLD_START` file into `/var/nis`, because that file gets overwritten during initialization. This example copies the cold-start file of previously initialized `client1` into the `/tmp` directory of uninitialized `client2`.

   ```
   client2# exit
   client2% rcp client1:/var/nis/NIS_COLD_START /tmp
   client2% su
   ```

2. **Initialize the client from the cold-start file.**

   Use the `nisinit` command with the `-c` and `-C` options.

   ```
   client2# nisinit -c  -C /tmp/NIS_COLD_START
   This machine is in the doc.com. NIS+ domain.
   Setting up NIS+ client ...
   All done.
   ```

NIS+ Client Configuration Summary

Table 6–6 shows a summary of the steps required to configure a client named `client1` in the `doc.com` domain. It assumes the simplest case, so be sure you are familiar with the more thorough task descriptions before you use this summary as a reference. For the sake of brevity, this summary does not show the responses to each command.

TABLE 6–6 Setting Up a Client: Command Summary

Tasks	Commands
Log in to domain's master.	`rootmaster%`
Create DES credentials for client.	`rootmaster% nisaddcred -p unix.client1.doc.com -P client1.doc.com. des`
Ascertain the Diffie-Hellman .key length.	`rootmaster% nisauthconf`
Log in, as superuser, to the client.	`client1% su` `Password:`
Assign the client a domain name.	`client1# domainname doc.com` `client1# domainname > /etc/defaultdomain`
Check that the client's switch configuration file has the correct settings.	`client1# more /etc/nsswitch.conf`
Set the Diffie-Hellman key length	`client1# nisauthconf dh640-0 des`
Clean out `/var/nis`.	`client1# rm -rf /var/nis/*`
Initialize the client.	`client1# nisinit -c -H rootmaster`

Kill and restart the keyserver.	`client1# ps -ef | grep keyserv`
	`client1# kill -9` *process-id*
	`client1# keyserv`

Run `keylogin` on the client.	`client1# keylogin -r password:`
Reboot the client.	`client1# init 6`

CHAPTER 7

Configuring NIS+ Servers

This chapter provides step-by-step procedures for using the NIS+ commands to set up NIS+ servers (except the root master) and add replica servers to existing NIS+ domains.

Setting Up an NIS+ Server

It is much easier to perform this task with the NIS+ installation scripts, as described in Part 1, than with the NIS+ command set described here. The methods described in this chapter should be used only by those administrators who are very familiar with NIS+ and who require some nonstandard features or configurations not provided by the installation scripts.

Standard Versus NIS-Compatible Configuration Procedures

The differences between setting up an NIS-compatible and a standard NIS+ server are the same as the differences between setting up standard and NIS-compatible root master servers (see "Standard Versus NIS-Compatible Configuration Procedures" on page 130). The NIS+ daemon for an NIS-compatible server must be started with the `-Y` option (and the `-B` option for DNS forwarding), which allows the server to answer requests from NIS clients. This is described in step 2 (the equivalent step for standard NIS+ servers is step 3).

Note – Whenever `rpc.nisd` is started with either the `-Y` or `-B` option, a secondary daemon named `rpc.nisd_resolv` is spawned to provide name resolution. This secondary daemon must be separately killed whenever you kill the primary `rpc.nisd` daemon.

Here is a summary of the entire configuration process:

1. Log in as superuser to the new replica server.
2. [NIS-Compatibility Only] Start the NIS+ daemon with `-Y`.
3. [Standard NIS+ Only] Start the NIS+ daemon.

Security Considerations

Note – The NIS+ security system is complex. If you are not familiar with NIS+ security, you might want to review the security-related chapters of *Solaris Naming Administration Guide* before starting to configure your NIS+ environment.

The security level at which you start the server determines the credentials that its clients must have. For instance, if the server is configured with security level 2 (the default), the clients in the domain it supports must have DES credentials. If you have configured the client according to the instructions in this book, the client has DES credentials in the proper domain, and you can start the server with security level 2.

Note – Security level 0 is for administrator configuration and testing purposes only. Security level 1 is not supported. Do not use level 0 or 1 in any environment where ordinary users are doing their normal work. Operating networks should always be run at security level 2.

Prerequisites

- The root domain must already be configured (see Chapter 5).
- The server must have already been initialized as an NIS+ client (see Chapter 6).
- To configure a server you must be logged in as superuser on that machine.
- For the server to run in NIS-compatibility mode and support DNS forwarding, it must have a properly configured `/etc/resolv.conf` file (described in"Setting Up DNS Service" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*).

Information You Need

You need the superuser password of the client that you will convert into a server.

▼ How to Configure an NIS+ Server

While it is possible to have a master or replica server serving more than one domain, doing so is not recommended.

1. **Log in as superuser to the new replica server.**

   The following steps assume that you rebooted the machine after you set it up as an NIS+ client, as instructed in "Configuring the Client" on page 148. Rebooting starts the cache manager, which is a recommended prerequisite to the following step. If you did not reboot the machine, restart the cache manager now, using `nis_cachemgr`.

2. **[NIS-Compatibility Only] Start the NIS+ daemon with `-Y`.**

   Perform this step only if you are setting up the server in NIS-compatibility mode; if setting up a standard NIS+ server, perform step 3 instead. This step also includes instructions for supporting the DNS forwarding capabilities of NIS clients.

   This step has two parts. The first part starts the NIS+ daemon in NIS-compatibility mode. The second part makes sure that when the server is rebooted, the NIS+ daemon restarts in NIS-compatibility mode.

   a. **Run `rpc.nisd` with the `-Y` and `-B` flags.**

      ```
      compatserver# rpc.nisd -Y -B
      ```

      The `-Y` option invokes an interface that answers NIS requests in addition to NIS+ requests. The `-B` option supports DNS forwarding.

   b. **Edit the `/etc/init.d/rpc` file.**

      Search for the string `EMULYP=-Y` in the `/etc/init.d/rpc` file and uncomment that line.

      To retain DNS forwarding capabilities, add a `-B` flag to the `EMULYP=-Y` line. (If you don't need to retain DNS forwarding capabilities, uncomment the line, but don't add the `-B` flag.)

      This step creates a directory called `/var/nis/data` and a transaction log file called `trans.log`, which is placed in `/var/nis`.

      ```
      compatserver# ls -F /var/nis
      NIS_COLD_START data/ trans.log data.dict
      ```

      The `trans.log` file is a transaction log. You can examine the contents of the transaction log by using the `nislog` command, described in the directories chapter of *Solaris Naming Administration Guide*.

Caution – Do not move or rename the `/var/nis` or `/var/nis/data` directories. Do not move or rename the `/var/nis/trans.log` or `/var/nis/data.dict` files. If you are upgrading from Solaris Release 2.4 or earlier, the older `/hostname` subdirectory is automatically converted to `/var/nis/data` and the relevant files are converted as necessary. Do *not* change these new names after the conversion has occurred.

Now this server is ready to be designated a master or replica of a domain, as described in Chapter 8. This step completes this task. A task summary is provided on "Server Configuration Summary" on page 171.

3. **[Standard NIS+ Only] Start the NIS+ daemon.**

   Run the `rpc.nisd` command.

   ```
   server# rpc.nisd
   ```

   To verify that the NIS+ daemon is indeed running, use the `ps` command.

   ```
   server# ps -ef | grep rpc.nisd
   root 1081 1 16:43:33 ? 0:01 rpc.nisd
   root 1087 1004 11 16:44:09 pts/1 0:00 grep rpc.nisd
   ```

   This step creates a directory called `/var/nis/data` and a transaction log file called `trans.log` which is placed in `/var/nis`.

   ```
   compatserver# ls -F /var/nis
   NIS_COLD_START data/ trans.log data.dict
   ```

   The `compatserver.log` file is a transaction log. You can examine the contents of the transaction log by using the `nislog` command, described in Chapter 18.

Caution – Do not move or rename the `/var/nis` or `/var/nis/data` directories. Do not move or rename the `/var/nis/trans.log` or `/var/nis/data.dict` files. If you are upgrading from Solaris Release 2.4 or earlier, the older `/hostname` subdirectory will be automatically converted to `/var/nis/data` and the relevant files will also be converted as necessary. Do *not* change these new names after the conversion has occurred.

Now this server is ready to be designated a master or replica of a domain, as described in Chapter 8. This step completes this task. A task summary is provided on "Server Configuration Summary" on page 171.

Adding a Replica to an Existing Domain

To have regularly available NIS+ service, you should always create one or more replica servers for each domain. Having replicas can also speed network-request resolution because multiple servers are available to handle requests.

For performance reasons, you should have no more than a few replicas per domain. If your network includes multiple subnets or different sites connected by a Wide Area Network (WAN), you might need additional replicas:

- *Subnets*. If you have a domain that spans multiple subnets, it is a good idea to have at least one replica server within each subnet so that, if the connection between nets is temporarily out of service, each subnet can continue to function until the connection is restored.
- *Remote sites*. If you have a domain spanning multiple sites linked over a WAN, it is a good idea to have at least one replica server on each side of the WAN link. For example, it may make sense from an organizational point of view to have two physically distant sites in the same NIS+ domain. If the domain's master server and all of its replicas are at the first site, there will be much NIS+ network traffic between the first and second sites. Creating an additional replica at the second site should reduce network traffic. .

See "Determining Server Requirements" on page 608 for more information on replica distribution and on how to determine the optimum number of replicas. To add a replica to an existing domain you must first configure the new replica, then load the NIS+ data set for your namespace.

The two ways to configure and load a new replica server are:

- *Scripts*. You can use the `nisserver` script, as described in "Creating a Root Replica Server" on page 111. This method automatically performs a full re-sync to load the NIS+ data set on to the new replica server. This is the preferred method because it is easiest, but it might be slower than using the NIS+ command set and backup/restore.
- *NIS+ command set*. You can use the NIS+ command set to configure a replica, as described in "Using NIS+ Commands to Configure a Replica Server" on page 166. This requires more knowledge of NIS+ than using `nisserver`. One advantage of this method is that it gives you the maximum amount of control and monitoring. Another advantage is that you can bring up a replica by manually creating the domain directories, then loading the NIS+ data set using `nisbackup` and `nisrestore`. Using the NIS+ backup and restore capability loads data faster than that used by `nisserver`.

  The two ways to load the NIS+ data set on to the newly configured replica server are:

- `nisping`. When you configure a new replica server with either the `nisserver` script or the NIS+ command set, the master server automatically begins to load the namespace data set on to the new replica over the network using `nisping`. If your namespace is large, this could take a long time, during which requests for naming information could be delayed. See " Using `nisping` to Load Data on to a Replica Server" on page 170 for details.
- *Backup and restore*. You can interrupt the transfer of data via `nisping`, and use the NIS+ backup and restore capabilities to load your namespace data on to a newly configured replica server, as described in "Using `nisrestore` to Load Data on to a Replica Server" on page 168. This is the preferred method because the replica's data set is downloaded on to the replica, which is much faster than having the master transfer the data set to the replica over the network.

Using NIS+ Commands to Configure a Replica Server

This section describes how to add a replica server to an existing domain using the NIS+ command.

Security Considerations

The NIS+ principal performing this operation must have modify rights to the domain's directory object.

Prerequisites

- The domain must have already been configured and have a master server up and running.
- The new replica server must already be configured as an NIS+ server, as described in "Setting Up an NIS+ Server" on page 161.

Information You Need

- Name of the server
- Name of the domain

Using NIS+ Commands to Configure a Replica Server-Task Map

TABLE 7–1 Using NIS+ Commands to Configure a Replica Server

Task	Description	For Instructions, Go To
Setting Up an NIS+ Server	Use NIS+ commands to set up an NIS+ server	"How to Configure a Replica Server With NIS+ Commands" on page 167

▼ How to Configure a Replica Server With NIS+ Commands

In this example, the master server is named `master1`, and the new replica is named `replica2`.

1. **Log in to the domain's master server.**
2. **Make sure that `rpc.nisd` is running.**
3. **Add the replica to the domain.**

   Run the `nismkdir` command with the `-s` option. The example below adds the replica machine named `replica2` to the `doc.com.` domain.

```
master1# nismkdir -s replica2 doc.com.
master1# nismkdir -s replica2 org_dir.doc.com.
master1# nismkdir -s replica2 groups_dir.doc.com.
```

   When you run the `nismkdir` command on a directory object that already exists, it does not recreate the directory but modifies it, according to the flags you provide. In this case, the `-s` flag assigns the domain an additional replica server. You can verify that the replica was added by examining the directory object's definition, using the `niscat -o` command.

Caution – Never run `nismkdir` on the replica machine. Running `nismkdir` on a replica creates communications problems between the master and the replicas.

Your new replica is now configured. You can now load your NIS+ data set on to the replica. You can do this in two ways:

- `nisping`. If you do nothing, your master server will use the `nisping` command to load your namespace data on to your newly configured replica server. If your namespace is large, this process can take hours. During this process, requests for naming information can be delayed. See " Using `nisping` to Load Data on to a Replica Server" on page 170 for details.

- *Backup and restore*. You can interrupt the transfer of data via `nisping` and use the NIS+ backup and restore capabilities to load your namespace data on to a newly configured replica server, as described in "Using `nisrestore` to Load Data on to a Replica Server" on page 168. Because it is so much faster and more efficient, this is the preferred method.

Using `nisrestore` to Load Data on to a Replica Server

This section describes how to use the NIS+ backup and restore utilities to load namespace data on to a newly configured replica. This is the preferred method of loading data on to a replica.

Security Considerations

The NIS+ principal performing this operation must have modify rights to the domain's directory object.

Prerequisites

- The domain must have already been configured and have a master server up and running.
- The new replica server must already be configured as an NIS+ server, as described in "Setting Up an NIS+ Server" on page 161.
- The new replica server must be configured as a replica, as described in "Using NIS+ Commands to Configure a Replica Server" on page 166.

Using `nisrestore` to Load Data on to a Replica Server — Task Map

TABLE 7–2 Using `nisrestore` to Load Data on to a Replica Server

Task	Description	For Instructions, Go To
Using `nisrestore` to Load Data on to a Replica Server	Use the `nisrestore` command to load data on to a replica server	"How to Load Namespace Data—`nisrestore` Method" on page 169

▼ How to Load Namespace Data—`nisrestore` Method

In this example, the master server is named `master1`, and the new replica is named `replica2`.

1. **Kill `rpc.nisd` on the new replica server.**

   This interrupts the automatic transfer of namespace data from the master to the replica with the `nisping` command.

2. **Perform an NIS+ backup on the master server.**

   This step is described in more detail in *Solaris Naming Administration Guide*. The example below shows how to use the `nisbackup` command to backup up the `master1` server to the `/var/master1_bakup` directory.

   ```
   master1# nisbackup -a /var/master1_bakup
   ```

   The most convenient method of using `nisrestore` to configure a new replica is to back up the master's data to an NFS mounted directory that the new replica can access. This example assumes that both the master and the new replica server have access to the `/var/master1_bakup` directory.

   Another method is to use the `tar` command to copy the data from the `/var/master1_bakup` directory to some transferable storage media, such as a tape cartridge, then copy the data from storage media into a directory mounted on the new replica, then use that directory as the source for the `nisrestore` command, as described in step 3.

3. **Download the NIS+ data set onto the new replica using the `nisrestore` command.**

   This step is described in more detail in *Solaris Naming Administration Guide*. The example below shows how to use the `nisrestore` command to down load NIS+ data on to the `client2` replica from the `/var/master1_bakup` directory.

   ```
   replica2# nisrestore -a /var/master1_bakup
   ```

   If the replica you are creating is for the root domain, or if you get an error message that `nisrestore` cannot verify or look up needed data, then use the `nisrestore -f` option. For example:

   ```
   replica2# nisrestore -f -a /var/master1_bakup
   ```

4. **Restart `rpc.nisd` on the new replica**

   See "How to Configure an NIS+ Server" on page 163 for details.

Using `nisping` to Load Data on to a Replica Server

This section describes how to use the `nisping` command to load namespace data onto a newly configured replica. In most cases, it is not necessary to actually run the `nisping` command because the process should begin automatically.

The problem with the `nisping` method is that it requires a full resync of data from the master to the replica over the network using NIS+ protocols. If your namespace is large, this process can take hours, during which requests for naming information can be delayed.

Security Considerations

The NIS+ principal performing this operation must have modify rights to the domain's directory object.

Prerequisites

- The domain must have already been configured and have a master server up and running.
- The new replica server must already be configured as an NIS+ server, as described in "Setting Up an NIS+ Server" on page 161.
- The new replica server must by configured as a replica, as described in "Using NIS+ Commands to Configure a Replica Server" on page 166.

Using `nisping` to Load Data on to a Replica Server — Task Map

TABLE 7–3 Using `nisping` to Load Data on to a Replica Server

Task	Description	For Instructions, Go To
Using `nisping` to Load Data on to a Replica Server	Use `nisping` to load data on to a replica server	"How to Load Namespace Data—`nisping` Method" on page 171

▼ How to Load Namespace Data—`nisping` Method

Normally, the loading for namespace data is automatically initiated by the master server. If that does not occur, run the `nisping` command as described below.

- **Run `nisping` on the directories**

  This step sends a message (a "ping") to the new replica, telling it to ask the master server for an update. If the replica does not belong to the root domain, be sure to specify its domain name. (The example below includes the domain name only for completeness. Since the example used throughout this task adds a replica to the root domain, the `doc.com.` domain name in the example below is not necessary.)

```
master1# nisping doc.com.
master1# nisping org_dir.doc.com.
master1# nisping groups_dir.doc.com.
```

  You should see results similar to these:

```
master1# nisping doc.com.
Pinging replicas serving directory doc.com. :
Master server is master1.doc.com.
 No last update time
Replica server is replica1.doc.com.
 Last update seen was Wed Nov 18 11:24:32 1992
 Pinging ... replica2.doc.com.
```

  If your namespace is large, this process can take a significant amount of time. For more information about `nisping`, see the directories chapter of *Solaris Naming Administration Guide*.

Server Configuration Summary

Table 7–5 and Table 7–4 provide a summary of the tasks described in this chapter. They assume the simplest cases, so be sure you are familiar with the more thorough task descriptions before you use this summary as a reference. This summary does not show the server's responses to each command.

TABLE 7–4 Adding a Replica Named `replica2` to `doc.com.`: Command Summary

Tasks	Commands
Log in as superuser to domain master.	`master1% su`

TABLE 7–4 Adding a Replica Named `replica2` to `doc.com.`: Command Summary *(Continued)*

Tasks	Commands

Designate the new replica.	`# nismkdir -s replica2 doc.com.`
	`# nismkdir -s replica2 org_dir.doc.com.`
	`# nismkdir -s replica2 groups_dir.doc.com.`

Ping the replica.	`# /usr/lib/nis/nisping doc.com.`
	`# /usr/lib/nis/nisping org_dir.doc.com.`
	`# /usr/lib/nis/nisping groups_dir.doc.com.`

Note – Rather than using `nisping` to transfer data to the new replica, as shown in the example above, an easier method is to use the NIS+ backup and restore capability, as described in "Using `nisrestore` to Load Data on to a Replica Server" on page 168.

TABLE 7–5 Starting Up a Non-root Master Server: Command Summary

Tasks	Commands
Log in to the server as root.	`server%su`
NIS-compat only: Start daemon with `-Y -B`	`server# rpc.nisd -Y - B`
Change to `EMULYP= -Y -B`.	`server# vi /etc/inet.d/rpc`
NIS+-Only: Start daemon.	`server# rpc.nisd`

CHAPTER 8

Configuring a Non-Root Domain

This chapter provides step-by-step instructions for using the NIS+ command set to configure a subdomain domain (also known as a non-root domain) including designating its master and replica servers.

Setting Up a Non-Root Domain

Note – It is much easier to perform this task with the NIS+ installation scripts, as described in Part 1, than with the NIS+ command set as described here. The methods described in this chapter should be used only by those administrators who are very familiar with NIS+ and who require some nonstandard features or configurations not provided by the installation scripts.

You should not configure a non-root domain until *after* you have configured its servers.

Setting up a non-root domain involves the following tasks:

- Establishing security for the domain
- Creating the domain's directories
- Creating the domain's tables
- Designating the domain's servers

As with setting up the root domain, these tasks cannot be performed sequentially. To make the configuration process easier to execute, they have been broken down into individual steps and the steps have been arranged into the most efficient order.

Standard Versus NIS-Compatible Configuration Procedures

The differences between NIS-compatible and standard NIS+ servers in subdomains are the same as they are for servers in the root domain (see "Standard Versus NIS-Compatible Configuration Procedures" on page 130).

The NIS+ daemon for each server in an NIS-compatible domain should have been started with the `-Y` option, as instructed in Chapter 7. An NIS-compatible domain also requires its tables to provide read rights for the nobody class, which allows NIS clients to access the information stored in them. This is accomplished with the `-Y` option to the `nissetup` command, shown in step 4. (The standard NIS+ domain version uses the same command but without the `-Y` option, so it is described in the same step.)

Here is a summary of the entire configuration process:

1. Log in to the domain's master server.
2. Name the domain's administrative group.
3. Create the domain's directory and designate its servers.
4. Create the domain's subdirectories and tables.
5. Create the domain's admin group.
6. Assign full group access rights to the directory object.
7. Add the servers to the domain's admin group.
8. Add credentials for other administrators.
9. Add the administrators to the domain's admin group.

Security Considerations

Note – The NIS+ security system is complex. If you are not familiar with NIS+ security, you might want to review Chapter 17before starting to configure your NIS+ environment.

At most sites, to preserve the security of the parent domain, only the parent domain's master server or an administrator who belongs to the parent domain's admin group is allowed to create a domain beneath it. Although this is a policy decision and not a requirement of NIS+, the instructions in this chapter assume that you are following that policy. Of course, the parent domain's admin group must have create rights to the parent directory object. To verify this, use the `niscat -o` command.

```
rootmaster# niscat -o doc.com.
Object Name : Doc
Owner : rootmaster
Group : admin.doc.com.
Domain : Com.
Access Rights : r---rmcdrmcdr---
```

:

If you are more concerned about convenience than security, you can make the new domain's master server a member of its parent domain's admin group, then perform the entire procedure from the server. Use the `nisgrpadm` command, described in the .Chapter 17

Prerequisites

- The parent domain must be configured and running.
- The server that will be designated as this domain's master must be initialized and running NIS+.
- If you will designate a replica server, the master server must be able to obtain the replica's IP address through its `/etc/hosts` or `/etc/inet/ipnodes` file or from its NIS+ hosts table.

Information You Need

- The name of the new domain (for step 3)
- The name of the new domain's master and replica servers
- The name of the new domain's admin group (for step 2)
- User IDs (UID) of the administrators who will belong to the new domain's admin group (for step 8)

Setting Up a Non-root Domain — Task Map

TABLE 8–1 Setting Up a Non-root Domain

Task	Description	For Instructions, Go To
Setting Up a Non-root Domain	Use NIS+ commands to set up a non-root domain	"How to Configure a Non-root Domain" on page 175

▼ How to Configure a Non-root Domain

1. **Log in to the domain's master server.**

   Log in to the server that you will designate as the new domain's master. The steps in this task use the server named `smaster`, which belongs to the `doc.com.` domain,

and will become the master server of the `sales.doc.com.` subdomain. The administrator performing this task is `nisboss.doc.com.`, a member of the `admin.doc.com.` group. That group has full access rights to the `doc.com.` directory object.

2. **Name the domain's administrative group.**

   Although you won't actually create the admin group until step 5, you need to identify it now. This enables the `nismkdir` command used in the following step to create the directory object with the proper access rights for the group. It does the same for the `nissetup` utility used in step 4.

   Set the value of the environment variable `NIS_GROUP` to the name of the domain's admin group. Here are two examples, one for C shell users and one for Bourne or Korn shell users. They both set `NIS_GROUP` to `admin.sales.doc.com.`

   For C Shell

   ```
   smaster# setenv NIS_GROUP admin.sales.doc.com.
   ```

   For Bourne or Korn Shell

   ```
   smaster# NIS_GROUP=admin.sales.doc.com.
   smaster# export NIS_GROUP
   ```

3. **Create the domain's directory and designate its servers.**

   The `nismkdir` command, in one step, creates the new domain's directory and designates its supporting servers. It has the following syntax:

   ```
   nismkdir -m master -s replica domain
   ```

   The `-m` flag designates its master server, and the `-s` flag designates its replica.

   ```
   smaster# nismkdir -m smaster -s salesreplica sales.doc.com.
   ```

Caution – Always run `nismkdir` on the master server. Never run `nismkdir` on the replica machine. Running `nismkdir` on a replica creates communications problems between the master and the replica.

The directory is loaded into `/var/nis`. Use the `niscat -o` command to view it (do not use `cat` or `more`).

```
smaster# niscat -o sales.doc.com.
Object Name : Sales
Owner : nisboss.doc.com.
Group : admin.sales.doc.com.
Domain : doc.com.
Access Rights : ----rmcdr---r---
.
```

Unlike the root directory, this directory object *does* have the proper group assignment. As a result, you won't have to use `nischgrp`.

4. **Create the domain's subdirectories and tables.**

   This step adds the `org_dir` and `groups_dir` directories and the NIS+ tables beneath the new directory object. Use the `nissetup` utility, but be sure to add the new domain name. And, for an NIS-compatible domain, include the `-Y` flag.

   NIS compatible

   ```
   smaster# /usr/lib/nis/nissetup -Y sales.doc.com.
   ```

   NIS+

   ```
   smaster# /usr/lib/nis/nissetup sales.doc.com.
   ```

   Each object added by the utility is listed in the output:

   ```
   smaster# /usr/lib/nis/nissetup
   org_dir.sales.doc.com. created
   groups_dir.sales.doc.com. created
   auto_master.org_dir.sales.doc.com. created
   auto_home.org.dir.sales.doc.com. created
   bootparams.org_dir.sales.doc.com. created
   cred.org_dir.sales.doc.com. created
   ethers.org_dir.sales.doc.com. created
   group.org_dir.sales.doc.com. created
   hosts.org_dir.sales.doc.com. created
   mail_aliases.org_dir.sales.doc.com. created
   sendmailvars.org_dir.sales.doc.com. created
   netmasks.org_dir.sales.doc.com. created
   netgroup.org_dir.sales.doc.com. created
   networks.org_dir.sales.doc.com. created
   passwd.org_dir.sales.doc.com. created
   protocols.org_dir.sales.doc.com. created
   rpc.org_dir.sales.doc.com. created
   services.org_dir.sales.doc.com. created
   timezone.org_dir.sales.doc.com. created
   ```

   The `-Y` option creates the same tables and subdirectories as for a standard NIS+ domain, but assigns read rights to the nobody class so that requests from NIS clients, which are unauthenticated, can access information in the NIS+ tables.

   You can verify the existence of the `org_dir` and `groups_dir` directories by looking in your master server's `/var/nis/data` directory. They are listed along with the root object and other NIS+ tables. The tables are listed under the `org_dir` directory. You can examine the contents of any table by using the `niscat` command, described in Chapter 9 (although at this point the tables are empty).

5. **Create the domain's admin group.**

   This step creates the admin group named in step 2. Use the `nisgrpadm` command with the `-c` option. This example creates the `admin.sales.doc.com.` group

   ```
   smaster# nisgrpadm -c admin.sales.doc.com.
    Group admin.sales.doc.com. created.
   ```

   This step only creates the group—it does not identify its members. That is done in step 9.

6. **Assign full group access rights to the directory object.**

   By default, the directory object grants only its group read access, which makes the group no more useful than the world class. To make the configuration of clients and subdomains easier, change the access rights that the directory object grants its group from read to read, modify, create, and destroy. Use the `nischmod` command.

```
smaster# nischmod g+rmcd sales.doc.com.
```

   Complete instructions for using the `nischmod` command are provided in Chapter 15.

7. **Add the servers to the domain's admin group.**

   At this point, the domain's group has no members. Add the master and replica servers, using the `nisgrpadm` command with the `-a` option. The first argument is the group name; the others are the names of the new members. This example adds `smaster.doc.com.` and `salesreplica.doc.com.` to the `admin.sales.doc.com.` group:

```
smaster# nisgrpadm -a admin.sales.doc.com. smaster.doc.com.
salesreplica.doc.com.
Added smaster.doc.com. to group admin.sales.doc.com.
Added salesreplica.doc.com. to group admin.sales.doc.com.
```

   To verify that the servers are indeed members of the group, use the `nisgrpadm` command with the `-l` option (see Chapter 17.

```
smaster# nisgrpadm -l admin.sales.doc.com.
 Group entry for admin.sales.doc.com. group:
 Explicit members:
 smaster.doc.com.
 salesreplica.doc.com.
 No implicit members
 No recursive members
 No explicit nonmembers
 No implicit nonmembers
 No recursive nonmembers
```

8. **Add credentials for other administrators.**

   Add the credentials of the other administrators who will work in the domain.

   For administrators who already have DES credentials in another domain, add LOCAL credentials. Use the `nisaddcred` command with both the `-p` and the `-P` flags.

```
smaster# nisaddcred -p 33355 -P nisboss.doc.com. local
```

   For administrators who do not yet have credentials, you can proceed in two different ways.

   - One way is to ask them to add their own credentials. However, they will have to do this as superuser. Here is an example in which an administrator with a UID of 22244 and a principal name of `juan.sales.doc.com.` adds his own credentials to the `sales.doc.com.` domain.

```
smaster# nisaddcred -p 22244 -P juan.sales.doc.com. local
smaster# nisaddcred -p unix.22244@sales.doc.com -P juan.sales.doc.com. des
```

```
Adding key pair for unix.22244@sales.doc.com.
Enter login password:
```

- The other way is for you to create temporary credentials for the other administrators, using dummy passwords (each administrator must have an entry in the NIS+ passwd table).

```
smaster# nisaddcred -p 22244 -P juan.sales.doc.com. local
smaster# nisaddcred -p unix.22244@sales.doc.com -P juan.sales.doc.com. des
Adding key pair for unix.22244@sales.doc.com.
Enter juan's login password:
nisaddcred: WARNING: password differs from login passwd.
Retype password:
```

Each administrator can later change his or her network password by using the `chkey` command. The credentials and keys chapters of *Solaris Naming Administration Guide* describe how to do this.

Note – In the two examples shown in step 8, the domain name following the lower case `-p` flag must *never* end in a trailing dot, while the domain name following the upper case `-P` flag must *always* end in a trailing dot.

---

9. **Add the administrators to the domain's admin group.**

   You don't have to wait for the other administrators to change their dummy passwords to perform this step. Use the `nisgrpadm` command with the `-a` option. The first argument is the group name, and the remaining arguments are the names of the administrators. This example adds the administrator `juan` to the `admin.sales.doc.com.` group:

   ```
   smaster# nisgrpadm -a admin.sales.doc.com. juan.sales.doc.com.
   Added juan.sales.doc.com. to group admin.sales.doc.com.
   ```

10. **Allocate sufficient swap space to accommodate NIS+ tables.**

    Swap space should be double the size of the maximum size of `rpc.nisd`. To determine how much memory `rpc.nisd` is using, issue the following command:

    ```
    rootmaster# /usr/lib/nis/nisstat
    ```

    `rpc.nisd` will under certain circumstances `fork` a copy of itself. If there is not enough memory, `rpc.nisd` fails.

    You can also calculate the memory and swap space requirements for NIS+ tables. For example, if you have 180,000 users and 180,000 hosts in your NIS+ tables, those two tables occupy approximately 190 Mbytes of memory. When you add credentials for 180,000 users and 180,000 hosts, the `cred` table has 540,000 entries (one entry for each local user credential, one entry for each DES user credential, and one entry for each host). The `cred` table occupies approximately 285 Mbytes of memory. In this example, `rpc.nisd` occupies at least 190 Mbytes + 285 Mbytes = 475 Mbytes of memory. So, you will require at least 1 Gbyte swap space. You will also want at least 500 Mbytes of memory to hold `rpc.nisd` entirely in memory.

Subdomain Configuration Summary

Table 8–2 is a summary of the steps required to configure a non-root domain. It assumes the simplest case, so be sure you are familiar with the more thorough task descriptions before you use this summary as a reference. This summary does not show the server's responses to each command.

TABLE 8–2 Setting Up a Subdomain Command Summary

Tasks	Commands
Log in as superuser to domain master.	`smaster% su`
Name the domain's admin group.	`# NIS_GROUP=admin.sales.doc.com.` `# export NIS_GROUP`
Create the domain's directory and designate its servers.	`# nismkdir -m smaster -s salesreplica sales.doc.com.`
Create `org_dir`, `groups_dir`, and tables. (For NIS-compatibility, use `-Y`.)	`# /usr/lib/nis/nissetup sales.doc.com.`
Create the admin group.	`# nisgrpadm -c admin.sales.doc.com.`
Assign full group rights to the domain's directory.	`# nischmod g+rmcd sales.doc.com.`
Add servers to admin group.	`# nisgrpadm -a admin.sales.doc.com. smaster.doc.com. sreplica.doc.com.`
Add credentials for other admins.	`# nisaddcred -p 22244 -P juan.sales.doc.com. local` `# nisaddcred -p unix.22244@sales.doc.com. juan.sales.doc.com. DES`
Add admins to domain's admin group.	`# nisgrpadm -a admin.sales.doc.com. juan.sales.doc.com.`

CHAPTER 9

Setting Up NIS+ Tables

This chapter provides step-by-step instructions for using the NIS+ command set to populate NIS+ tables on a master server from `/etc` files or NIS maps, how to transfer information back from NIS+ tables to NIS maps, how to limit access to the passwd column of the `passwd` table.

Setting Up Tables

Note – It is much easier to perform this task with the NIS+ installation scripts, as described in Part 1, than with the NIS+ command set, as described here. The methods described in this chapter should be used only by those administrators who are very familiar with NIS+ and who require some nonstandard features or configurations not provided by the installation scripts. Also, if you have them available, the Solstice AdminSuite tools provide easier methods of working with NIS+ tables.

You can populate NIS+ tables in four ways:

- From files, as described in "Populating NIS+ Tables From Files" on page 182
- From NIS maps, as described in "Populating NIS+ Tables From NIS Maps" on page 188
- With the `nispopulate` script, as described in "Populating NIS+ Tables" on page 97 and "Populating the New Subdomain's Tables" on page 119
- With Solstice AdminSuite tools, if you have them available

When populating tables from maps or files, the tables should have already been created in the process of setting up a root or subdomain, as explained in Chapter 5 and Chapter 8. Although you can populate a domain's tables at any time after they are created, it is recommended that you do so immediately after setting up the domain.

This enables you to add clients more easily, since the required information about the clients should already be available in the domain's tables.

Populating Tables—Options

When you populate a table—whether from a file or an NIS map—you can use any of these options:

- *Replace* - With the replace option, NIS+ first deletes all existing entries in the table and then adds the entries from the source. In a large table, this adds a large set of entries into the master server's `/var/nis/trans.log` file (one set for removing the existing entries, another for adding the new ones), taking up space in `/var/nis`. Thus, propagation to replicas will take longer.
- *Append* - The append option adds the source entries to the NIS+ table. Existing entries are not touched.
- *Merge* — The merge option produces the same results as the replace option but uses a different process. The Merge option updates existing entries rather than deleting and then replacing them. With the merge option, NIS+ handles three types of entries differently:
  - Entries that exist only in the source are added to the table.
  - Entries that exist in both the source and the table are updated in the table.
  - Entries that exist only in the NIS+ table are deleted from the table. When updating a large table with a file or map whose contents are not vastly different from those of the table, the merge option can spare the server a great many operations. Because it deletes only the entries that are not duplicated in the source (the replace option deletes *all entries, indiscriminately), it saves one delete and one add operation for every duplicate entry. Therefore, this is the preferred option.*

Populating NIS+ Tables From Files

This task transfers the contents of an ASCII file, such as `/etc/hosts`, into an NIS+ table.

Here is an outline of the procedure:

1. Check the content of each file that you will be transferring data from.

2. Make a copy of each file. Use this copy for the actual transfer. In this guide, copies of files to be transferred are given names ending in `xfr` (for example, `hosts.xfr`).
3. Log in to an NIS+ client. (You must have credentials and permissions allowing you to update the tables. See "Files Security Considerations" on page 183, below.)
4. Add `/usr/lib/nis` to the search path for this shell (if not already done).
5. Use `nisaddent` to transfer any of these files one at a time: `aliases`, `bootparams`, `ethers`, `group`, `hosts`, `netgroup`, `netmasks`, `networks`, `passwd`, `protocols`, `rpc`, `services`, `shadow`, and `ipnodes`.

Note – The new `/etc/inet/ipnodes` file contains IPv4 and IPv6 addresses. Use `nisaddent` to transfer the `/etc/inet/ipnodes` file into the `ipnodes.org_dir` table.

---

6. Transfer the `publickey` file.
7. Transfer the automounter information.
8. Ping any replicas.
9. Checkpoint the tables.

Files Security Considerations

You can populate NIS+ tables from any NIS+ client or from the root master server. You do not have to be logged in as superuser (root) to populate NIS+ tables, but you do have to have the proper credentials and access rights. If you are going to replace or merge the entries in the table with the entries from the text file, you must have create and destroy rights to the table. If you are going to append the new entries, you only need create rights.

Note – The NIS+ security system is complex. If you are not familiar with NIS+ security, you may want to review the security-related NIS+ chapters of this guide before starting to set up your NIS+ environment.

After you complete this operation, the table entries will be owned by the NIS+ principal that performed the operation and the group specified by the `NIS_GROUP` environment variable.

Prerequisites

- The domain must have already been set up and its master server must be running.

- The domain's servers must have enough swap space to accommodate the new table information.
- The information in the file must be formatted appropriately for the table into which it will be loaded. See "Prerequisites to Running `nispopulate`" on page 98 for information concering what format a text file must have to be transferred into its corresponding NIS+ table. Local `/etc` files are usually formatted properly, but may have several comments that you need to remove.
- Machine and user names cannot be duplicated. All users and all machines must have unique names. You cannot have a machine with the same name as a user.
- Machine names cannot contain dots (periods) or underscores. For example, a machine named `sales.alpha` is not allowed. Hyphens, however, are allowed. For example, a machine name such as `sales-alpha` is allowed.

Information You Need

You need the name and location of the text files that will be transferred.

Populating NIS+ Tables From Files — Task Map

TABLE 9–1 Populating NIS+ Tables From Files

Task	Description	For Instructions, Go To
Populating NIS+ Tables From Files	Populate NIS+ tables from files	"How to Populate NIS+ Tables From Files" on page 184

▼ How to Populate NIS+ Tables From Files

1. **Check each file that you will be transferring data from.**

   Make sure that there are no spurious or incorrect entries. Make sure that the right data is in the correct place and formatted properly. Remove any outdated, invalid, or corrupt entries. You should also remove any incomplete or partial entries. (It is easier to add incomplete entries after setup than to try transferring incomplete or damaged entries from the file.)

2. **Make a working copy of each file you will be transferring.**

   Use this working copy for the actual file transfer steps described in this section. Give each working copy the same filename extension (for example, `.xfr`).

   ```
   rootmaster% cp /etc/hosts /etc/hosts.xfr
   ```

For safety reasons, you might also copy all of the files you plan to use to some directory other than `/etc`. The `nisaddent` and `nispopulate` commands allow you to specify the file source directory.

3. **Log in to an NIS+ client.**

   You can perform this task from any NIS+ client—just be sure that the client belongs to the same domain as the tables into which you want to transfer the information. The examples in this task use the root master server. Because the administrator in these examples is logged on as superuser, the NIS+ principal actually performing this operation (and therefore needing the proper credentials and access rights) is the root master server.

   However, it is *not necessary* to be a superuser (root) or to be logged in on the root master server to update NIS+ tables. Regular users or superusers on any machine can update NIS+ tables, so long as they have the proper credentials, authorization, file permissions.

4. **Add `/usr/lib/nis` to the search path for this shell.**

   Since you will be using the `/usr/lib/nis/nisaddent` command once per table, adding its prefix to the search path will save you the trouble of typing it each time. Here are two examples, one for C shell users and one for Bourne or Korn shell users:

   For C Shell

   ```
   rootmaster# setenv PATH $PATH:/usr/lib/nis
   ```

   For Bourne or Korn Shell

   ```
   rootmaster# PATH=$PATH:/usr/lib/nis
   rootmaster# export PATH
   ```

5. **Use `nisaddent` to transfer any of these files, one at a time:**

   ```
   aliases
   bootparams
   ethers
   group
   hosts
   ipnodes
   netgroup
   netmasks
   networks
   protocols
   rpc, services
   ```

   The `publickey`, automounter, `passwd`, and `shadow` files require slightly different procedures; for the `publickey` file, go to step 6; for the automounter files, go to step 7; for the `passwd` and `shadow` files, go to step 8.

   By default, `nisaddent` *appends* the information. To replace or merge instead, use the `-r` or `-m` options.

   To replace:

   ```
   rootmaster# nisaddent -r -f filename table [domain]
   ```

To append:

```
rootmaster# nisaddent -a -f filename table [domain]
```

To merge:

```
rootmaster# nisaddent -m -f filename table [domain]
```

The best option for populating the tables for the first time is the `-a` option, the default. The best option to synchronize the NIS+ tables with NIS maps or `/etc` files is the `-m` (merge) option.

- *filename* is the name of the file. The common convention is to append `.xfr` to the end of these file names to identify them as transfer files created with `nisaddent`.
- *table* is the name of the NIS+ table. The *domain* argument is optional; use it only to populate tables in a different domain. Here are some examples, entered from the root domain's master server. The source files are edited versions of the `/etc` files:

```
rootmaster# nisaddent -m -f /etc/hosts.xfr hosts
rootmaster# nisaddent -m -f /etc/groups.xfr groups
```

If you perform this operation from a non-root server, keep in mind that a non-root server belongs to the domain above the one it supports; therefore, it is a client of another domain. For example, the `sales.doc.com.` master server belongs to the `doc.com.` domain. To populate tables in the `sales.doc.com.` domain from that master server, you must append the `sales.doc.com.` domain name to the `nisaddent` statement.

```
salesmaster# nisaddent -f /etc/hosts.xfr hosts Sales.doc.com.
```

If you perform this operation as a client of the `sales.doc.com.` domain, you do not need to append the domain name to the syntax.

To verify that the entries were transferred into the NIS+ table, use the `niscat` command, as described more fully in .Chapter 19

```
rootmaster# niscat groups.org_dir
root::0:root
other::1::
bin::2:root,bin,daemon
.
```

Troubleshooting tip: If `niscat` does not now show the updates immediately, it could be because the changes have not been sent by the master server to one or more of the replica servers. In this case, you can either wait and try again in five or ten minutes or use `niscat`'s `-M` option, which specifies that `niscat` obtain its data from the master server.

6. **Transfer the `publickey` file.**

   Because the domain's `cred` table already stores some credentials, you need to make sure they are not overwritten by the contents of the `publickey` text file that you transfer into the cred table. You can avoid this by removing those credentials from the `publickey` text file. For `rootmaster`, there might be one or more lines like the following, all of which should be removed:

```
unix.rootmaster@doc.com public-key:private-key [alg-type]
```

Then you can transfer the contents of the `publickey` file to the cred table. Use `nisaddent`, with the `-a` (add) option.

```
rootmaster# nisaddent -a -f /etc/publickey.xfr -t cred.org_dir publickey [domain]
```

Note, however, that this operation transfers only DES credentials into the `cred` table. You still need to create their LOCAL credentials to the cred table.

7. **Transfer the automounter information.**

   Although the `nissetup` utility creates `auto_master` and `auto_home` tables, they are not considered standard NIS+ tables. Therefore, transferring information into them requires a slightly different syntax; in particular, you must use the `-t` flag and specify that the table is of type key-value.

```
rootmaster# nisaddent -f auto.master.xfr -t auto_master.org_dir key-value
rootmaster# nisaddent -f auto.home.xfr -t auto_home.org_dir key-value
```

8. **Build the NIS+ `passwd` table.**

   The NIS+ `passwd` table is composed of data drawn from both the `/etc/passwd` and `/etc/shadow` files. Thus, you must run `nisaddent` twice to build the passwd table: once for the `/etc/passwd` file, using `passwd` as the target table, and once for the `/etc/shadow` file, using `shadow` as the target table. (Note that when running `nisaddent` on the `shadow` file, you specify `shadow` as the target table, even though there is no shadow table and the data is actually being placed in the shadow column of the passwd table.)

   ```
   rootmaster# nisaddent -m -f /etc/passwd.xfr passwd
   rootmaster# nisaddent -m -f /etc/shadow.xfr shadow
   ```

9. **Transfer your updates to your replica servers by running `nisping`.**

   Running `nisping` updates any replica servers with your changes.

   ```
   master1# nisping domain
   master1# nisping org_dir.domaincom.
   master1# nisping groups_dir.domain
   ```

10. **Checkpoint the tables.**

    Now that you have updated the in-memory copies of the NIS+ data set on your master and replica servers, you should write those changes into the table files on disk. This is called *checkpointing*. (Checkpoint is not *mandatory* at this time, so long as you have regularly scheduled checkpoints that will take care of it later. But if your changes have been significant, it is a good idea to get them written to disk as soon as convenient.)

    This step ensures that all the servers supporting the domain transfer the new information from their `.log` files to the disk-based copies of the tables. If you have just set up the root domain, this step affects only the root master server, since the root domain does not yet have replicas. To checkpoint, use the `nisping` command with the `-C` (uppercase) option.

```
rootmaster# nisping -C org_dir
Checkpointing replicas serving directory org_dir.doc.com. :
Master server is rootmaster.doc.com.
 Last update occurred at July 14, 1997
Master server is rootmaster.doc.com.
checkpoint succeeded.
```

If you do not have enough swap space, the server is unable to checkpoint properly, but it will not notify you. One way to make sure that you have sufficient swap space is to list the contents of a table with the `niscat` command. If you do not have enough swap space, you will see this error message:

```
can't list table: Server busy, Try Again.
```

Even though it doesn't *seem* to, this message indicates that you don't have enough swap space. Increase the swap space and checkpoint the domain again.

Populating NIS+ Tables From NIS Maps

This task transfers the contents of an NIS map into an NIS+ table. Here is a list of the steps:

1. Check the content of each NIS map that you will be transferring data from.
2. Log in to an NIS+ client.
3. Add `/usr/lib/nis` to the search path for this shell.
4. Use `nisaddent` to transfer any of these maps, one at a time: `aliases`, `bootparams`, `ethers`, `group`, `hosts`, `netgroup`, `netmasks`, `networks`, `passwd`, `protocols`, `rpc`, `services`.
5. Transfer the `publickey` map.
6. Transfer the automounter information.
7. Update your replicas with your changes by running `nisping`.
8. Checkpoint the tables.

Maps Security Considerations

You can perform this task from any NIS+ client as long as you (or superuser on the client) have the proper credentials and access rights. If you are going to replace or merge the entries in the table with the entries from the NIS map, you must have create and destroy rights to the table. If you are going to append the new entries, you need only create rights.

After you complete this operation, the table entries are owned by the NIS+ principal that performed the operation (either you or, if logged on as superuser, the client) and the group specified by the `NIS_GROUP` environment variable.

Prerequisites

- The domain must have already been set up and its master server must be running.
- The `dbm` files (`.pag` and `.dir` files) for the NIS maps you are going to load into the NIS+ tables must already be in a subdirectory of `/var/yp`.
- Machine and user names cannot be duplicated. All users and all machines must have unique names. You cannot have a machine with the same name as a user.
- Machine names cannot contain dots (periods). For example, a machine named `sales.alpha` is not allowed. A machine named `sales-alpha` is allowed.

Information You Need

You need the name and location of the NIS maps.

Populating NIS+ Tables From NIS Maps — Task Map

TABLE 9–2 Populating NIS+ Tables From NIS Maps

Task	Description	For Instructions, Go To
Populating NIS+ Tables From NIS Maps	Populate NIS+ tables from NIS maps	"How to Populate Tables From Maps" on page 189

▼ How to Populate Tables From Maps

1. **Check each NIS map that you will be transferring data from.**

   Make sure that there are no spurious or incorrect entries. Make sure that the right data is in the correct place and format properly. Remove any outdated, invalid, or corrupt entries. You should also remove any incomplete or partial entries. (It is easier to add incomplete entries after setup than to try transferring incomplete or damages entries from the map.)

2. **Log in to an NIS+ client.**

   You can perform this task from any NIS+ client—so long as that client belongs to the same domain as the tables into which you want to transfer the information. The examples in this task use the root master server. Since the administrator in these examples is logged in as superuser, the NIS+ principal actually performing this operation (and therefore needing the proper credentials and access rights) is the root master server.

3. **Add** `/usr/lib/nis` **to the search path for this shell.**

   Because you will be using the `/usr/lib/nis/nisaddent` command once for each table, adding its prefix to the search path will save you the trouble of typing it each time. Here are two examples, one for C shell users and one for Bourne or Korn shell users:

   For C Shell

   ```
   rootmaster# setenv PATH $PATH:/usr/lib/nis
   ```

   For Bourne or Korn Shell

   ```
   rootmaster# PATH=$PATH:/usr/lib/nis
   rootmaster# export PATH
   ```

4. **Use** `nisaddent` **to transfer any of these maps, one at a time:**

   `aliases`, `bootparams`, `ethers`, `group`, `hosts`, `netgroup`, `netmasks`, `networks`, `passwd`, `protocols`, `rpc`, `services`.

   The `-publickey` and automounter maps require slightly different procedures; for the `publickey` file, go to step 6, and for the automounter files, go to step 7.

   By default, `nisaddent` *appends* the file information to the table information. To replace or merge instead, use the `-r` or `-m` options:

   To replace:

   ```
   rootmaster# nisaddent -r -y nisdomain table
   ```

   To append:

   ```
   rootmaster# nisaddent -a -y nisdomain table
   ```

   To merge:

   ```
   rootmaster# nisaddent -m -y nisdomain table
   ```

   The best option for populating the tables for the first time is the `-a` option, which is the default. The best option to synchronize the NIS+ tables with NIS maps or `/etc` files is the `-m` (merge) option.

   The `-y` (lowercase) option indicates an NIS domain instead of a text file. The *nisdomain* argument is the name of the NIS domain whose map you are going transfer into the NIS+ table. You don't have to name the actual map; the `nisaddent` utility automatically selects the NIS map that corresponds to the *table* argument. Here are some examples:

```
rootmaster# nisaddent -m -y olddoc hosts
rootmaster# nisaddent -m -y olddoc passwd
rootmaster# nisaddent -m -y olddoc groups
```

The first example transfers the contents of the `hosts.byname` and `hosts.byaddr` maps in the `olddoc` (NIS) domain to the NIS+ hosts table in the root domain (NIS+). The second transfers the NIS maps that store password-related information into the NIS+ passwd table. The third does the same with group-related information. For more information about the `nisaddent` command, see .Chapter 19

5. **Transfer the `publickey` map.**

   Since the domain's cred table already stores some credentials, you need to make sure they are not overwritten by the contents of the `publickey` map that you transfer into the cred table.

   a. **First, dump the `publickey` map to a file, then open that file with your text editor.**

      ```
      rootmaster# makedbm -u /var/yp/olddoc/publickey.byname /etc/publickey.xfr
      rootmaster# vi /tmp/publickey.tmp
      ```

   b. **Now remove the credentials of the machine you are logged in to from the `publickey` map.**

      For `rootmaster`, there might be one or lines like the following, all of which should be removed:

      ```
      unix.rootmaster@doc.com public-key:private-key [alg-type]
      ```

   c. **Now you can transfer the contents of the *file*—not the map—into the cred table. Use `nisaddent`, with the `-a` (add) option.**

```
rootmaster# nisaddent -a -f /etc/publickey.xfr -t cred.org_dir Publickey
```

      Notice that this operation transfers only DES credentials into the `cred` table. You still need to create their LOCAL credentials to the `cred` table.

6. **Transfer the automounter information.**

   Although the `nissetup` utility creates `auto_master` and `auto_home` tables, they are not considered standard NIS+ tables. Therefore, transferring information into them requires a slightly different syntax:

```
rootmaster# nisaddent -y olddoc -Y auto.master -t auto_master.org_dir key-value
rootmaster# nisaddent -y olddoc -Y auto.home -t auto_home.org_dir key-value
```

   The `-m` and `-y` options are still required, as is the NIS domain name (in this instance, `olddoc`). However, you must precede the name of the NIS map (for example, `auto.master`) with a `-Y` (uppercase). Then, as is required when transferring automounter *text files*, you must use the `-t` option, which indicates that this is a nonstandard NIS+ table. Its arguments are the name of the NIS+ directory object (`auto_master.org_dir`) and the type of table (key-value). Be sure to append the `org_dir` suffixes to the NIS+ table names.

7. **Transfer your updates to your replica servers by running `nisping`.**

   Running `nisping` updates any replica servers with your changes.

   ```
   master1# nisping domain
   master1# nisping org_dir.domaincom.
   master1# nisping groups_dir.domain
   ```

8. **Checkpoint the tables.**

   This step ensures that all the servers supporting the domain transfer the new information from their `.log` files to the disk-based copies of the tables. If you just finished setting up the root domain, this step affects only the root master server, since the root domain does not yet have replicas. Use the `nisping` command with the `-C` (uppercase) option.

   ```
   rootmaster# nisping -C org_dir
   Checkpointing replicas serving directory org_dir.doc.com. :
   Master server is rootmaster.doc.com.
    Last update occurred at July 14, 1994
   Master server is rootmaster.doc.com.
   checkpoint succeeded.
   ```

   If you do not have enough swap space, the server is unable to checkpoint properly, but it does not notify you. One way to make sure you have sufficient swap space is to use list the contents of a table with the `niscat` command. If you do not have enough swap space, you will see this error message:

   ```
   can't list table: Server busy, Try Again.
   ```

   Even though it does not *seem* to, this message indicates that you do not have enough swap space. Increase the swap space and checkpoint the domain again.

Transferring Information From NIS+ to NIS

This task transfers the contents of NIS+ tables into NIS maps on a Solaris 1.x NIS master server. Here is an outline of the procedure:

1. Log in to the NIS+ server.
2. Transfer the NIS+ tables in to output files.
3. Transfer the contents of the output files to the NIS maps.

NIS to NIS+ Security Considerations

To perform this task, you must have read access to each table whose contents you transfer.

Prerequisites

The maps must already have been built on the NIS server.

Transferring Information From NIS+ to NIS — Task Map

TABLE 9–3 Transferring Information From NIS+ to NIS

Task	Description	For Instructions, Go To
Transferring Information From NIS+ to NIS	Transfer information from NIS+ tables to NIS maps on a Solaris 1.x NIS master server	"How to Transfer Information From NIS+ to NIS" on page 193

▼ How to Transfer Information From NIS+ to NIS

1. **Log in to the NIS+ server.**

   This example uses the server named `dualserver`.

2. **Transfer the NIS+ tables to output files.**

   Use the `nisaddent` command with the `-d` option, once for each table.

   ```
   dualserver% /usr/lib/nis/nisaddent -d -t table tabletype > filename
   ```

   The `-d` option transfers the contents of *table* to *filename*, converting the contents back to standard `/etc` file format.

3. **Transfer the contents of the output files in to the NIS maps.**

   The NIS+ output files are ASCII files that you can use as input files for the NIS maps. Copy them into the NIS master's `/etc` directory, then use `make` as usual.

   ```
   dualserver# cd /var/yp
   dualserver# make
   ```

Limiting Access to the `Passwd` Column to Owners and Administrators

This task describes how to limit read access to the password-related columns of the `passwd` table to the entry owner and the table administrators, without affecting the read access of other authenticated principals (including applications) to the remaining columns of the passwd table.

This task establishes the following rights:

```
                        Nobody  Owner   Group  World
Table Level Rights:     ----    rmcd    rmcd   ----
Passwd Column Rights:   ----    rm--    rmcd   ----
Shadow Column Rights:   ----    rm--    rmcd   ----
```

`Passwd` Column Security Considerations

- The domain must *not* be running in NIS-compatibility mode.
- All clients of the domain must have DES credentials.
- All clients of the domain must be running Solaris Release 2.3 or a later release.
- Users' network passwords (used to encrypt their DES credentials) must be the same directory as their login passwords.

Prerequisites

- The `passwd` table must have already been set up. It need not have any information in it, however.
- The NIS+ principal performing this task must have modify rights to the `passwd` table.

Information You Need

All you need is the name of the `passwd` table.

Limiting Access to the Passwd Column to Owners and Administrators — Task Map

TABLE 9–4 Limiting Access to the Passwd Column to Owners and Administrators

Task	Description	For Instructions, Go To
Limiting Access to the Passwd Column to Owners and Administrators	Modify `passwd.org_dir`, via NIS+ commands, to restrict access to the passwd column for owners and administrators.	"How to Limit Read Access to the Passwd Column" on page 195

▼ How to Limit Read Access to the Passwd Column

1. **Log in to the domain's master server.**

   The examples in this task use the root master server, `rootmaster`.

2. **Check the current table and column permissions.**

   Use the `niscat -o` command.

   ```
   rootmaster# niscat -o passwd.org_dir
   ```

   This task assumes the existing permissions are:

   ```
   Access Rights    : ----rmcdrmcdr---
   Columns          :
                        [0]  Name              : name
                             Access Rights : r-----------r---
                        [1]  Name              : passwd
                             Access Rights : -----m----------
                        [2]  Name              : uid
                             Access Rights : r-----------r---
                        [3]  Name              : gid
                             Access Rights : r-----------r---
                        [4]  Name              : gcos
                             Access Rights : r----m------r---
                        [5]  Name              : home
                             Access Rights : r-----------r---
                        [6]  Name              : shell
                             Access Rights : r-----------r---
                        [7]  Name              : shadow
                             Access Rights : r-----------r---
   ```

   If your permissions are different, you may need to use a different syntax. For instructions, seeChapter 15.

3. **Change the table permissions.**

   Use the `nischmod` command to change the table's object-level permissions to `----rmcdrmcd ----`

```
rootmaster# nischmod og=rmcd,nw= passwd.org_dir
```

4. **Change the column permissions.**

   Use the `nistbladm` command with the `-u` option to change the permissions of the passwd and shadow columns to:

```
passwd ---- rm-- ---- ----
shadow ---- r--- ---- ----
rootmaster# nistbladm -u passwd=o+r, shadow=o+r passwd.org_dir
```

5. **Verify the new permissions.**

   Use the `niscat -o` command, as you did in step 2. The permissions should look the same as they do in that step's output.

Table Population Summaries

Following are summaries of the steps required to populate NIS+ tables. They assume the simplest case, so be sure you are familiar with the more thorough task descriptions before you use this summary as a reference. For brevity, these summaries do not show the server's responses to each command.

TABLE 9–5 Transferring Files Into NIS+ Tables: Command Summary

Tasks	Commands
Log in to an NIS+ client.	`rootmaster%`
Create working copies of the files to be transferred.	`% cp /etc/hosts /etc/hosts.xfr`
Add `/usr/lib/nis` to search path.	`% PATH=$PATH:/usr/lib/nis; export PATH`
Transfer each file, one at a time.	`% nisaddent -m -f /etc/hosts.xfr hosts`
Remove old server credentials from `publickey` file.	`% vi /etc/publickey.xfer`
Transfer it to the cred table.	`% nisaddent -a -f /etc/publickey.xfr cred`
	`% nisaddent -f auto.master.xfr -t auto_master.org_dir key-value`
Transfer the automounter files.	`% nisaddent -f auto.home.xfr -t auto_home.org_dir key-value`
Checkpoint the table directory.	`% nisping -C org_dir`

TABLE 9–6 Transferring Maps Into NIS+ Tables: Command Summary

Tasks	Commands
Log in to an NIS+ client.	`rootmaster%`
Add `/usr/lib/nis` to search path.	`% PATH=$PATH:/usr/lib/nis; export PATH`
Transfer each map, one at a time.	`% nisaddent -m -y olddoc hosts`
Dump `publickey` map to a file.	`% makedbm -u /var/yp/olddoc/publickey.byname > /etc/publickey.xfr`
Remove new credentials.	`% vi /etc/publickey.xfr`
Transfer the `publickey` file.	`% nisaddent -a -f /etc/publickey.xfr -t cred.ortg_dir publickey`
Transfer the automounter maps.	`% nisaddent -y olddoc -Y auto.master -t auto_master.org_dir key-value` `% nisaddent -y olddoc -Y auto.home -t auto_home.org_dir key-value`
Checkpoint the table directory.	`% nisping -C org_dir`

TABLE 9–7 Transferring NIS+ Tables to NIS Maps: Command Summary

Tasks	Commands
Log in to NIS+ server.	`dualserver%`
Transfer NIS+ tables to files.	`% /usr/lib/nis/nisaddent -d [-t` *table*`]` *tabletype* `>` *filename*
Transfer files to NIS maps.	`% makedbm` *flags output-file NIS-dbm-file*

TABLE 9–8 Limiting Access to Passwd Column: Command Summary

Tasks	Commands
Log into the domain's master server.	`rootmaster#`
Check the table's existing rights.	`# niscat -o passwd.org_dir`
Assign the table new rights.	`# nischmod og=rmcd,nw= passwd.org_dir`
Assign the columns new rights	`# nistbladm -u passwd=o+r, shadow=n+r passwd.org_dir`
Verify the new rights.	`# niscat -o passwd.org_dir`

PART III NIS+ Administration

This part describes the administration and troubleshooting of the NIS+ naming service in the Solaris operating environment.

CHAPTER 10

NIS+ Tables and Information

This chapter describes the structure of NIS+ tables and provides a brief overview of how they can be set up.

NIS+ Table Structure

NIS+ stores a wide variety of network information in tables. NIS+ tables provide several features not found in simple text files or maps. They have a column-entry structure, they accept search paths, they can be linked together, and they can be set up in several different ways. NIS+ provides 16 preconfigured system tables, and you can also create your own tables. Table 10–1 lists the preconfigured NIS+ tables.

TABLE 10–1 NIS+ Tables

Table	Information in the Table
hosts	Network address and host name of every machine in the domain
bootparams	Location of the root, swap, and dump partition of every diskless client in the domain
passwd	Password information about every user in the domain.
cred	Credentials for principals who belong to the domain
group	The group name, group password, group ID, and members of every UNIX group in the domain
netgroup	The netgroups to which machines and users in the domain may belong
mail_aliases	Information about the mail aliases of users in the domain

TABLE 10–1 NIS+ Tables *(Continued)*

Table	Information in the Table
timezone	The time zone of every machine in the domain
networks	The networks in the domain and their canonical names
netmasks	The networks in the domain and their associated netmasks
ethers	The Ethernet address of every machine in the domain
services	The names of IP services used in the domain and their port numbers
protocols	The list of IP protocols used in the domain
RPC	The RPC program numbers for RPC services available in the domain
auto_home	The location of all user's home directories in the domain
auto_master	Automounter map information

Because it contains only information related to NIS+ security, the Cred table, is described in Chapter 12.

These tables store a wide variety of information, ranging from user names to Internet services. Most of this information is generated during a setup or configuration procedure. For instance, an entry in the passwd table is created when a user account is set up. An entry in the hosts table is created when a machine is added to the network. And an entry in the networks table is created when a new network is set up.

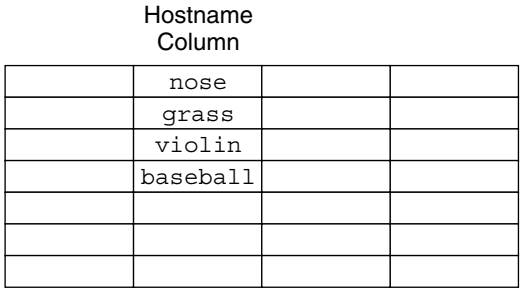
Since this information is generated from such a wide field of operations, much of it is beyond the scope of this manual. However, as a convenience, Appendix C, Information in NIS+ Tables, summarizes the information contained in each column of the tables, providing details only when necessary to keep things from getting confusing, such as when distinguishing groups from NIS+ groups and netgroups. For thorough explanations of the information, consult Solaris system and network administration manuals.

Note – You can create more automounter maps for a domain, but be sure to store them as NIS+ tables and list them in the auto_master table. When creating additional automount maps to supplement `auto_master` (which is created for you), the column names must `key` and `value`. For more information about the automounter consult books about the automounter or books that describe the NFS file system.

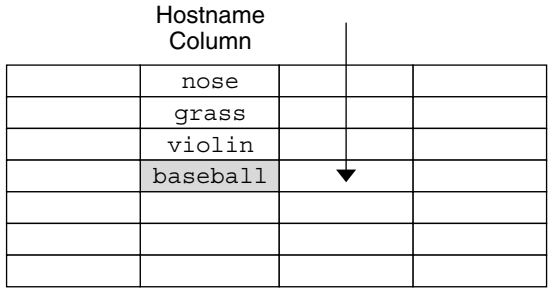
Note – As a naming service, NIS+ tables are designed to store references to objects, not the objects themselves. For this reason, NIS+ does not support tables with large entries. If a table contains excessively large entries, `rpc.nisd` may fail.

Columns and Entries

Although NIS+ tables store different types of information, they all have the same underlying structure; they are each made up of rows and columns (the rows are called "entries" or "entry objects"):



A client can access information by a key, or by any column that is searchable. For example, to find the network address of a machine named `baseball`, a client could look through the hostname column until it found `baseball`.



It then would move along the baseball entry to find its network address:

	Address Column	Hostname Column		
		nose		
		grass		
		violin		
Baseball Row	129.44.1.2	baseball		

Because a client can access table information at any level, NIS+ provides security mechanisms for all three levels. For instance, an administrator could assign read rights to everyone for a table at the object level, modify rights to the owner at the column level, and modify rights to the group at the entry level. Details about table security are provided in Chapter 15.

Search Paths

A table contains information only about its *local* domain. For instance, tables in the `doc.com.` domain contain information only about the users, clients, and services of the `doc.com.` domain. The tables in the `sales.doc.com.` domain store information only about the users, clients, and services of the `sales.doc.com.` domain. And so on.

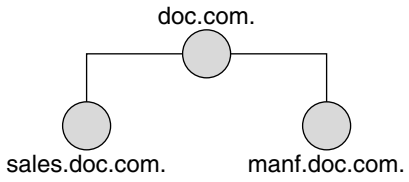
If a client in one domain tries to find information that is stored in another domain, it has to provide a fully qualified name. As described in "`NIS_PATH` Environment Variable" on page 81 if the `NIS_PATH` environment variable is set up properly, the NIS+ service will do this automatically.

Every NIS+ table can also specify a *search path* that a server will follow when looking for information. The search path is an ordered list of NIS+ tables, separated by colons:

table:*table*:*table*. . .

The table names in the search path don't have to be fully qualified; they can be expanded just like names entered at the command line. When a server cannot find information in its local table, it returns the table's search path to the client. The client uses that path to look for the information in every table named in the search path, in order, until it finds the information or runs out of names.

Here is an example that demonstrates the benefit of search paths. Assume the following domain hierarchy:



The hosts tables of the lower two domains have the following contents:

TABLE 10–2 Example Hosts Table

sales.doc.com.		manf.doc.com.	
127.0.0.1	localhost	127.0.0.1	localhost
111.22.3.22	luna	123.45.6.1	sirius
111.22.3.24	phoebus	123.45.6.112	rigel
111.22.3.25	europa	123.45.6.90	antares
111.22.3.27	ganymede	123.45.6.101	polaris
111.22.3.28	mailhost	123.45.6.79	mailhost

Assume now that a user logged onto the `luna` machine in the `sales.doc.com.` domain wants to log in remotely to another client. Without providing a fully qualified name, that user can only remotely log on to five machines: `localhost`, `phoebus`, `europa`, `ganymede`, and the `mailhost`.

Now assume that the search path of the `hosts` table in the `sales.doc.com.` domain listed the `hosts` table from the `manf.doc.com.` domain:

```
hosts.org_dir.manf.doc.com.
```

Now a user in the `sales.doc.com.` domain can enter something like `rlogin sirius`, and the NIS+ server will find it. It will first look for `sirius` in the local domain, but when it does not find a match, it will look in the `manf.doc.com.` domain. How does the client know how to find the `manf.doc.com.` domain? As described in Chapter 2, the information is stored in its directory cache. If it is not stored in its directory cache, the client will obtain the information by following the process described in Chapter 2.

There is a slight drawback, though, to specifying a search path. If the user were to enter an incorrect name, such as `rlogin luba` (rather than “luna”), the server would need to look through three tables—instead of just one—before returning an error message. If you set up search paths throughout the namespace, an operation may end up searching through the tables in 10 domains instead of just 2 or 3. Another drawback

is a performance loss from having many clients contact more than one set of servers when they need to access NIS+ tables.

You should also be aware that since "mailhost" is often used as an alias, when trying to find information about a specific mailhost, you should use its fully qualified name (for example, `mailhost.sales.doc.com.`), or NIS+ will return *all* the mailhosts it finds in all the domains it searches through.

You can specify a table's search path by using the `-p` option to the `nistbladm` command, as described in "The `nistbladm` Command" on page 353.

Ways to Set Up Tables

Setting up NIS+ tables involves three or four tasks:

1. Creating the `org_dir` directory
2. Creating the system tables
3. Creating non-system tables (optional)
4. Populating the tables with information

As described in "NIS+ Files and Directories" on page 59, NIS+ system tables are stored under an `org_dir` directory. So, before you can create any tables, you must create the `org_dir` directory that will hold them. You can do this in three ways.

- Use the `nisserver` script. The `nisserver` script creates the appropriate directories and a full set of system tables. Running the `nisserver` script is the recommended method.
- Use the `nismkdir` command. The `nismkdir` command simply creates the directory.
- Use the `/usr/lib/nis/nissetup` utility. The `nissetup` utility creates the `org_dir` and `groups_dir` directories and a full set of system tables.

The `nisserver` script and the `nissetup` and `nismkdir` utilities are described in "The `nismkdir` Command" on page 334. Additional information on the `nismkdir` command can be found in "The `nismkdir` Command" on page 334.

A benefit of the `nissetup` utility is its capability to assign the proper access rights to the tables of a domain whose servers are running in NIS-compatibility mode. When entered with the `-Y` flag, it assigns read permissions to the nobody class of the objects it creates, allowing NIS clients, who are unauthenticated, to get information from the domain's NIS+ tables.

The 16 NIS+ system tables and the type of information they store are described in Chapter 10. To create them, you could use one of the three ways mentioned above. The

`nistbladm` utility also creates and modifies NIS+ tables. You could conceivably create all the tables in a namespace with the `nistbladm` command, but you would have to type much more and you would have to know the correct column names and access rights. A much easier way is to use the `nisserver` script.

To create a non-system table—that is, a table that has not been preconfigured by NIS+—use the `nistbladm` command. (Note that if you are creating additional automount maps, the first column must be named `key` and the second column named `value`.)

You can populate NIS+ tables in three ways: from NIS maps, from ASCII files (such as `/etc` files), and manually.

If you are upgrading from the NIS service, you already have most of your network information stored in NIS maps. You *don't* have to re-enter this information manually into NIS+ tables. You can transfer it automatically with the `nispopulate` script or the `nisaddent` utility.

If you are not using another network information service, but maintain network data in a set of `/etc` files, you *don't* have to re-enter this information, either. You can transfer it automatically, also using the `nispopulate` script or the `nisaddent` utility.

If you are setting up a network for the first time, you may not have much network information stored anywhere. In that case, you'll need to first get the information and then enter it manually into the NIS+ tables. You can do this with the `nistbladm` command. You can also do it by entering all the information for a particular table into an *input file*—which is essentially the same as an `/etc` file—and then transferring the contents of the file with the `nispopulate` script or the `nisaddent` utility.

How Tables Are Updated

When a domain is set up, its servers receive their first versions of the domain's NIS+ tables. These versions are stored on disk, but when a server begins operating, it loads them into memory. When a server receives an update to a table, it immediately updates its memory-based version of the table. When it receives a request for information, it uses the memory-based copy for its reply.

Of course, the server also needs to store its updates on disk. Since updating disk-based tables takes time, all NIS+ servers keep *log* files for their tables. The log files are designed to temporarily store changes made to the table, until they can be updated on disk. They use the table name as the prefix and append `.log`. For example:

```
hosts.org_dir.log
bootparams.org_dir.log
password.org_dir.log
ipnodes.org_dir.log
```

You should update disk-based copies of a table on a daily basis so that the log files don't grow too large and take up too much disk space. This process is called *checkpointing*. To do this, use the `nisping -C` command.

CHAPTER 11

NIS+ Security Overview

This chapter describes the NIS+ security system and how it affects the entire NIS+ namespace.

Solaris Security—Overview

In essence, Solaris security is provided by gates that users must pass through in order to enter the Solaris environment, and permission matrixes that determine what they are able to do once inside. (See Figure 11–1for a schematic representation of this system.)

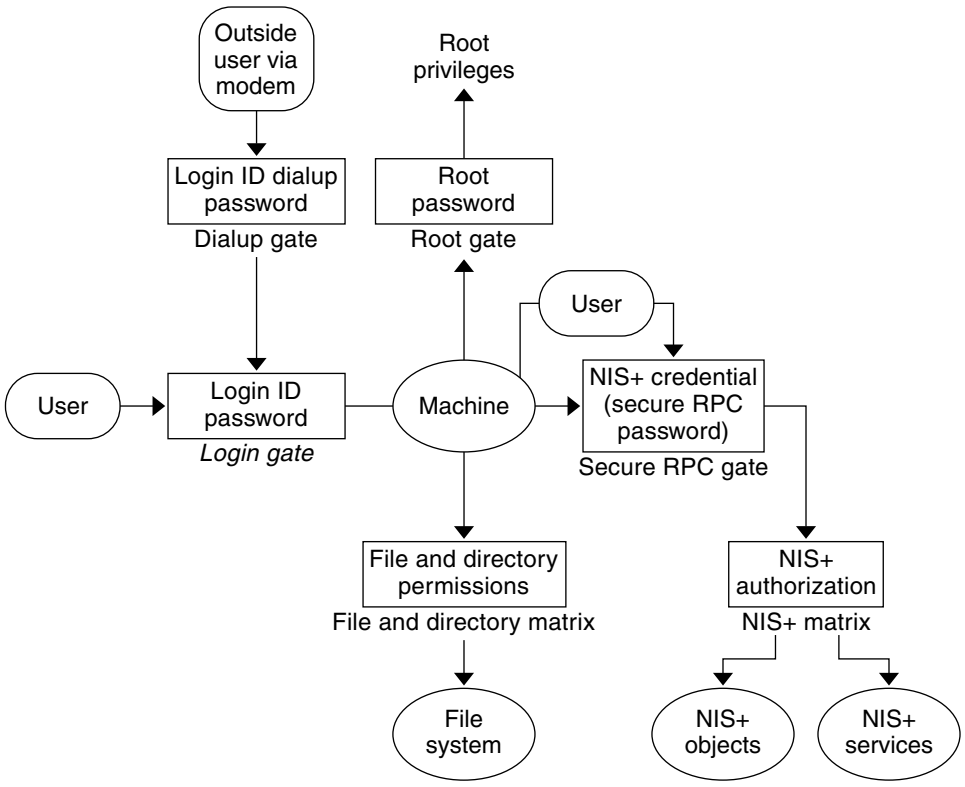


FIGURE 11–1 Solaris Security Gates and Filters

As you can see in the above figure, the overall system is composed of four gates and two permission matrixes:

- *Dialup gate*. To access a given Solaris environment from the outside through a modem and phone line, you must provide a valid Login ID and Dialup password.
- *Login gate*. To enter a given Solaris environment you must provide a valid login ID and user password.
- *File and Directory Matrix*. Once you have gained access to a Solaris environment, your ability to read, execute, modify, create, and destroy files and directories is governed by the applicable permissions matrix.
- *Root gate*. To gain access to root privileges, you must provide a valid super user (root) password.
- *Secure RPC gate*. In an NIS+ environment running at security level 2 (the default), when you try to use NIS+ services and gain access to NIS+ objects (servers, directories, tables, table entries, and so forth) your identity is confirmed by NIS+ using the Secure RPC process.

Consult your Solaris documentation for detailed descriptions of the Dialup, Login, and Root gates, and the File and Directory permissions matrix.

To enter the Secure RPC gate requires presentation of a Secure RPC password. (In some contexts *Secure RPC passwords* have been referred to as *network passwords*.) Your Secure RPC password and your login password normally are identical and when that is the case you are passed through the gate automatically without having to re-enter your password. (See "Secure RPC Password Versus Login Password Problem" on page 234 for information regarding cases where the two passwords are not the same.)

A set of *credentials* are used to automatically pass your requests through the Secure RPC gate. The process of generating, presenting, and validating your credentials is called *authentication* because it confirms who you are and that you have a valid Secure RPC password. This authentication process is automatically performed every time you request an NIS+ service.

In an NIS+ environment running in NIS-compatibility mode (also known as YP-compatibility mode), the protection provided by the Secure RPC gate is significantly weakened because everyone has read rights for all NIS+ objects and modify rights for those entries that apply to them regardless of whether or not they have a valid credential (that is, regardless of whether or not the authentication process has confirmed their identity and validated their Secure RPC password). Since that allows *anyone* to have read rights for all NIS+ objects and modify rights for those entries that apply to them, an NIS+ network running in compatibility mode is less secure than one running in normal mode.

For details on how to create and administer NIS+ authentication and credentials, see Chapter 12.

- *NIS+ objects matrix*. Once you have been properly authenticated to NIS+ your ability to read, modify, create, and destroy NIS+ objects is governed by the applicable permissions matrix. This process is called NIS+ *authorization*.

  For details NIS+ permissions and authorization, see Chapter 15.

NIS+ Security—Overview

NIS+ security is an integral part of the NIS+ namespace. You cannot set up security and the namespace independently. For this reason, instructions for setting up security are woven through the steps used to set up the other components of the namespace. Once an NIS+ security environment has been set up, you can add and remove users, change permissions, reassign group members, and all other routine administrative tasks needed to manage an evolving network.

The security features of NIS+ protect the information in the namespace, as well as the structure of the namespace itself, from unauthorized access. Without these security

features, any NIS+ client could obtain and change information stored in the namespace or even damage it.

NIS+ security does two things:

- *Authentication*. Authentication is used to identify NIS+ principals. Every time a principal (user or machine) tries to access an NIS+ object, the user's identity and Secure RPC password is confirmed and validated.
- *Authorization*. Authorization is used to specify access rights. Every time NIS+ principals try to access NIS+ objects, they are placed in one of four authorization classes (owner, group, world, nobody). The NIS+ security system allows NIS+ administrators to specify different read, modify, create, or destroy rights to NIS+ objects for each class. Thus, for example, a given class could be permitted to modify a particular column in the passwd table but not read that column, or a different class could be allowed to read some entries of a table but not others.

In essence, then, NIS+ security is a two-step process:

1. *Authentication*. NIS+ uses credentials to confirm that you are who you claim to be.
2. *Authorization*. Once your identity is established by the authentication process, NIS+ determines your class. What you can do with a given NIS+ object or service depends on which class you belong to. This is similar in concept to the standard UNIX file and directory permissions system. (See "Authorization Classes" on page 217 for more information on classes.)

This process, for example, prevents someone with root privileges on machine A from using the `su` command to assume the identity of a second user and then accessing NIS+ objects with the second user's NIS+ access privileges.

Note, however, that NIS+ cannot prevent someone who knows another user's login password from assuming that other user's identity and NIS+ access privileges. Nor can NIS+ prevent a user with root privileges from assuming the identity of another user who is logged in from the *same* machine.

Figure 11–2 details this process:

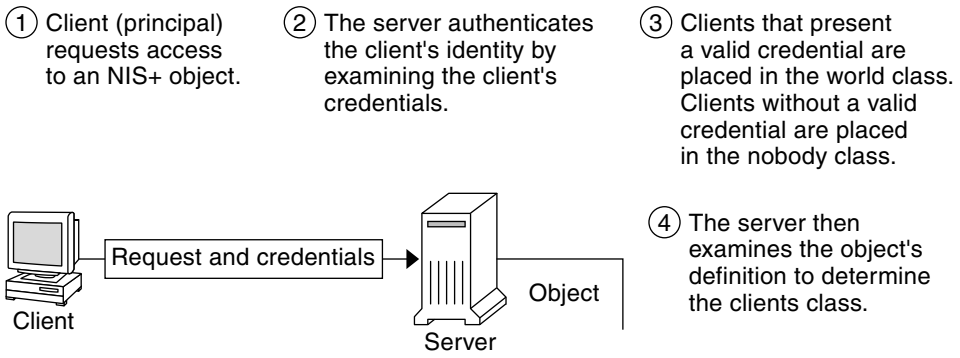


FIGURE 11–2 Summary of the NIS+ Security Process

NIS+ Principals

NIS+ principals are the entities (clients) that submit requests for NIS+ services. An NIS+ principal may be someone who is logged in to a client machine as a regular user, someone who is logged in as superuser, or any process that runs with superuser permission on an NIS+ client machine. Thus, an NIS+ principal can be a client user or a client machine.

An NIS+ principal can also be the entity that supplies an NIS+ service from an NIS+ server. Since all NIS+ servers are also NIS+ clients, much of this discussion also applies to servers.

NIS+ Security Levels

NIS+ servers operate at one of two security levels. These levels determine the type of credential principals that must submit for their requests to be authenticated. NIS+ is designed to run at the most secure level, which is security level 2. Level 0 is provided only for testing, setup, and debugging purposes. These security levels are summarized in Table 11–1.

TABLE 11–1 NIS+ Security Levels

Security Level	Description
0	Security level 0 is designed for testing and setting up the initial NIS+ namespace. An NIS+ server running at security level 0 grants any NIS+ principal full access rights to all NIS+ objects in the domain. Level 0 is for setup purposes only and should only be used by administrators for that purpose. Level 0 should not be used on networks in normal operation by regular users.
1	Security level 1 uses AUTH_SYS security. This level is not supported by NIS+ and should not be used.
2	Security level 2 is the default. It is the highest level of security currently provided by NIS+. It authenticates only requests that use DES credentials. Requests with no credentials are assigned to the nobody class and have whatever access rights that have been granted to that class. Requests that use invalid DES credentials are retried. After repeated failure to obtain a valid DES credential, requests with invalid credentials fail with an authentication error. (A credential might be invalid for a variety of reasons such as the principal making the request is not keylogged in on that machine, the clocks are out of synch, there is a key mismatch, and so forth.)

Security Levels and Password Commands

In Solaris releases 2.0 through 2.4, you used the `nispasswd` command to change your password. However, `nispasswd` could not function without credentials. (In other words, it could not function under security level 0 unless there were credentials existing from some previous higher level.) Starting with Solaris Release 2.5, the `passwd` command should now be used to change your own password regardless of security level or credential status.

NIS+ Authentication and Credentials—Introduction

The purpose of NIS+ credentials is to *authenticate* (confirm) the identity of each principal requesting an NIS+ service or access to an NIS+ object. In essence, the NIS+ credential/authorization process is an implementation of the Secure RPC system.

The credential/authentication system prevents someone from assuming some other user's identity. That is, it prevents someone with root privileges on one machine from

using the `su` command to assume the identity of a second user who is not logged in and then accessing NIS+ objects with the second user's NIS+ access privileges.

Once a server authenticates a principal, the principal is placed in one of four authorization classes. The server then checks the NIS+ object that the principal wants to access to see what activities that class of principal is authorized to perform. (See "NIS+ Authorization and Access—Introduction" on page 217 for further information on authorization.)

User and Machine Credentials

There are two basic types of principal, *users* and *machines,* and thus two different types of credentials:

- *User credentials.* When someone is logged in to an NIS+ client as a regular user, requests for NIS+ services include that person's *user* credentials.
- *Machine credentials.* When a user is logged in to an NIS+ client as superuser, request for services use the *client machine's* credentials.

DES versus LOCAL Credentials

NIS+ principals can have two types of credential: DES and LOCAL.

DES Credentials

Note – DES credentials are only one method of achieving authentication. In the future, other methods may be available. Thus, do not equate DES credentials with NIS+ credentials.

In this document, the term DES credentials is used generically to denote a Diffie-Hellman key based authentication, regardless of key length. The system allows you to specify the key length from a pre-determined set. Use `nisauthconf`(1M) to set or display the Diffie-Hellman key length.

DES (Data Encryption Standard) credentials are the type of credential that provide secure authentication. When this guide refers to NIS+ checking a credential to authenticate an NIS+ principal, it is the DES credential that NIS+ is validating.

Each time a principal requests an NIS+ service or access to an NIS+ object, the software uses the credential information stored for that principal to generate a

credential for that principal. DES credentials are generated from information created for each principal by an NIS+ administrator, as explained in Chapter 12.

- When the validity of a principal's DES credential is confirmed by NIS+, that principal is *authenticated*.
- A principal must be authenticated in order to be placed in the owner, group, or world authorization classes. In other words, you must have a valid DES credential in order to be placed in one of those classes. (Principals who do not have a valid DES credential are automatically placed in the nobody class.)
- DES credential information is always stored in the cred table of the principal's home domain, regardless of whether that principal is a client user or a client machine.

LOCAL Credentials

LOCAL credentials are simply a map between a user's User ID number and NIS+ principal name which includes their home domain name. When users log in, the system looks up their LOCAL credential, which identifies their home domain where their DES credential is stored. The system uses that information to get the user's DES credential information.

When users log in to a remote domain, those requests use their LOCAL credential which points back to their home domain; NIS+ then queries the user's home domain for that user's DES credential information. This allows a user to be authenticated in a remote domain even though the user's DES credential information is not stored in that domain.

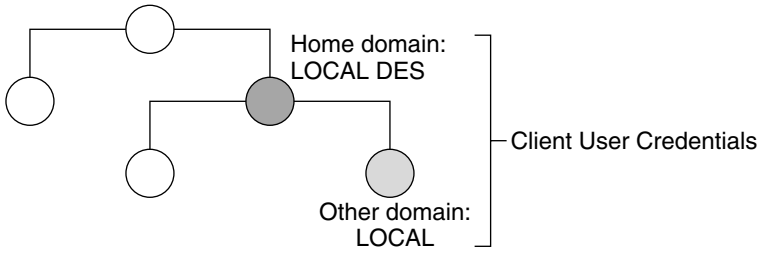


FIGURE 11–3 Credentials and Domains

LOCAL credential information can be stored in any domain. In fact, in order to log into a remote domain and be authenticated, a client user *must* have a LOCAL credential in the cred table of the remote domain. If a user does not have a LOCAL credential in a remote domain the user is trying to access, NIS+ will be unable to locate the user's home domain to obtain the user's DES credential. In such a case the user would not be authenticated and would be placed in the nobody class.

User Types and Credential Types

A user can have both types of credentials, but a machine can only have DES credentials.

Root cannot have NIS+ access, as root, to other machines because the root UID of every machine is always zero. If root (UID=0) of machine A tried to access machine B as root, that would conflict with machine B's already existing root (UID=0). Thus, a LOCAL credential doesn't make sense for a client *machine*; so it is allowed only for a client *user*.

TABLE 11–2 Types of Credentials

Type of Credential	Client User	Client machine
DES	Yes	Yes
LOCAL	Yes	No

NIS+ Authorization and Access—Introduction

The basic purpose of NIS+ authorization is to specify the access rights that each NIS+ principal has for each NIS+ object and service.

Once the principal making an NIS+ request is authenticated, NIS+ places them in an authorization class. The access rights (permissions) that specify which activities a principal may do with a given NIS+ object are assigned on a class basis. In other words, one authorization class may have certain access rights while a different class has different rights.

- *Authorization classes.* There are four authorization classes: owner, group, world, and nobody. (See "Authorization Classes" on page 217 below for details.)
- *Access rights.* There are four types of access rights (permissions): create, destroy, modify, and read. (See " NIS+ Access Rights" on page 221 for details.)

Authorization Classes

NIS+ objects do not grant access rights directly to NIS+ principals. Instead, they grant access rights to four *classes of principal*:

- *Owner.* The principal who happens to be the object's owner gets the rights granted to the owner class.
- *Group.* Each NIS+ object has one group associated with it. The members of an object's group are specified by the NIS+ administrator. The principals who belong to the object's group class get the rights granted to the group class. (In this context, *group* refers to NIS+ groups, not UNIX or net groups.)
- *World.* The world class encompasses all NIS+ principals that a server has been able to authenticate. (That is, everyone who has been authenticated but who is not in either the owner or group classes.)
- *Nobody.* Everyone belongs to the nobody class even those who are not authenticated.

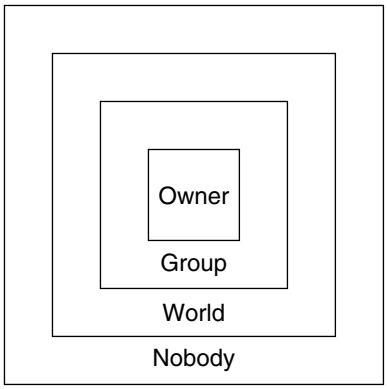


FIGURE 11–4 Authorization Classes

For any NIS+ request, the system determines which class the requesting principal belongs to and the principal then can use whatever access rights belonging to that class.

An object can grant any combination of access rights to each of these classes. Normally, however, a higher class is assigned the same rights as all the lower classes, plus possible additional rights.

For instance, an object could grant read access to the nobody and world classes; both read and modify access to the group class; and read, modify, create, and destroy access to the owner class.

The four classes are described in detail below.

The Owner Class

The owner is a *single* NIS+ principal.

A principal making a request for access to an NIS+ object must be authenticated (present a valid DES credential) before being granted owner access rights.

By default, an object's owner is the principal that created the object. However, an object's owner can cede ownership to another principal in two ways:

- One way is for the principal to specify a different owner at the time the object is created (see "Specifying Access Rights in Commands" on page 276).
- A second way is for the principal to change the ownership of the object after it is created (see "Changing Ownership of Objects and Entries" on page 287).

Once a principal gives up ownership, that principal gives up all owner's access rights to the object and keeps only the rights the object assigns to either the group, the world, or nobody.

The Group Class

The object's group is a *single* NIS+ group. (In this context, *group* refers to NIS+ groups, not UNIX or net groups.)

A principal making a request for access to an NIS+ object must be authenticated (present a valid DES credential) and belong to the group before being granted group access rights.

An NIS+ group is a collection of NIS+ principals, grouped together as a convenience for providing access to the namespace. The access rights granted to an NIS+ group apply to all the principals that are members of that group. (An object's owner, however, does not need to belong to the object's group.)

When an object is created it may be assigned a default group. A nondefault group can be specified for an object when it is created or later. An object's group may be changed at any time.

Note – Information about NIS+ groups is not stored in the NIS+ `group` table. The `group` table stores information about UNIX groups. Information about NIS+ groups is stored in the appropriate `groups_dir` directory object.

Information about NIS+ groups is stored in NIS+ group *objects*, under the `groups_dir` subdirectory of every NIS+ domain:

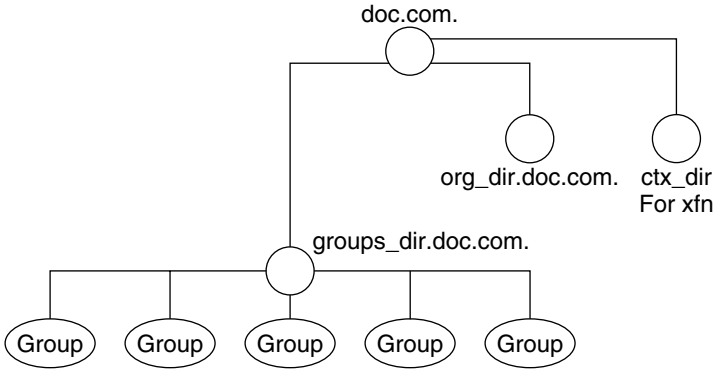


FIGURE 11–5 NIS+ Directory Structure

Instructions for administering NIS+ groups are provided in Chapter 17.

The World Class

The world class contains all NIS+ principals that are authenticated by NIS+. In other words, the world class includes everyone in the owner and group class, plus everyone else who presents a valid DES credential.

Access rights granted to the world class apply to all authenticated principals.

The Nobody Class

The nobody class is composed of anyone who is not properly authenticated. In other words, the nobody class includes everyone who does not present a valid DES credential.

Authorization Classes and the NIS+ Object Hierarchy

There is a hierarchy of NIS+ objects and authorization classes that can apply independently to each level. The standard default NIS+ directory hierarchy is:

- *Directory level*. In each NIS+ domain there are two NIS+ directory objects: `groups_dir` and `org_dir`. Each `groups_dir` directory object contains various groups. Each `org_dir` directory object contains various tables.
- *Group level or table level*. Groups contain individual entries and possibly other groups. Tables contain both columns and individual entries.
- *Column level*. A given table will have one or more columns.

- *Entry (row) level*. A given group or table will have one or more entries.

The four authorization classes apply at each level. Thus, a directory object will have its own owner and group. The individual tables within a directory object will have their own individual owners and groups which may be different than the owner and group of the directory object. Within a table, an entry (row) may have its own individual owner or group which may be different than the owner and group of the table as a whole or the directory object as a whole. Within a table, individual columns have the same owner and group as the table as a whole.

NIS+ Access Rights

NIS+ objects specify their access rights as part of their object definitions. (You can examine these by using the `niscat -o` command, described on page 172.)

NIS+ objects specify access rights for NIS+ principals in the same way that UNIX files specify permissions for UNIX users. Access rights specify the types of operations that NIS+ principals are allowed to perform on NIS+ objects.

NIS+ operations vary among different types of objects, but they all fall into one of the four access rights categories: read, modify, create, and destroy.

- *Read* A principal with read rights to an object can view the contents of that object.
- *Modify.* A principal with modify rights to an object can change the contents of that object.
- *Destroy.* A principal with destroy rights to an object can destroy or delete the object.
- *Create.* A principal with create rights to a higher level object can create new objects within that level. In other words, if you have create rights to an NIS+ directory object, you can create new tables within that directory. If you have create rights to an NIS+ table, you can create new columns and entries within that table.

Every communication from an NIS+ client to an NIS+ server is, in effect, a request to perform one of these operations on a specific NIS+ object. For instance, when an NIS+ principal requests the IP address of another machine, it is effectively requesting read access to the *hosts* table object, which stores that type of information. When a principal asks the server to add a directory to the NIS+ namespace, it is actually requesting *modify* access to the directory's parent object.

Keep in mind that these rights logically evolve down from directory to table to table column and entry levels. For example, to create a new table, you must have create rights for the NIS+ directory object where the table will be stored. When you create that table, you become its default owner. As owner, you can assign yourself create rights to the table which allows you to create new entries in the table. If you create new entries in a table, you become the default owner of those entries. As table owner, you can also grant table-level create rights to others. For example, you can give your table's group class table-level create rights. In that case, any member of the table's

group can create new entries in the table. The individual member of the group who creates a new table entry becomes the default owner of that entry.

The NIS+ Administrator

An NIS+ administrator is anyone who has *administrative rights* over an NIS+ object. For the purpose of this discussion, administrative rights are defined as create, destroy, and for some objects, modify rights. (See " NIS+ Access Rights" on page 221 for a description of NIS+ access rights.)

Whoever creates an NIS+ object sets the initial access rights to that object. If the creator restricts administrative rights to the object's owner (initially the creator), than only the owner has administrative power over that object. On the other hand, if the creator grants administrative rights to the object's group, then everyone in that group has administrative power over that object.

Thus, who ever has administrative rights over an object is considered to be an NIS+ administrator for that object.

In other words, the NIS+ software does not enforce any requirement that there be a single NIS+ administrator.

Theoretically, you could grant administrative rights to the world class, or even the nobody class. The software allows you to do that. But granting administrative rights beyond the group class effectively nullifies NIS+ security. Thus, if you grant administrative rights to either the World or the nobody class you are, in effect, defeating the purpose of NIS+ security.

NIS+ Password, Credential, and Key Commands

Use the following commands to administer passwords, credentials, and keys (see the appropriate man pages for a full description of each command):

- `chkey`. Changes a principal's Secure RPC key pair. Do not use `chkey` unless necessary, use `passwd` instead. See "Changing Keys for an NIS+ Principal" on page 250 for more information.
- `keylogin`. Decrypts and stores a principal's secret key with the `keyserv`.

- `keylogout`. Deletes stored secret key from `keyserv`.
- `keyserv`. Enables the server for storing private encryption keys. See "Keylogin" on page 249 for more information.
- `newkey`. Creates a new key pair in public-key database.
- `nisaddcred`. Creates credentials for NIS+ principals. See "Creating Credential Information" on page 238 and "Administering NIS+ Credential Information" on page 246 for more information.
- `nisauthconf`. Display or set the Diffie-Hellman key length.
- `nisupdkeys`. Updates public keys in directory objects. See "Updating Public Keys" on page 255 for more information.
- `passwd`. Changes and administers principal's password. See Chapter 16 for more information.

CHAPTER 12

Administering NIS+ Credentials

This chapter describes NIS+ credentials and how to administer them.

Note – Some NIS+ security tasks can be performed more easily with Solstice AdminSuite tools if you have them available.

NIS+ Credentials

NIS+ credentials are used to identify NIS+ users. This chapter assumes that you have an adequate understanding of the NIS+ security system in general, and in particular of the role that credentials play in that system.

For a complete description of NIS+ credential-related commands and their syntax and options, see the NIS+ man pages.

Note – The description of DES credentials in this chapter is applicable to 192–bit Diffie-Hellman DES credentials. While similar, authentication using other key lengths differs in details. When the command line interface is used to manipulate the keys, the differences are transparent to both the user and the system administrator. Use `nisauthconf`(1M) to display or set the prescribed key lengths.

How Credentials Work

Note – Some NIS+ security tasks can be performed more easily with Solstice AdminSuite tools, if you have them available.

The credential/authentication system prevents someone from assuming some other user's identity. That is, it prevents someone with root privileges on one machine from using the `su` command to assume the identity of a second user who is either not logged in at all or logged in on another machine and then accessing NIS+ objects with the second user's NIS+ access privileges.

Caution – NIS+ cannot prevent someone who knows another user's login password from assuming that other user's identity and the other user's NIS+ access privileges. Nor can NIS+ prevent a user with root privileges from assuming the identity of another user who is currently logged in on the *same* machine.

See Chapter 6, Security Overview, for a description of how NIS+ credentials and authentication work with authorization and access rights to provide security for the NIS+ namespace.

Credential Versus Credential Information

To understand how DES credentials are created and how they work, you need to distinguish between the credential itself and the information that is used to create and verify it.

- *Credential information:* The data that is used to generate a DES credential and by the server to verify that credential.
- *DES credential*: The bundle of numbers that is sent by the principal to the server to authenticate the principal. A principal's credential is generated and verified each

time the principal makes an NIS+ request. See "The DES Credential in Detail" on page 231 for a detailed description of the DES credential.

Authentication Components

In order for the credential/authentication process to work the following components must be in place:

- *Principal's DES credential information*. This information is initially created by an NIS+ administrator for each principal. It is stored in the cred table of the principal's home domain. A principal's DES credential information consists of:
  - *Principal name.* This would be a user's fully qualified login ID or a machine's fully qualified host name.
  - *Principal's Secure RPC netname.* Each principal has a unique Secure RPC netname. (See "DES Credential Secure RPC Netname" on page 231 for more information on Secure RPC netnames.)
  - *Principal's public key*.
  - *Principal's encrypted private key*.
- *Principal's LOCAL credential*
- *Server's public keys*. Each directory object stores copies of the public keys of all the servers in that domain. Note that each server's DES credentials are also stored in the cred table.
- *Keyserver copy of principal's private key*. The keyserver has a copy of the private key of the principal that is currently logged in (user or machine).

How Principals Are Authenticated

There are three phases to the authorization process:

- *Preparation phase.* This consists of the setup work performed by an NIS+ administrator prior to the user logging in; for example, creating credential information for the user.
- *Login phase*. This consists of the actions taken by the system when a user logs in.
- *Request phase*. This consists of the actions taken by the software when an NIS+ principal makes a request for an NIS+ service or access to an NIS+ object.

These three phases are described in detail in the following subsections.

Credentials Preparation Phase

The easiest way for an NIS+ administrator to create credential information for users is to use the `nisclient` script.. This section describes how to create client information using the NIS+ command set.

Prior to an NIS+ principal logging in, an NIS+ administrator must create DES credential information for that principal (user or machine). The administrator must:

- Create a public key and an encrypted private key for each principal. These keys are stored in the principal's home domain cred table. This can be done with the `nisaddcred` command as described in "Creating Credential Information for NIS+ Principals" on page 242.
- Create server public keys. (See "Updating Public Keys" on page 255.)

Login Phase—Detailed Description

When a principal logs into the system the following steps are automatically performed:

1. The `keylogin` program is run for the principal. The `keylogin` program gets the principal's encrypted private key from the cred table and decrypts it using the principal's login password.

Note – When a principal's login password is different from his or her Secure RPC password, `keylogin` cannot decrypt it and the user starts getting "cannot decrypt" errors or the command fails without a message. For a discussion of this problem, see "Secure RPC Password Versus Login Password Problem" on page 234.

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1. The principal's decrypted private key is passed to the keyserver which stores it for use during the request phase.

Note – The decrypted private key remains stored for use by the keyserver until the user does an explicit `keylogout`. If the user simply logs out (or goes home for the day without logging out), the decrypted private key remains stored in the server. If someone with root privileges on a user's machine switched to the user's login ID, that person would then have use of the user's decrypted private key and could access NIS+ objects using the user's access authorization. Thus, for added security, users should be cautioned to perform an *explicit* `keylogout` when they cease work. If they also log out of the system, all they need do is log back in when they return. If they do not explicitly log out, they will have to perform an explicit `keylogin` when they return to work.

Request Phase—Detailed Description

Every time an NIS+ principal requests access to an NIS+ object, the NIS+ software performs a multistage process to authenticate that principal:

1. NIS+ checks the cred table of the object's domain. If:
   - The principal has LOCAL credential information, NIS+ uses the domain information contained in the LOCAL credential to find the principal's home domain cred table where it obtains the information it needs.
   - The principal has no credential information, the rest of the process is aborted and the principal is given the authorization access class of nobody.
2. NIS+ gets the user's DES credential from the cred table of the user's home domain. The encrypted private key is decrypted with the user's password and saved by the keyserver.
3. NIS+ obtains the server's public key from the NIS+ directory object.
4. The keyserver takes the principal's decrypted private key and the public key of the object's server (the server where the object is stored) and uses them to create a *common key*.
5. The common key is then used to generate an encrypted *DES key*. To do this, Secure RPC generates a random number which is then encrypted using the common key. For this reason, the DES key is sometimes referred to as the *random key* or the *random DES key*.
6. NIS+ then takes the current time of the principal's server and creates a time stamp that is encrypted using the DES key.
7. NIS+ then creates a 15-second window, which is encrypted with the DES key. This *window* is the maximum amount of time that is permitted between the time stamp and the server's internal clock.
8. NIS+ then forms the principal's DES credential, which is composed of the following:

- The principal's Secure RPC netname (`unix.`*identifier@domain*) from the principal's cred table.
- The principal's encrypted DES key from the keyserver
- The encrypted time stamp
- The encrypted window

9. NIS+ then passes the following information to the server where the NIS+ object is stored:
   - The access request (whatever it might be)
   - The principal's DES credential
   - Window verifier (encrypted), which is the encrypted window plus one
10. The object's server receives this information.
11. The object's server uses the Secure RPC netname portion of the credential to look up the principal's public key in the cred table of the principal's home domain.
12. The server then uses the principal's public key and the server's private key to regenerate the common key. This common key must match the common key that was generated by the principal's private key and the server's public key.
13. The common key is used to decrypt the DES key that arrived as part of the principal's credential.
14. The server decrypts the principal's time stamp with the newly decrypted DES key and verifies it with the window verifier.
15. The server then compares the decrypted and verified time stamp with the server's current time and proceeds as follows:
    a. If the time difference at the server *exceeds* the window limit, the request is denied and the process aborts with an error message. For example, suppose the time stamp is 9:00am and the window is one minute. If the request is received and decrypted by the server after 9:01am, it is denied.
    b. If the time stamp is within the window limit, the server checks to see if the time stamp is *greater* than the one previously received from the principal. This ensures that NIS+ requests are handled in the correct order.
       - Requests received out of order are rejected with an error message. For example, if the time stamp is 9:00am and the most recently received request from this principal had a time stamp of 9:02am, the request would be rejected.
       - Requests that have a time stamp equal to the previous one are rejected with an error message. This ensures that a replayed request is not acted on twice. For example, if the time stamp is 9:00am and the most recently received request from this principal also had a time stamp of 9:00am, this request would be rejected.
16. If the time stamp is within the window limit, and greater than the previous request from that principal, the server accepts the request.

17. The server then complies with the request and stores the time stamp from this principal as the most recently received and acted on request.
18. To confirm to the principal that the information received from the server in answer to the request comes from a trusted server, the server encrypts the time stamp with the principal's DES key and sends it back to the principal along with the data.
19. At the principal's end, the returned time stamp is decrypted with the principal's DES key.
    - If the decryption succeeds, the information from the server is returned to the requester.
    - If the decryption fails for some reason, an error message is displayed.

The DES Credential in Detail

The DES credential consists of:

- The principal's *Secure RPC netname* (see "DES Credential Secure RPC Netname" on page 231).
- A *verification* field (see "DES Credential Verification Field" on page 232).

DES Credential Secure RPC Netname

- *Secure RPC netname*. This portion of the credential is used to identify the NIS+ principal. Every Secure RPC netname contains three components:
    - *Prefix*. The prefix is always the word `unix`.
    - *Identifier*. If the principal is a client user, the ID field is the user's UID. If the principal is a client machine, the ID field is the machine's hostname.
    - *Domain name*. The domain name is the name of the domain that contains the principal's DES credential (in other words, the principal's home domain).

Note – Remember that an NIS+ principal name *always* has a trailing dot, and a Secure RPC netname *never* has a trailing dot.

TABLE 12–1 Secure RPC Netname Format

Principal	Prefix	Identifie	Domain	Example
User	`unix`	UID	Domain containing user's password entry and the DES credential itself	unix.24601@sales.doc.com
machine	`unix`	hostname	The domain name returned by executing the domainname command on that machine	unix.machine7@sales.doc.com

DES Credential Verification Field

The verification field is used to make sure the credential is not forged. It is generated from the credential information stored in the cred table.

The verification field is composed of:

- The principal's encrypted DES key, generated from the principal's private key and the NIS+ server's public key as described in "Request Phase—Detailed Description" on page 229
- The encrypted time stamp
- The time window

How the DES Credential Is Generated

To generate its DES credential, the principal depends on the `keylogin` command, which must have been executed *before* the principal tries to generate its credential. The `keylogin` command (often referred to simply as a *keylogin*) is executed automatically when an NIS+ principal logs in. See .Figure 12–2

Note – Note that if the principal's login password is different from the principal's Secure RPC password, a successful keylogin cannot be performed. See "Secure RPC Password Versus Login Password Problem" on page 234 for a discussion of this situation.

The purpose of the keylogin is to give the principal access to the principal's private key. `keylogin` fetches the principal's private key from the cred table, decrypts it with the principal's *Secure RPC password* (remember that the private key was originally encrypted with the principal's Secure RPC password), and stores it locally with the keyserver for future NIS+ requests.

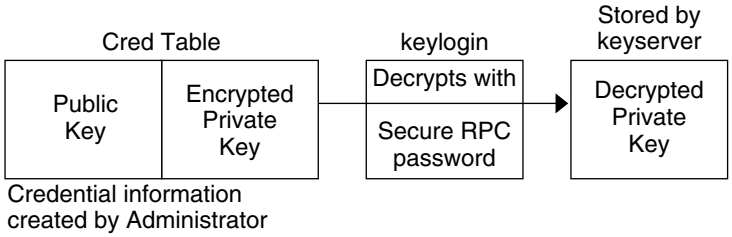


FIGURE 12–1 `keylogin` Generates a Principal's Private Key

To generate its DES credential, the principal still needs the public key of the server to which it will send the request. This information is stored in the principal's directory object. Once the principal has this information, it can form the verification field of the credential.

First, the principal generates a random DES key for encrypting various credential information. The principal uses its own private key (stored in the keyserver) and the server's public key to generate a common key that is used to generate and encrypt the random DES key. It then generates a time stamp that is encrypted with the DES key and combines it with other credential-related information into the verification field:

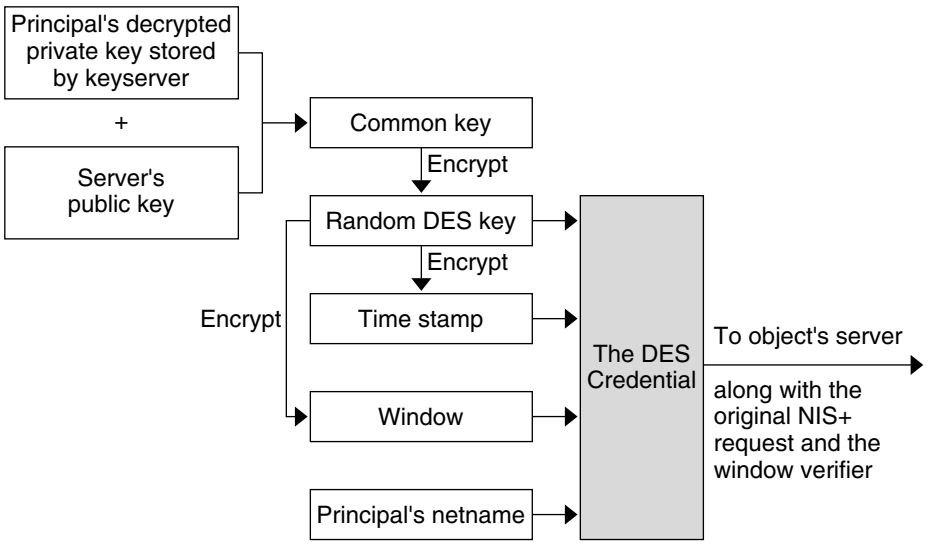


FIGURE 12–2 Creating the DES Credential

Secure RPC Password Versus Login Password Problem

When a principal's login password is different from his or her Secure RPC password, `keylogin` cannot decrypt it at login time because `keylogin` defaults to using the principal's login password, and the private key was encrypted using the principal's Secure RPC password.

When this occurs, the principal can log in to the system, but for NIS+ purposes the principal is placed in the authorization class of nobody because the keyserver does not have a decrypted private key for that user. Since most NIS+ environments are set up to deny the nobody class create, destroy, and modify rights to most NIS+ objects, this results in "permission denied" errors when the user tries to access NIS+ objects.

Note – In this context, *network password* is sometimes used as a synonym for *Secure RPC password*. When prompted for your "network password," enter your Secure RPC password.

To be placed in one of the other authorization classes, a user in this situation must explicitly run the `keylogin` program and give the principal's Secure RPC password when `keylogin` prompts for a password. (See "Keylogin" on page 249.)

But an explicit `keylogin` provides only a temporary solution that is good only for the current login session. The keyserver now has a decrypted private key for the user, but the private key in the user's cred table is still encrypted using the user's Secure RPC password, which is different than the user's login password. The next time the user logs in, the same problem recurs. To permanently solve the problem the user needs to re-encrypt the private key in the cred table to one based on the user's login ID rather than the user's Secure RPC password. To do this, the user needs to run `chkey -p` as described in "Changing Keys for an NIS+ Principal" on page 250.

Thus, to permanently solve problems related to a difference in Secure RPC password and login password, the user (or an administrator acting for the user) must perform these steps:

1. Log in using the login password.
2. Run the `keylogin` program to temporarily get a decrypted private key stored in the keyserver and thus gain temporary NIS+ access privileges.
3. Run `chkey -p` to permanently change the encrypted private key in the cred table to one based on the user's login password.
4. When you are ready to finish this login session, run `keylogout`.
5. Log off the system with `logout`.

Cached Public Keys Problems

Occasionally, you might find that even though you have created the proper credentials and assigned the proper access rights, some principal requests still get denied. The most common cause of this problem is the existence of stale objects with old versions of a server's public key. You can usually correct this problem by:

- Running `nisupdkeys` on the domain you are trying to access. (See "The `nisupdkeys` Command" on page 255 for information on using the `nisupdkeys` command and "Stale and Outdated Credential Information" on page 448 for information on how to correct this type of problem.)
- Killing the `nis_cachmgr` on your machine, removing `/var/nis/NIS_SHARED_DIRCACHE`, and then restarting `nis_cachemgr`.

Where Credential-Related Information Is Stored

This section describes where credential-related information is stored throughout the NIS+ namespace.

Credential-related information, such as public keys, is stored in many locations throughout the namespace. NIS+ updates this information periodically, depending on the time-to-live values of the objects that store it, but sometimes, between updates, it gets out of sync. As a result, you may find that operations that should work, do not. lists all the objects, tables, and files that store credential-related information and how to reset it.

TABLE 12–2 Where Credential-Related Information Is Stored

Item	Stores	To Reset or Change
cred table	NIS+ principal's public key and private key. These are the master copies of these keys.	Use `nisaddcred` to create new credentials; it updates existing credentials. An alternative is `chkey`.
directory object	A copy of the public key of each server that supports it.	Run the `/usr/lib/nis/nisupdkeys` command on the directory object.
keyserver	The secret key of the NIS+ principal that is currently logged in.	Run `keylogin` for a principal user or `keylogin -r`for a principal machine.
NIS+ daemon	Copies of directory objects, which in turn contain copies of their servers' public keys.	Kill the `rpc.nisd` daemon and the cache manager and remove `NIS_SHARED_DIRCACHE` from `/var/nis`. Then restart both.
Directory cache	A copy of directory objects, which in turn contain copies of their servers' public keys.	Kill the NIS+ cache manager and restart it with the `nis_cachemgr -i` command. The `-i` option resets the directory cache from the cold-start file and restarts the cache manager.

TABLE 12–2 Where Credential-Related Information Is Stored *(Continued)*

Item	Stores	To Reset or Change
cold-start file	A copy of a directory object, which in turn contains copies of its servers' public keys.	On the root master, kill the NIS+ daemon and restart it. The daemon reloads new information into the existing `NIS_COLD_START` file. On a client machine, first remove the `NIS_COLD_START` and `NIS_SHARED_DIRCACHE` files from `/var/nis`, and kill the cache manager. Then re-initialize the principal with `nisinit -c`. The principal's trusted server reloads new information into the machine's `NIS_COLD_START` file.
`passwd` table	A user's password.	Use the `passwd -r nisplus` command. It changes the password in the NIS+ passwd table and updates it in the cred table.
`passwd` file	A user's password or a machine's superuser password.	Use the `passwd -r nisplus` command, whether logged in as super user or as yourself, whichever is appropriate.
`passwd` map (NIS)	A user's password	Use the `passwd -r nisplus` command.

The `cred` Table in Detail

Credential information for principals is stored in a *cred table*. The `cred` table is one of the 16 standard NIS+ tables. Each domain has one `cred` table, which stores the credential information of client machines that belong to that domain and client users who are allowed to log into them. (In other words, the principals of that domain.) The `cred` tables are located in their domains' `org_dir` subdirectory.

Caution – Never link a `cred` table. Each `org_dir` directory must have its own cred table. Never use a link to some other `org_dir` cred table.

For users, the `cred` table stores LOCAL credential information for all users who are allowed to log into any of the machines in the domain. The `cred` table also stores DES credential information for those users that have the domain as their home domain.

You can view the contents of a `cred` table with the `niscat` command, described in Chapter 19.

The `cred` table as shown in Table 12–3 has five columns:

TABLE 12–3 `cred` Table Credential Information

	NIS+ Principal Name	Authentication Type	Authentication Name	Public Data	Private Data
Column Name	cname	auth_type	auth_name	public_data	private_data
User	Fully qualified principal name	LOCAL	UID	GID list	
Machine	Fully qualified principal name	DES	Secure RPC netname	Public key	Encrypted Private key

The Authentication Type column, determines the types of values found in the other four columns.

- *LOCAL*. If the authentication type is LOCAL, the other columns contain a principal user's name, UID, and GID; the last column is empty.
- *DES*. If the authentication type is DES, the other columns contain a principal's name, Secure RPC netname, public key, and encrypted private key. These keys are used in conjunction with other information to encrypt and decrypt a DES credential.

Creating Credential Information

There are several methods of creating and administering credential information:

- Use Solstice AdminSuite tools if you have them available. They provide easier methods of credential administration and are recommended for administering individual credentials.
- Use the `nisclient` script. This is another easy method of creating or altering credentials for a single principal. Because of its convenience, this is a recommended method of administering individual credentials. gives step by step instructions on using the `nisclient` script to create credential information.
- Use the `nispopulate` script. This is an easy method of creating or altering credentials for a one or more principals who already have information on them stored in NIS maps or `/etc` files. Because of its convenience, this is a recommended method of administering credentials for groups of NIS+ principals. For step by step instructions on using the `nispopulate` script to create credential information, see."Populating NIS+ Tables" on page 97

- Use the `nisaddcred` command. The section below describes how credentials and credential information are created using `nisaddcred`.

The `nisaddcred` Command

The command used to create credential information is `nisaddcred`.

Note – You can also use the `nispopulate` and `nisclient` scripts to create credential information. They, in turn, use the `nisaddcred` command. These scripts are much easier to use, and more efficient, than the `nisaddcred` command. Unless your network requires special features, you should use the scripts.

The `nisaddcred` command creates, updates, and removes LOCAL and DES credential information. To create credential information, you must have create rights to the proper domain's cred table. To update a credential, you must have modify rights to the cred table or, at least, to that particular entry in the cred table. To delete a credential, you must have destroy rights to the cred table or the entry in the cred table.

- To create or update credentials for another NIS+ principal, use:

  For LOCAL credentials

  ```
  nisaddcred -p uid -P principal-name local
  ```

  For DES credentials

  ```
  nisaddcred -p rpc-netname -P principal-name des
  ```

- To update your own credentials, use:

  For LOCAL credentials

  ```
  nisaddcred -local
  ```

  For DES credentials, use:

  ```
  nisaddcred des
  ```

- To remove credentials, use:

  ```
  nisaddcred -r principal-name
  ```

Related Commands

In addition to the `nisaddcred` command described in this chapter, two other commands can provide some useful information about credentials:

TABLE 12–4 Additional Credential-Related Commands

Command	Description	See
`niscat -o`	Lists a directory's properties. By looking in the public key field of the directory's server, you can tell whether the directory object is storing a public key.	"Listing the Object Properties of a Directory" on page 332
`nismatch-`	When run on the cred table, displays credential information for *principal*.	"The `nismatch` and `nisgrep` Commands" on page 370

How `nisaddcred` Creates Credential Information

Use `nisaddcred` to create LOCAL and DES credential information.

LOCAL Credential Information

When used to create LOCAL credential information, `nisaddcred` simply extracts the principal user's UID (and GID) from the principal's login record and places it in the domain's cred table.

DES Credential Information

When used to create DES credential information, `nisaddcred` goes through a two-part process:

1. Forming the principal's Secure RPC netname. A Secure RPC netname is formed by taking the principal's user ID number from the password record and combining it with the domain name (`unix.1050@doc.com`, for example).
2. Generating the principal's private and public keys.

To encrypt the private key, `nisaddcred` needs the principal's Secure RPC password. When the `nisaddcred` command is invoked with the `-des` argument, it prompts the principal for a Secure RPC password. Normally, this password is the same as the principal's login password. (If it is different, the user will have to perform additional steps when logging in, as described in "Secure RPC Password Versus Login Password Problem" on page 234.)

The `nisaddcred` command generates a pair of random, but mathematically related 192-bit authentication keys using the Diffie-Hellman cryptography scheme. These keys are called the Diffie-Hellman key-pair, or simply *key-pair* for short.

One of these is the *private key*, and the other is the *public key*. The public key is placed in the public data field of the cred table. The private key is placed in the private data field, but only after being encrypted with the principal's Secure RPC password:

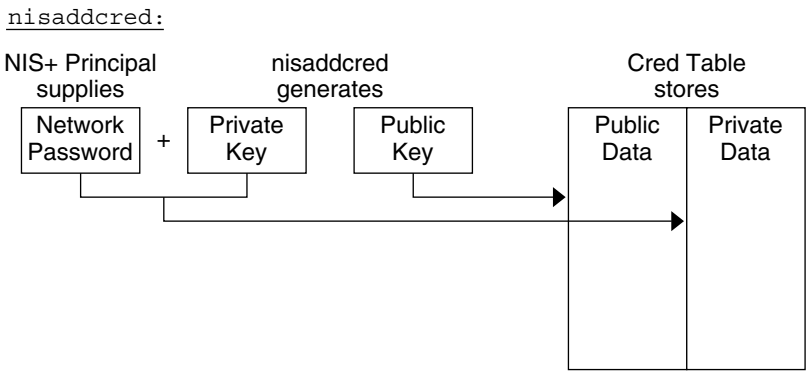


FIGURE 12–3 How nisaddcred Creates a Principal's Keys

The principal's private key is encrypted as a security precaution because the cred table, by default, is readable by all NIS+ principals, even unauthenticated ones.

The Secure RPC Netname and NIS+ Principal Name

When creating credential information, you will often have to enter a principal's *rpc-netname* and *principal-name*. Each has its own syntax:

- *Secure RPC netname*. A Secure RPC netname is a name whose syntax is determined by the Secure RPC protocol. Therefore, it does not follow NIS+ naming conventions:
  - For users, the syntax is: `unix.`*uid@domain*
  - For machines, the syntax is: `unix.`*hostname@domain*

  If a Secure RPC netname identifies a user, it requires the user's UID. If it identifies a machine, it requires the machine's host name. (When used with the `nisaddcred` command it is always preceded by the `-p` (lowercase) flag.)

  A Secure RPC netname always begins with the `unix` (all lowercase) prefix and ends with a domain name. However, because it follows the Secure RPC protocol, the domain name *does not* contain a trailing dot.
- *Principal name*. An NIS+ principal follows the normal NIS+ naming conventions, but it must always be fully qualified. the syntax is: *principal.domain*.

Whether it identifies a client user or a client machine, it begins with the principal's *name*, followed by a dot and the complete domain name, ending in a dot. (When used with `nisaddcred` to create credential information, it is always preceded by the `-P` (uppercase) flag. When used to remove credential information, it does not use the `-P` flag.)

Creating Credential Information for the Administrator

When a namespace is first set up, credential information is created first for the administrators who will support the domain. Once they have credential information, they can create credential information for other administrators, client machines, and client users.

When you try to create your own credential information, you run into a problem of circularity: you cannot create your own credential information unless you have Create rights to your domain's cred table, but if the NIS+ environment is properly set up, you cannot have such rights until you have credentials. You have to step out of the loop somehow. You can do this in one of two ways:

- By creating your credential information while logged in as superuser to your domain's master server
- By having another administrator create your credential information using a dummy password, then changing your password with the `chkey` command.

In either case, your credential information is thus created by another NIS+ principal. To create your own credential information, follow the instructions in "Creating Credential Information for NIS+ Principals" on page 242.

Creating Credential Information for NIS+ Principals

Credential information for NIS+ principals can be created any time after their domain has been set up; in other words, once a cred table exists.

To create credential information for an NIS+ principal:

- You must have Create rights to the cred table of the principal's home domain.
- The principal must be recognized by the server. This means that:
  - If the principal is a user, the principal must have an entry either in the domain's NIS+ passwd table or in the server's `/etc/passwd` file.

- If the principal is a machine, it must have an entry either in the domain's NIS+ Hosts table or in the server's

Once those conditions are met, you can use the `nisaddcred` command with both the `-p` and `-P` options:

For LOCAL credentials

```
nisaddcred -p uid -P principal-name local
```

For DES credentials

```
nisaddcred -p rpc.netname -P principal-name des
```

Remember these principles:

- You can create both LOCAL and DES credential information for a principal user.
- You can only create DES credential information for a principal machine.
- You can create DES credential information only in the principal's home domain (user or machine).
- You can create LOCAL credential information for a user in both the user's home domain and in other domains.

For User Principals—Example

This example creates both LOCAL and DES credential information for an NIS+ user named `morena` who has a UID of `11177`. She belongs to the `doc.com.` domain, so this example enters her credential information from a principal machine of that domain:

```
client# nisaddcred -p 11177 -P morena.doc.com. local
client# nisaddcred -p unix.11177@sales.doc.com \
   -P morena.doc.com. des
Adding key pair for unix.11177@sales.doc.com
   (morena.doc.com.).
Enter login password:
```

The proper response to the `Enter login password:` prompt is morena's login password. (If you don't know her login password, you can use a dummy password that she can later change using `chkey`, as described in the next example.)

Using a Dummy Password and `chkey`—Example

If you don't know the user's login password, you can use a dummy password as described below.

Table 12–5, shows how another administrator, whose credential information you create using a dummy password, can then use `chkey` to change his or her own password. In this example, you create credential information for an administrator named Eiji who has a UID of 119. Eiji, whose login ID is `eiji`, belongs to the root domain, so you would enter his credential information from the root master server which is named `rootmaster`.

TABLE 12–5 Creating Administrator Credentials: Command Summary

Tasks	Commands
Create LOCAL credential information for Eiji.	`rootmaster# nisaddcred -p 119 -P eiji.doc.com. local`
Create DES credential information for Eiji.	`rootmaster# nisaddcred -p unix.119@doc.com -P eiji.doc.com. des` `Adding key pair for unix.119@doc.com (eiji.doc.com.).`
Type dummy password for Eiji.	Enter eiji's login password: nisaddcred: WARNING: password differs from login passwd
Re-enter dummy password.	`Retype password:`
You tell Eiji the dummy password that you used.	
Eiji logs into rootmaster.	`rootmaster% login: eiji`
Eiji enters real login password.	`Password:`
Eiji gets error message but is allowed to log in anyway.	`Password does not decrypt secret key for unix.119@doc.com.`
Eiji runs keylogin.	`rootmaster% keylogin`
Eiji types dummy passwor	`Password:` *dummy-password*

Eiji runs `chkey`	`rootmaster% chkey -p`
	`Updating nisplus publickey database`
	`Generating new key for'unix.119@doc.com'.`

Eiji types real login password.	`Enter login password:`
Eiji re-types real login password.	Retype password: Done.

First, you would create Eiji's credential information in the usual way, but using a dummy login password. NIS+ would warn you and ask you to re-type it. When you did, the operation would be complete. The domain's cred table would contain Eiji's

credential information based on the dummy password. The domain's passwd table (or `/etc/passwd` file), however, would still have his login password entry so that he can log on to the system.

Then, Eiji would log in to the domain's master server, typing his *correct* login password (since the login procedure checks the password entry in the passwd table or `/etc/passwd` file). From there, Eiji would first run `keylogin`, using the dummy password (since a `keylogin` checks the cred table), and then use the `chkey -p` command to change the cred entry to the real thing.

Creating in Another Domain—Example

The two previous examples created credential information for a principal user while the principal user was logged in to the master server of the principal's home domain. However, if you have the proper access rights, you can create credential information in another domain. Simply append the domain name to this syntax:

For LOCAL credentials

`nisaddcred -p` *uid* `-P` *principal-name* `local` *domain-name*

For DES credentials

`nisaddcred -p` *rpc-netname* `-P` *principal-name* `des` *domain-name*

The following example first creates LOCAL and DES credential information for an administrator named Chou in her home domain, which happens to be the root domain, then adds her LOCAL credential information to the `doc.com` domain. Chou's UID is 11155. This command is typed on from the root master server. For simplicity, it assumes you are entering Chou's correct login password.

```
rmaster# nisaddcred -p 11155 -P chou.doc.com. local
rmaster# nisaddcred -p unix.11155@doc.com -P chou.doc.com. des
Adding key pair for unix.11155@doc.com (chou.doc.com.).
Enter login password:
rootmaster# nisaddcred -p 11155 -P chou.doc.com. local doc.com.
```

LOCAL credential information maps a UID to an NIS+ principal name. Although an NIS+ principal that is a client user can have different user IDs in different domains, it can have only one NIS+ principal name. So, if an NIS+ principal such as chou will be logging in from a domain other than her home domain, not only should she have a password entry in that domain, but also a LOCAL credential in that domain's cred table.

For machines—Example

This example creates credential information for a principal *machine*. Its host name is starshine1 and it belongs to the root domain. Therefore, its credential information is created from the root master server. In this example, you create them while logged in as root to the root master; however, if you already have valid credential information and the proper access rights, you could create them while logged in as yourself.

```
rootmaster# nisaddcred -p unix.starshine1@doc.com -P starshine1.doc.com. des
Adding key pair for unix.starshine1@doc.com
 (starshine1.doc.com.).
Enter starshine1.doc.com.'s root login password:
Retype password:
```

The proper response to the password prompt is the principal machine's superuser password. Of course, you could use a dummy password that would later be changed by someone logged in as superuser to that principal machine.

Administering NIS+ Credential Information

The following sections describe how to use the `nisaddcred` command to administer existing credential information. You must have create, modify, read, and destroy rights to the cred table to perform these operations.

Updating Your Own Credential Information

Updating your own credential information is considerably easier than creating it. Just type the simple versions of the `nisaddcred` command while logged in as yourself:

```
# nisaddcred des
# nisaddcred local
```

To update credential information for someone else, you simply perform the same procedure that you would use to create that person's credential information.

Removing Credential Information

The `nisaddcred` command removes a principal's credential information, but only from the local domain where the command is run.

Thus, to completely remove a principal from the entire system, you must explicitly remove that principal's credential information from the principal's home domain and all domains where the principal has LOCAL credential information.

To remove credential information, you must have modify rights to the local domain's cred table. Use the `-r` option and specify the principal with a full NIS+ principal name:

```
# nisaddcred -r principal-name
```

The following two examples remove the LOCAL and DES credential information of the administrator Morena.`doc.com.` The first example removes both types of credential information from her home domain (`doc.com.`), the second removes her LOCAL credential information from the `sales.doc.com.` domain. Note how they are each entered from the appropriate domain's master servers.

```
rootmaster# nisaddcred -r morena.doc.com.
salesmaster# nisaddcred -r morena.doc.com.
```

To verify that the credential information was indeed removed, run `nismatch` on the cred table, as shown below. For more information about `nismatch`, see Chapter 19.

```
rootmaster# nismatch morena.doc.com. cred.org_dir
salesmaster# nismatch morena.doc.com. cred.org_dir
```

CHAPTER 13

Administering NIS+ Keys

This chapter describes NIS+ keys and how to administer them.

Note – Some NIS+ security tasks can be performed more easily with Solstice AdminSuite tools if you have them available.

NIS+ Keys

NIS+ keys are used to encrypt NIS+ related information.

This chapter assumes that you have an adequate understanding of the NIS+ security system in general, and in particular of the role that keys play in that system (see Chapter 11, for this information).

For a complete description of NIS+ key-related commands and their syntax and options, see the NIS+ man pages. (The `nisaddcred` command also performs some key-related operations. See Chapter 12 for more information.)

Keylogin

When a principal logs in, the login process prompts for a password. That password is used to pass the user through the login security gate and give the user access to the network. The login process also decrypts the user's private key stored in the user's

home domain cred table and passes that private key to the keyserver. The keyserver then uses that decrypted private key to authenticate the user each time the user accesses an NIS+ object.

Normally, this is the only time the principal is asked to provide a password. However, if the principal's private key in the cred table was encrypted with a password that was *different* from the user's login password, `login` cannot decrypt it using the login password at login time, and thus cannot provide a decrypted private key to the keyserver. (This most often occurs when a user's private key in the cred table was encrypted with a Secure RPC password different from the user's login password.)

Note – In this context, *network password* is sometimes used as a synonym for *Secure RPC password*.

To temporarily remedy this problem, the principal must perform a keylogin, using the `keylogin` command, after every login. (The `-r` flag is used to keylogin the superuser principal and to store the superuser's key in `/etc/.rootkey` on a host.)

For a principal user

```
keylogin
```

For a principal machine (only once)

```
keylogin -r
```

Note, however, that performing an explicit keylogin with the original password provides only a temporary solution good for the current login session only. The private key in the cred table is still encrypted with a password different than the user's login password so the *next* time the user logs in the problem will reoccur. To permanently solve this problem, the user must run `chkey` to change the password used to encrypt the private key to the user's login password (see "Changing Keys for an NIS+ Principal" on page 250).

Changing Keys for an NIS+ Principal

The `chkey` command changes an NIS+ principal's public and private keys that are stored in the cred table. It does not affect the principal's entry either in the passwd table or in the `/etc/passwd` file.

The `chkey` command:

- Generates new keys and encrypts the private key with the password. Run `chkey` with the `-p` option to re-encrypt the existing private key with a new password.

- Generates a new Diffie-Hellman key pair and encrypts the private key with the password you provide. (Multiple Diffie-Hellman key pairs can exist for each principal.) In most cases, however, you do not want a new keypair, you want to re-encrypt your *current* existing private key with the new password. To do this, run `chkey` with the `-p` option.

See the man pages for more information on these subjects.

Note – In an NIS+ environment, when you change your login password with any of the current administration tools or the `passwd` (or `nispasswd`) commands, your private key in the cred table is automatically re-encrypted with the new password for you. Thus, you do not need to explicitly run `chkey` after a change of login password.

The `chkey` command interacts with the keyserver, the cred table, and the passwd table. In order to run `chkey`, you:

- Must have an entry in the passwd table of your home domain. Failure to meet this requirement will result in an error message.
- Must run `keylogin` to make sure that the keyserver has a decrypted private key for you.
- Must have modify rights to the cred table. If you do not have modify rights you will get a "permission denied" type of error message.
- Must know the original password with which the private key in the cred table was encrypted. (In most cases, this your Secure RPC password.)

To use the `chkey` command to re-encrypt your private key with your login password, you first run `keylogin` using the original password, and then use `chkey -p`, as shown in Table 13–1 ,which illustrates how to perform a `keylogin` and `chkey` for a principal user:

TABLE 13–1 Re-encrypting Your Private Key : Command Summary

Tasks	Commands
Log in.	`Sirius% login` *Login-name*
Provide login password.	`Password:`
If login password and Secure RPC password are different, perform a `keylogin`.	`Sirius% keylogin`
Provide the original password that was used to encrypt the private key.	`Password:` *Secure RPC password*
Run `chkey`.	Sirius% `chkey -p` Updating nisplus publickey database Updating new key for 'unix.1199@Doc.com'.

TABLE 13–1 Re-encrypting Your Private Key : Command Summary *(Continued)*

Tasks	Commands
Enter login password.	`Enter login password:` *login-password*
Re-enter login password	`Retype password:`

Changing the Keys

The following sections describe how to change the keys of an NIS+ principal.

Note – Whenever you change a server's keys, you must also update the key information of all the clients in that domain as explained in "Updating Client Key Information" on page 257.

Changing Root Keys From Root

Table 13–2, shows how to change the keys for the root master server from the root master (as root):

TABLE 13–2 Changing a Root Master's Keys: Command Summary

Tasks	Commands
Create new DES credentials	rootmaster# nisaddcred des
Find the Process ID of `rpc.nisd`	`rootmaster# ps -e | grep rpc.nisd`
Kill the NIS+ daemon	`rootmaster# kill` *pid*
Restart NIS+ daemon with no security	`rootmaster# rpc.nisd -S0`
Perform a keylogout (previous keylogin is now out of date).	`rootmaster# keylogout -f`
Update the keys in the directories served by the master	`rootmaster# nisupdkeys` *dirs*
Find the Process ID of `rpc.nisd`	`rootmaster# ps -e | grep rpc.nisd`
Kill the NIS+ daemon	`rootmaster# kill` *pid*
Restart NIS+ daemon with default security	`rootmaster# rpc.nisd`
Perform a keylogin	`rootmaster# keylogin`

Where:

- *pid* is the process ID number reported by the `ps -e | grep rpc.nisd` command.
- *dirs* are the directory objects you wish to update. (That is, the directory objects that are served by `rootmaster`.)

In the first step of the process outlined in Table 13–2, `nisaddcred` updates the cred table for the root master, updates `/etc/.rootkey` and performs a keylogin for the root master. At this point the directory objects served by the master have not been updated and their credential information is now out of synch with the root master. The subsequent steps described in Table 13–2 are necessary to successfully update all the objects.

Note – Whenever you change a server's keys, you must also update the key information of all the clients in that domain as explained in "Updating Client Key Information" on page 257.

Changing Root Keys From Another Machine

To change the keys for the root master server from some other machine you must have the required NIS+ credentials and authorization to do so.

TABLE 13–3 Remotely Changing Root Master Keys: Command Summary

Tasks	Commands
Create the new DES credentials	`othermachine% nisaddcred -p` *principal* `-P` *nisprincipal* `des`
Update the directory objects.	`othermachine% nisupdkeys` *dirs*
Update `/etc.roootkey.`	`othermachine% keylogin -r`
Reinitialize othermachine as client	`othermachine% nisinit -cH`

Where:

- *principal* is the root machine's Secure RPC netname. For example: `unix.rootmaster@doc.com` (no dot at the end).
- *nis-principal* is the root machine's NIS+ principal name. For example, `rootmaster.doc.com.` (a dot at the end).
- *dirs* are the directory objects you want to update (that is, the directory objects that are served by `rootmaster`).

When running `nisupdkeys` be sure to update all relevant directory objects at the same time. In other words, do them all with one command. Separate updates may result in an authentication error.

Note – Whenever you change a server's keys, you must also update the key information of all the clients in that domain as explained in "Updating Client Key Information" on page 257.

Changing the Keys of a Root Replica From the Replica

To change the keys of a root replica from the replica, use these commands:

```
replica# nisaddcred des
replica# nisupdkeys dirs
```

Where:

- *dirs* are the directory objects you wish to update, (that is, the directory objects that are served by `replica`).

When running `nisupdkeys` be sure to update all relevant directory objects at the same time. In other words, do them all with one command. Separate updates may result in an authentication error.

Note – Whenever you change a server's keys, you must also update the key information of all the clients in that domain as explained in "Updating Client Key Information" on page 257.

Changing the Keys of a Nonroot Server

To change the keys of a nonroot server (master or replica) from the server, use these commands:

```
subreplica# nisaddcred des
subreplica# nisupdkeys parentdir dirs
```

Where:

- *parentdir* is the non-root server's parent directory (that is, the directory containing `subreplica`'s NIS+ server).
- *dirs* are the directory objects you want to update (that is, the directory objects that are served by `subreplica`).

When running `nisupdkeys` be sure to update all relevant directory objects at the same time. In other words, do them all with one command. Separate updates may result in an authentication error.

Note – Whenever you change a server's keys, you must also update the key information of all the clients in that domain, as explained in "Updating Client Key Information" on page 257.

Updating Public Keys

The public keys of NIS+ servers are stored in several locations throughout the namespace. When new credential information is created for the server, a new key pair is generated and stored in the cred table. However, namespace directory objects still have copies of the server's *old* public key. The `nisupdkeys` command is used to update those directory object copies.

The `nisupdkeys` Command

If a new keypair is generated because the old key pair has been compromised or the password used to encrypt the private key is forgotten, the `nisupdkeys` can be used to update the old public key in the directory objects.

The `nisupdkeys` command can:

- Update the key of one particular server
- Update the keys of all the servers that support an NIS+ directory object
- Remove a server's public key from the directory object
- Update a server's IP address, if that has changed

However, `nisupdkeys` cannot update the `NIS_COLD_START` files on the principal machines. To update their copies of a server's keys, NIS+ clients should run the `nisclient` command. Or, if the NIS+ cache manager is running and more than one server is available in the coldstart file, the principals can wait until the time-to-live expires on the directory object. When that happens, the cache manager automatically updates the cold-start file. The default time-to-live is 12 hours.

To use the `nisupdkeys` command, you must have modify rights to the NIS+ directory object.

Updating Public Keys Arguments and Examples

The `nisupdkeys` command is located in `/usr/lib/nis`. The `nisupdkeys` command uses the following arguments (for a complete description of the `nisupdkeys` command and a full list of all its arguments, see the `nisupdkeys` man page):

TABLE 13–4 `nisupdkeys` Arguments

Argument	Effect
(no argument)	Updates all keys of servers for current domain
directoryname	Updates the keys of the directory object for the named directory.
`-H` *servername*	Updates the keys of the named server for the current domain directory object. A fully qualified host name can be used to update the keys of servers in other domains.
`-s -H` *servername*	Updates the keys of all the directory objects served by the named server.
`-C`	Clears the keys.

Table 13–5 gives an example of updating a public key:

TABLE 13–5 Updating a Public Key: Command Examples

Tasks	Commands

Update all keys of all servers of the current domain (`doc.com`).	`rootmaster# /usr/lib/nis/nisupdkeys`
	Fetch Public key for server rootmaster.doc.com.
	`netname='unix.rootmaster@doc.com'`
	Updating rootmaster.doc.com.'s public key.
	`Public key:` *public-key*

Update keys of all servers supporting the `sales.doc.com` domain directory object.	`salesmaster# nisupdkeys sales.doc.com(` Screen notices not shown)
Update keys for a server named `master7` in all the directories that store them.	`rootmaster# nisupdkeys -H master7`
Clear the keys stored by the `sales.doc.com` directory object.	`rootmaster# nisupdkeys -C sales.doc.com`
Clear the keys for the current domain directory object for the server named `master7.`	`rootmaster# nisupdkeys -C -H master7`

Updating IP Addresses

If you change a server's IP address, or add additional addresses, you need to run `nisupdkeys` to update NIS+ address information.

To update the IP addresses of one or more servers, use the `nisupdkeys` command `-a` option.

To update the IP addresses of servers of a given domain

```
rootmaster# nisupdkeys -a domain
```

To update the IP address of a particular server

```
rootmaster# nisupdkeys -a -H server
```

Updating Client Key Information

Whenever you change any server's keys, you must update all of the clients as well. Remember, that all NIS+ servers are also NIS+ clients, so if you update the keys on one server, you must update key information on all other machines in the domain regardless of whether or not they are NIS+ servers or ordinary clients.

There are three ways to update client key information:

- The easiest way to update an individual client's key information is by running the `nisclient` script on the client.
- Another way to update an individual client's key information is by running the `nisinit` command on the client as described in "Initializing a Client" on page 342.
- You can globally update client key information for all the machines in a domain by shortening the Time To Live value of the domain's directory object as explained in "Globally Updating Client Key Information" on page 257.

Globally Updating Client Key Information

After changing a server's keys, you can globally update client key information for all the machines in a domain by:

1. **Use the `nischttl` command to reduce the Time To Live (TTL) value of the domain's directory object so that the value expires almost immediately.**

   For example, if you have changed the keys for a server in the `sales.doc.com.` domain, to reduce the directory's TTL value to one minute you would enter:

   ```
   client% nischttl 60 sales.doc.com.
   ```

2. **When the directory's TTL value expires, the cache manager expires the entry and then obtains the new, updated information for clients.**

3. **Once the directory object's TTL value has expired, reset the directory object's TTL to its default value.**

   For example, to reset the TTL value to 12 hours for the `sales.doc.com.` domain's directory object, you would enter:

   ```
   client% nischttl 12h sales.doc.com.
   ```

   See "The `nischttl` Command" on page 349 for more information on working with TTL values.

CHAPTER 14

NIS+ Administering Enhanced Security Credentials

Diffie-Hellman Extended Key

NIS+ offers increased security at the RPC(3N) layer beyond 192 bit Diffie-Hellman (RPC(3N) security flavor AUTH_DES) using the RPCSEC_GSS RPC(3N) security flavor. See the nisauthconf(1M) command for a list of which security mechanisms are available on the system. Along with more stringent cryptographic strength, these security mechanisms also provide integrity for each NIS+ transaction. That is, the data for each NIS+ transaction is verified that it has not been modified.

System administraters can take advantage of the more stringent security mechanisms either by running nisauthconf(1M) before the NIS+ server environment is constructed or after, using the guidelines below.

Transitioning to a New Public Key-based Security Mechanism

The more stringent security mechanisms of the public key cryptography family such as Diffie Hellman 640 bit (dh640-0) will require new credentials for each principal to be added to the existing cred table. The procedure outlined below is for a system currently running with Diffie-Hellman 192 bit (RPC security flavor AUTH_DES) security that will be converted to running with Diffie-Hellman 640 bit (RPC security flavor RPCSEC_GSS) security. Although this transition document highlights the most likely case, the principles are the same for converting from any one security

mechanism type of the public key cryptography family to another security mechanism of the public key cryptography family.

Note – The following example assumes that $PATH includes `/usr/lib/nis`.

Configuring NIS+ Security Mechanisms

NIS+ security configuration is done with the `nisauthconf`(1M) command. `nisauthconf` takes a list of security mechanisms in order of preference. A security mechanism may use one or more authentication flavors specified in `secure_rpc`(3N). If **`des`** is the only specified mechanism, then NIS+ only uses AUTH_DES for authentication with other NIS+ clients and servers. Any other security mechanisms after des will be ignored by NIS+, except for `nisaddcred`(1M).

```
nisauthconf [-v] [mechanism, ...]
```

Where mechanism is a RPC security mechanism that is available on the system. See `nisauthconf`(1M) for the list of mechanisms available. If no mechanisms are specified, then a list of currently configured mechanisms is printed.

Creating New Security Mechanism Credentials

Credential information for the new mechanism must be created for each NIS+ user and host principal. In order to do this, on one of the machines running NIS+, the `nisauthconf`(1M) command must be run to allow the creation of new credentials while the system continues to authenticate with the current mechanism. Also see “Creating Credential Information for NIS+ Principals” on page 242 for details on credential creation basics.

New Security Mechanism Credentials –Example

Converting des to dh640-0; the `nisauthconf` should be run as root and the `nisaddcred` should be run as any principal that has Create rights in the principal’s

home directory. The server is named server1 and the user principal is named morena. User morena has UID 11177.

```
client# nisauthconf des dh640-0
client% nisaddcred -P server1.doc.com. -p unix.server1@doc.com dh640-0
      (screen notices not shown)
client% nisaddcred -P morena.doc.com. -p unix.11177@doc.com -ldummy-password dh640-0
      (screen notices not shown)
```

Adding New Keys to NIS+ Directory Objects

Once the new credentials have been generated for all the servers, run `nisupdkeys`(1m) to add the new public keys to all the directory objects served by these servers. To use the `nisupdkeys`(1m) command, you must have modify rights to the NIS+ directory object. See "Updating Public Keys" on page 255 for more details.

Caution – All servers that serve these NIS+ directories and all clients that access these directories must be running Solaris 7 or later.

Adding New Public Keys to NIS+ Directory Objects—Example

In this example, the directories that are being served by the servers with new public keys are `doc.com`, `org_dir.doc.com.`, `groups_dir.doc.com.`. The update will be done as the master server principal. Before running the new mechanism, `nisupdkeys` needs to be configured with `nisauthconf`(1M). In this example, the current authentication mechanism is des and the new mechanism is dh640-0.

```
masterserver#    nisauthconf dh640-0 des
masterserver#    nisupdkeys doc.com.
            (screen notices not shown)
masterserver#  nisupdkeys org_dir.doc.com.
            (screen notices not shown)
masterserver#    nisupdkeys groups_dir.doc.com.
            (screen notices not shown)
```

Configuring NIS+ Servers to Accept New Security Mechanism Credentials

On each server, configure NIS+ authentication so that it accepts both the old and new credentials. This will require running `nisauthconf`(1m) and `keylogin`(1) and restarting `keyserv`(1m). The `keylogin`(1) command stores the keys for each mechanism in the `/etc/.rootkey`. See "Keylogin" on page 249 for basic `keylogin` details.

Configuring NIS+ Servers to Accept New Security Mechanism Credentials—Example

In this example, the current authentication mechanism is des and the new mechanism is dh640-0. Note the ordering is significant here; any mechanisms after the des entry will be ignored for client and server NIS+ authentication.

```
server# nisauthconf dh640-0 des
server# keylogin -r
        (screen notices not shown)
server# /etc/reboot
```

Configuring Machines to Use New Security Mechanism Credentials

Now that the servers can accept the new credentials, the machines can be converted to authenticate via the new credentials. To do this, run `nisauthconf`(1M) and `keylogin`(1) as root and reboot.

Configuring Machines to Use New Security Mechanism Credentials—Examples

In this example, the new mechanism is dh640-0 but the system will also attempt authentication with des credentials if the dh640-0 ones are not available or do not succeed.

```
workstation# nisauthconf dh640-0 des
workstation#  keylogin -r
        (screen notices not shown)
workstation# /etc/reboot
```

In the next example, the new mechanism is dh640-0 and authentication will *only* be attempted with this mechanism. Before configuring any system to authenticate via the new mechanism exclusively, the cached directory objects must be refreshed to include the keys for the new mechanism. This can be verified with `nisshowcache`(1M) . An alternative to waiting for the cached directory objects to time out and be refreshed in the following: kill `nis_cachemgr`(1M) , then construct a new `NIS_COLD_START` with `nisinit`(1M) and then restart `niscachemgr`(1M).

Manually Refresh Directory Objects—Example NETNAMER

To manually refresh directory objects:

```
# pkill -u 0 nis_cachemgr
# nisinit -cH masterserver
# niscachemgr -i
```

Caution – The machine principal and all users of this machne must have dh640-0 credentials in the `cred` table before the system can be configured to authenticate exclusively with dh640–0.

```
workstation# nisauthconf dh640-0
workstation#  keylogin -r
        (screen notices not shown)
workstation# /etc/reboot
```

Changing the Password Protecting New Credentials

For each user given new credentials with the dummy passwd, they need to run `chkey`(1) to convert to their login password. For more information, see “Changing Keys for an NIS+ Principal” on page 250.

Change Password Protecting New Credentials—Example

Run `chkey`(1) to convert to your login password:

```
# chkey -p
        (screen notices not shown)
```

Configuring Servers to Accept only New Security Mechanism Credentials

When converting from a lower grade security mechanism to a higher one, the maximum security benefit is achieved by configuring the NIS+ servers to only accept credentials of the new higher grade security mechanism type. Do this only after the servers have been successfully configured to authenticate via the old and the new mechanism.

Before configuring any system to authenticate via the new mechanism exclusively, the cached directory objects must be refreshed to include the keys for the new mechanism and verified with `nisshowcache`(1M) .

Configuring Servers to Accept only New Security Mechanism Credentials—Example

Run `nisauthconf`(1m) on each NIS+ server and reboot. In this example, the NIS+ server will be configured to *only* accept authentication of dh640-0 credentials.

```
server#  nisauthconf dh640-0
server# /etc/reboot
```

Optionally, the directory objects can now be updated to remove the old public keys. This should be done from the master server and `nisupdkeys`(1m) should be run once for each directory served by the servers authenticating only with the new security mechanism. In this example, the directories to be updated are `doc.com`, `org_dir.doc.com.`, and `groups_dir.doc.com.`.

```
masterserver#    nisupdkeys doc.com.
            (screen notices not shown)
masterserver#  nisupdkeys org_dir.doc.com.
            (screen notices not shown)
masterserver#    nisupdkeys groups_dir.doc.com.
```

Removing Old Credentials from the cred Table

If desired, the credentials of the old security mechanism can be removed from the `cred` table. You must have modify rights to the local domain's `cred` table. See "Removing Credential Information" on page 246 for more details.

Removing old Credentials from the cred Table—Example

In this example, the principal morena.doc.com will have her des credentials removed from the `cred` table.

```
master# nisaddcred -r morena.doc.com. dh192-0
```

CHAPTER 15

Administering NIS+ Access Rights

This chapter describes NIS+ access rights and how to administer them.

Note – Some NIS+ security tasks can be performed more easily with Solstice AdminSuite tools if you have them available.

NIS+ Access Rights

NIS+ access rights determine what operations NIS+ users can perform and what information they have access to. This chapter assumes that you have an adequate understanding of the NIS+ security system in general, and in particular of the role that access rights play in that system (see Chapter 11 for this information).

For a complete description of NIS+ access-related commands and their syntax and options, see the NIS+ man pages.

Introduction to Authorization and Access Rights

See “NIS+ Authorization and Access—Introduction” on page 217and , for a description of how authorization and access rights work with NIS+ credentials and authentication to provide security for the NIS+ namespace.

Authorization Classes—Review

As described more fully in "Authorization Classes" on page 217, NIS+ access rights are assigned on a class basis. There are four different NIS+ classes:

- *Owner*. The owner class is a *single* NIS+ principal. By default, an object's owner is the principal that created the object. However, an object's owner can transfer ownership to another principal who then becomes the new owner.
- *Group.* The group class is a *collection* of one or more NIS+ principals. An NIS+ object can have only one NIS+ group.
- *World*. The world class contains all NIS+ principals that are authenticated by NIS+ (in other words, everyone in the owner and group class, plus everyone else who presents a valid DES credential).
- *Nobody*. The nobody class is composed of anyone who is not properly authenticated (in other words, anyone who does not present a valid DES credential).

Access Rights—Review

As described more fully in " NIS+ Access Rights" on page 221, there are four types of NIS+ access rights:

- *Read.* A principal with read rights to an object can view the contents of that object.
- *Modify.* A principal with modify rights to an object can change the contents of that object.
- *Destroy.* A principal with Destroy rights to an object can delete the object.
- *Create.* A principal with create rights to a higher level object can create new objects within that level. In other words, if you have create rights to an NIS+ directory object, you can create new tables within that directory. If you have create rights to an NIS+ table, you can create new columns and entries within that table.

Keep in mind that these rights logically evolve down from directory to table to table column and entry levels. For example, to create a new table, you must have create rights for the NIS+ directory object where the table will be stored. When you create that table, you become its default owner. As owner, you can assign yourself create rights to the table which allows you to create new entries in the table. If you create new entries in a table, you become the default owner of those entries. As table owner, you can also grant table level create rights to others. For example, you can give your table's group class table level create rights. In that case, any member of the table's group can create new entries in the table. The individual member of the group who creates a new table entry becomes the default owner of that entry.

Concatenation of Access Rights

Authorization classes are concatenated. In other words, the higher class usually belongs to the lower class and automatically gets the rights assigned to the lower class. It works like this:

- *Owner class.* An object's owner may, or may not, belong to the object's group. If the owner does belong to the group, then the owner gets whatever rights are assigned to the group. The object's owner automatically belongs to the world and nobody classes, so the owner automatically gets whatever rights that object assigns to those two classes.
- *Group class.* Members of the object's group automatically belong to the world and nobody classes, so the group members automatically get whatever rights that object assigns to world and nobody.
- *World class*. The world class automatically gets the same rights to an object that are given to the nobody class.
- *Nobody class*. The nobody class only gets those rights an object specifically assigns to the nobody class.

The basic principle that governs this is that access rights override the absence of access rights. In other words, a higher class can have *more* rights than a lower class, but not *fewer* rights. (The one exception to this rule is that if the owner is not a member of the group, it is possible to give rights to the group class that the owner does not have.)

How Access Rights Are Assigned and Changed

When you create an NIS+ object, NIS+ assigns that object a default set of access rights for the owner and group classes. By default, the owner is the NIS+ principal who creates the object. The default group is the group named in the `NIS_GROUP` environment variable. (See for details.)

Specifying Different Default Rights

NIS+ provides two different ways to change the default rights that are automatically assigned to an NIS+ object when it is created.

- The `NIS_DEFAULTS` environment variable. `NIS_DEFAULTS` stores a set of security-related default values, one of which is access rights. These default access rights are the ones automatically assigned to an object when it is created. (See "Displaying NIS+ Defaults—The `nisdefaults` Command" on page 279 for details.)

  If the value of the `NIS_DEFAULTS` environment variable is changed, objects created after the change are assigned the new values. However, previously created

objects are not affected.

- The `-D` option, which is available with several NIS+ commands. When you use the `-D` option as part of the command to create an NIS+ object, it overrides the default rights specified by the `NIS_DEFAULTS` environment variable and allows you to explicitly specify an initial set of rights for that object. (See "Specifying Nondefault Security Values at Creation Time" on page 283 for details.)

Changing Access Rights to an Existing Object

When an NIS+ object is created, it comes into existence with a default set of access rights (from either the `NIS_DEFAULTS` environment variable or as specified with the `-D` option). These default rights can be changed with the

- `nischmod` command
- `nistbladm` command for table columns

Table, Column, and Entry Security

NIS+ tables allow you to specify access rights on the table three ways:

- You can specify access rights to the *table* as a whole
- You can specify access rights to each *entry* (row) by itself.
- You can specify access rights to each table *column* individually,

A *field* is the intersection between a column and an entry (row). All data values are entered in fields.

These column- and entry level access rights allow you to specify *additional* access to individual rows and columns that override table level restrictions, but column and entry level rights cannot be *more* restrictive than the table as a whole:

- *Table.* The table level is the base level. Access rights assigned at the table level apply to every piece of data in the table unless specifically modified by a column or entry exception. Thus, the table level rights should be the *most* restrictive.

  Note – Remember that authorization classes concatenate. A higher class gets the rights assigned to lower classes. See "Concatenation of Access Rights" on page 269

- *Column.* Column-level rights allow you to grant additional access rights on a column-by-column basis. For example, suppose the table level granted no access rights whatsoever to the world and nobody classes. In such a case, no one in those two classes could read, modify, create, or destroy any data in the table. You could use column-level rights to override that table level restriction and permit members of the world class the right to view data in a particular column.

On the other hand, if the table level grants table-wide read rights to the owner and group classes, you cannot use column-level rights to prevent the group class from having read rights to that column.

- *Entry (row).* entry level rights allow you to grant additional access rights on a row-by-row basis. For example, this allows you to permit individual users to change entries that apply to them, but not entries that apply to anyone else.

  Keep in mind that an entry's group does not have to be the same as the table's group. Tables and entries can have different groups. This means that you can permit members of a particular group to work with one set of entries while preventing them from affecting entries belonging to other groups.

Table, Column, Entry Example

Column- or entry level access rights can provide additional access in two ways: by extending the rights to additional principals or by providing additional rights to the same principals. Of course, both ways can be combined. Following are some examples.

Assume a table object granted read rights to the table's owner:

TABLE 15–1 Table, Column, Entry Example 1

	Nobody	Owner	Group	World
Table Access Rights:	----	r---	----	----

This means that the table's owner could read the contents of the entire table but no one else could read anything. You could then specify that Entry-2 of the table grant read rights to the group class:

TABLE 15–2 Table, Column, Entry Example 2

	Nobody	Owner	Group	World
Table Access Rights:	----	r---	----	----
Entry-2 Access Rights:	----	----	r---	----

Although only the owner could read all the contents of the table, any member of the table's group could read the contents of that particular entry. Now, assume that a particular column granted read rights to the world class:

TABLE 15–3 Table, Column, Entry Example 3

	Nobody	Owner	Group	World
Table Access Rights:	----	r---	----	----

TABLE 15–3 Table, Column, Entry Example 3 *(Continued)*

	Nobody	Owner	Group	World
Entry-2 Access Rights:	`----`	`----`	`r---`	`----`
Column-1 Access Rights:	`----`	`----`	`----`	`r---`

Members of the world class could now read that column *for all entries* in the table (light shading in Table 15–4). Members of the group class could read everything in Column-1 (because members of the group class are also members of the world class) and also all columns of Entry-2 (dark shading in Table 15–4). Neither the world nor the group classes could read any cells marked `*NP*` (for Nor Permitted).

TABLE 15–4 Table, Column, Entry Example 4

	Col 1	Col 2	Col 2
Entry-1	contents	`*NP*`	`*NP*`
Entry-2	contents	contents	contents
Entry-3	contents	`*NP*`	`*NP*`
Entry-4	contents	`*NP*`	`*NP*`
Entry-5	contents	`*NP*`	`*NP*`

Rights at Different Levels

This section describes how the four different access rights (read, create, modify, and destroy) work at the four different access levels (directory, table, column, and entry).

The objects that these various rights and levels act on are summarized in Table 15–5:

TABLE 15–5 Access Rights and Levels and the Objects They Act Upon

	Directory	Table	Column	Entry
Read	List directory contents	View table contents	View column contents	View entry (row) contents
Create	Create new directory or table objects	Add new entries (rows)	Enter new data values in a column	Enter new data values in an entry (row)
Modify	Move objects and change object names	Change data values anywhere in table	Change data values in a column	Change data values in an entry (row)

TABLE 15–5 Access Rights and Levels and the Objects They Act Upon *(Continued)*

	Directory	Table	Column	Entry
Destroy	Delete directory objects such as tables	Delete entries (rows)	Delete data values in a column	Delete data values in an entry (row)

Read Rights

- *Directory*. If you have read rights to a directory, you can list the contents of the directory.
- *Table*. If you have read rights to a table, you can view all the data in that table.
- *Column*. If you have read rights to a column, you can view all the data in that column.
- *Entry*. If you have read rights to an entry, you can view all the data in that entry.

Create Rights

- *Directory*. If you have create rights at the directory level, you can create new objects in the directory such as new tables.
- *Table*. If you have create rights at the table level, you can create new entries. (You cannot add new columns to an existing table regardless of what rights you have.)
- *Column*. If you have create rights to a column, you can enter new data values in the fields of that column. You cannot create new columns.
- *Entry*. If you have create rights to an entry, you can enter new data values in the fields of that row. (Entry level create rights do not permit you to create new rows.)

Modify Rights

- *Directory*. If you have modify rights at the directory level, you can move or rename directory objects.
- *Table*. If you have modify rights at the table level, you can change any data values in the table. You can create (add) new rows, but you cannot create new columns. If an existing field is blank, you can enter new data in it.
- *Column*. If you have modify rights to a column, you can change the data values in the fields of that column.
- *Entry*. If you have modify rights to an entry, you can change the data values in the fields of that row.

Destroy Rights

- *Directory*. If you have destroy rights at the directory level, you can destroy existing objects in the directory such as tables.
- *Table*. If you have destroy rights at the table level, you can destroy existing entries (rows) in the table but not columns. You cannot destroy existing columns in a table: you can only destroy entries.
- *Column*. If you have destroy rights to a column, you can destroy existing data values in the fields of that column.
- *Entry*. If you have destroy rights to an entry, you can destroy existing data values in the fields of that row.

Where Access Rights Are Stored

An object's access rights are specified and stored as part of the object's definition. This information is not stored in an NIS+ table.

Viewing an NIS+ Object's Access Rights

The access rights can be viewed by using the `niscat` command:

`niscat -o` *objectname*

Where *objectname* is the name of the object whose access rights you want to view.

This command returns the following information about an NIS+ object:

- *Owner*. The single NIS+ principal who has ownership rights. This is usually the person who created the object, but it could be someone to whom the original owner transferred ownership rights.
- *Group*. The object's NIS+ group.
- *Nobody class access rights*. The access rights granted to everyone, whether they are authenticated (have a valid DES credential) or not.
- *Owner class access rights*. The access rights granted to the object's owner.
- *Group class access rights*. The access rights granted to the principals in the object's group.
- *World class access rights*. The access rights granted to all authenticated NIS+ principals.

Access rights for the four authorization classes are displayed as a list of 16 characters, like this:

```
r---rmcdr---r---
```

Each character represents a type of access right:

- `r` represents read rights.
- `m` represents modify rights.
- `d` represents destroy rights.
- `c` represents create rights.
- `-` represents no access rights.

The first four characters represent the access rights granted to nobody, the next four to the owner, the next four to the group, and the last four to the world:

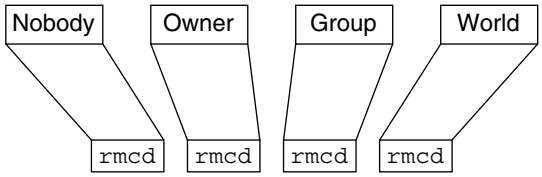


FIGURE 15–1 Access Rights Display

Note – Unlike UNIX file systems, the first set of rights is for nobody, not for the owner.

Default Access Rights

When you create an object, NIS+ assigns the object a default owner and group, and a default set of access rights for all four classes. The default owner is the NIS+ principal who creates the object. The default group is the group named in the `NIS_GROUP` environment variable. Table 15–6, shows the default access rights.

TABLE 15–6 Default Access Rights

Nobody	Owner	Group	World
-	read	read	read
-	modify	-	-
-	create	-	-
-	destroy	-	-

If you have the `NIS_DEFAULTS` environment variable set, the values specified in `NIS_DEFAULTS` will determine the defaults that are applied to new objects. When you create an object from the command line, you can use the `-D` flag to specify values other than the default values.

How a Server Grants Access Rights to Tables

This section discusses how a server grants access to tables objects, entries, and columns during each type of operation: read, modify, destroy, and create.

Note – At security level 0, a server enforces no NIS+ access rights and all clients are granted full access rights to the table object. Security level 0 is only for administrator setup and testing purposes. Do not use level 0 in any environment where ordinary users are performing their normal work.

The four factors that a server must consider when deciding whether to grant access are:

- The type of operation requested by the principal
- The table, entry, or column the principal is trying to access
- The authorization class the principal belongs to for that particular object
- The access rights that the table, entry, or column has assigned to the principal's authorization class

After authenticating the principal making the request by making sure the principal has a valid DES credential, an NIS+ server determines the type of operation and the object of the request.

- *Directory*. If the object is a directory or group, the server examines the object's definition to see what rights are granted to the four authorization classes, determines which class the principal belongs to, and then grants or denies the request based on the principal's class and the rights assigned to that class.
- *Table*. If the object is a table, the server examines the table's definition to see what table level rights are granted to the four authorization classes, and determines which class the principal belongs to. If the class to which the principal belongs does not have table level rights to perform the requested operation, the server then determines which row or column the operation concerns and determines if there are corresponding row- or column-level access rights permitting the principal to perform the requested operation.

Specifying Access Rights in Commands

This section assume an NIS+ environment running at security level 2 (the default level).

This section describes how to specify access rights, as well as owner, group owner, and object, when using any of the commands described in this chapter.

Syntax for Access Rights

This subsection describes the access rights syntax used with the various NIS+ commands that deal with authorization and access rights.

Class, Operator, and Rights Syntax

Access rights, whether specified in an environment variable or a command, are identified with three types of arguments: *class*, *operator*, and *right*.

- *Class*. Class refers to the type of NIS+ principal (authorization class) to which the *rights* will apply.

TABLE 15–7 Access Rights Syntax—Class

Class	Description
`n`	Nobody: all unauthenticated requests
`o`	The owner of the object or table entry
`g`	The group owner of the object or table entry
`w`	World: all authenticated principals
`a`	All: shorthand for owner, group, and world (this is the default)

- *Operator.* The operator indicates the kind of operation that will be performed with the *rights*.

TABLE 15–8 Access Rights Syntax—Operator

Operator	Description
`+`	Adds the access rights specified by *right*
`-`	Revokes the access rights specified by *right*
`=`	Explicitly changes the access rights specified by *right*; in other words, revokes all existing rights and replaces them with the new access rights.

- *Rights*. The rights are the access rights themselves. The accepted values for each are listed below.

TABLE 15–9 Access Rights Syntax—Rights

Right	Description
`r`	Reads the object definition or table entry
`m`	Modifies the object definition or table entry
`c`	Creates a table entry or column
`d`	Destroys a table entry or column

You can combine operations on a single command line by separating each operation from the next with a comma (,).

TABLE 15–10 Class, Operator, and Rights Syntax—Examples

Operations	Syntax
Add read access rights to the *owner* class	`o+r`
Change owner. group, and world classes' access rights to modify only from whatever they were before	`a=m`
Add read and modify rights to the world and nobody classes	`wn+m`
Remove all four rights from the group, world, and nobody classes	`gwn-rmcd`
Add create and destroy rights to the owner class and add read and modify rights to the world and nobody classes	`o+cd,wn+rm`

Syntax for Owner and Group

- *Owner*. To specify an owner, use an NIS+ principal name.
- *Group*. To specify an NIS+ group, use an NIS+ group name with the domain name appended.

  Remember that principal names are fully qualified *(principalname.domainname*).

  For owner

principalname

For group

groupname.domainname

Syntax for Objects and Table Entries

Objects and table entries use different syntaxes.

- Objects use simple object names.
- Table entries use indexed names.

For objects

objectname

For table entries

columnname=value] , *tablename*

Note – In this case, the brackets are part of the syntax.

Indexed names can specify more than one column-value pair. If so, the operation applies only to the entries that match *all* the column-value pairs. The more column-value pairs you provide, the more stringent the search.

For example:

TABLE 15–11 Object and Table Entry—Examples

Type	Example
Object	`hosts.org_dir.sales.doc.com.`
Table entry	`'[uid=33555],passwd.org_dir.Eng.doc.com.'`
Two-value table entry	`'[name=sales,gid=2],group.org_dir.doc.com.'`

Columns use a special version of indexed names. Because you can only work on columns with the `nistbladm` command, see"The `nistbladm` Command" on page 353 for more information.

Displaying NIS+ Defaults—The `nisdefaults` Command

The `nisdefaults` command displays the seven default values currently active in the namespace. These default values are either

- Preset values supplied by the NIS+ software

- The defaults specified in the `NIS_DEFAULTS` environment variable (if you have `NIS_DEFAULTS` values set)

Any object that you create on this machine will automatically acquire these default values unless you override them with the `-D` option of the command you are using to create the object.

TABLE 15–12 The Seven NIS+ Default Values and `nisdefaults` Options

Default	Option	From	Description
Domain	`-d`	`/etc/defaultdomain`	Displays the home domain of the machine from which the command was entered.
Group	`-g`	`NIS_GROUP` environment variable	Displays the group that would be assigned to the next object created from this shell.
Host	`-h`	`uname -n`	Displays the machine's host name.
Principal	`-p`	`gethostbyname()`	Displays the fully qualified user name or host name of the NIS+ principal who entered the `nisdefaults` command.
Access Rights	`-r`	`NIS_DEFAULTS` environment variable	Displays the access rights that will be assigned to the next object or entry created from this shell. Format: `----rmcdr---r---`
Search path	`-s`	`NIS_PATH` environment variable	Displays the syntax of the search path, which indicate the domains that NIS+ will search through when looking for information. Displays the value of the `NIS_PATH` environment variable if it is set.
Time-to-live	`-t`	`NIS_DEFAULTS` environment variable	Displays the time-to-live that will be assigned to the next object created from this shell. The default is 12 hours.
All (terse)	`-a`		Displays all seven defaults in terse format.
Verbose	`-v`	Display specified values in verbose mode.	

You can use these options to display all default values or any subset of them:

- To display all values in verbose format, type the `nisdefaults` command without arguments.

```
master% nisdefaults
Principal Name : topadmin.doc.com.
Domain Name : doc.com.
Host Name : rootmaster.doc.com.
Group Name : salesboss
Access Rights : ----rmcdr---r---
Time to live : 12:00:00:00:00
Search Path : doc.com.
```

- To display all values in terse format, add the `-a` option.
- To display a subset of the values, use the appropriate options. The values are displayed in terse mode. For example, to display the rights and search path defaults in terse mode, type:

```
rootmaster% nisdefaults -rs
----rmcdr---r---
doc.com.
```

- To display a subset of the values in verbose mode, add the `-v` flag.

Setting Default Security Values

This section describes how to perform tasks related to the `nisdefaults` command, the `NIS_DEFAULTS` environment variable, and the `-D` option. The `NIS_DEFAULTS` environment variable specifies the following default values:

- Owner
- Group
- Access rights
- Time-to-live.

The values that you set in the `NIS_DEFAULTS` environment variable are the default values applied to all NIS+ objects that you create using that shell (unless overridden by using the `-D` option with the command that creates the object).

You can specify the default values (owner, group, access rights, and time-to-live) specified with the `NIS_DEFAULTS` environment variable. Once you set the value of `NIS_DEFAULTS`, every object you create from that shell will acquire those defaults, unless you override them by using the `-D` option when you invoke a command.

Displaying the Value of `NIS_DEFAULTS`

You can check the setting of an environment variable by using the `echo` command, as shown below:

```
client% echo $NIS_DEFAULTS
owner=butler:group=gamblers:access=o+rmcd
```

You can also display a general list of the NIS+ defaults active in the namespace by using the `nisdefaults` command as described in "Displaying NIS+ Defaults—The `nisdefaults` Command" on page 279.

Changing Defaults

You can change the default access rights, owner, and group, by changing the value of the `NIS_DEFAULTS` environment variable. Use the environment command that is appropriate for your shell (`setenv` for C-shell or `$NIS_DEFAULTS=, export` for Bourne and Korn shells) with the following arguments:

- `access=`*right*, where *right* are the access rights using the formats described in "Specifying Access Rights in Commands" on page 276.
- `owner=`*name*, where *name* is the user name of the owner.
- `group=`*group*, where *group* is the name of the default group

You can combine two or more arguments into one line separated by colons:

`-owner=`*principal-name*`:-group=`*group-name*

Table 15–13 shows some examples:

TABLE 15–13 Changing Defaults—Examples

Tasks	Examples
This command grants owner read access as the default access right.	`client% setenv NIS_DEFAULTS access=o+r`
This command sets the default owner to be the user abe whose home	`client% setenv NIS_DEFAULTS owner=abe.doc.com.`
domain is doc.com.	
This command combines the first two examples on one code line.	`client% setenv NIS_DEFAULTS access=o+r:owner=abe.doc.com.`

All objects and entries created from the shell in which you changed the defaults will have the new values you specified. You cannot specify default settings for a table column or entry; the columns and entries simply inherit the defaults of the table.

Resetting the Value of `NIS_DEFAULTS`

You can reset the `NIS_DEFAULTS` variable to its original values, by typing the name of the variable without arguments, using the format appropriate to your shell:

For C shell

```
client# unsetenv NIS_DEFAULTS
```

For Bourne or Korn shell

```
client$ NIS_DEFAULTS=; export NIS_DEFAULTS
```

Specifying Nondefault Security Values at Creation Time

You can specify different (that is, nondefault) access rights, owner, and group, any time that you create an NIS+ object or table entry with any of the following NIS+ commands:

- `nismkdir`—Creates NIS+ directory objects
- `nisaddent`—Transfers entries into an NIS+ table
- `nistbladm`—Creates entries in an NIS+ table

To specify security values other than the default values, insert the `-D` option into the syntax of those commands, as described in "Specifying Access Rights in Commands" on page 276.

As when setting defaults, you can combine two or more arguments into one line. Remember that column and entry's owner and group are always the same as the table, so you cannot override them.

For example, to use the `nismkdir` command to create a `sales.doc.com` directory and override the default access right by granting the owner only read rights you would type:

```
client% nismkdir -D access=o+r sales.doc.com
```

Changing Object and Entry Access Rights

The `nischmod` command operates on the access rights of an NIS+ object or table entry. It does not operate on the access rights of a table column; for columns, use the `nistbladm` command with the `-D` option. For all `nischmod` operations, you must already have modify rights to the object or entry.

Using `nischmod` to Add Rights

To add rights for an object or entry use:

For object

`nischmod class+`*right object-name*

For table entry

`nischmod class+`*right* `[column-name=`*value*`],`*table-name*

For example, to add read and modify rights to the group of the `sales.doc.com.` directory object you would type:

```
client% nischmod g+rm sales.doc.com.
```

For example to add read and modify rights to group for the `name=abe` entry in the `hosts.org_dir.doc.com.` table you would type:

```
client% nischmod g+rm '[name=abe],hosts.org_dir.doc.com.'
```

Using `nischmod` to Remove Rights

To remove rights for an object or entry use:

For object

`nischmod` *class-right object-name*

For entry

`nischmod` *class-right* `[`*column-name=value*`],`*table-name*

For example, to remove create and destroy rights from the group of the `sales.doc.com.` directory object you would type:

```
client% nischmod g-cd sales.doc.com.
```

For example to remove destroy rights from group for the `name=abe` entry in the `hosts.org_dir.doc.com.` table, you would type:

```
client% nischmod g-d '[name=abe],hosts.org_dir.doc.com.'
```

Specifying Column Access Rights

The `nistbladm` command performs a variety of operations on NIS+ tables. Most of these tasks are described in "The `nistbladm` Command" on page 353. However, two of its options, `-c` and `-u` , enable you to perform some security-related tasks:

- The `-c` option. The `-c` option allows you to specify initial column access rights when creating a table with the `nistbladm` command.
- *The* `-u` option. The `-u` option allows you to change column access rights with the `nistbladm` command.

Setting Column Rights When Creating a Table

When a table is created, its columns are assigned the same rights as the table object. These table level, rights are derived from the `NIS_DEFAULTS` environment variable, or are specified as part of the command that creates the table. You can also use the `nistbladm -c` option to specify initial column access rights when creating a table with `nistbladm`. To use this option you must have create rights to the directory in which you will be creating the table. To set column rights when creating a table use:

`nistbladm -c` *`type 'columnname=[flags] [,access]... tablename'`*

Where:

- *type* is a character string identifying the kind of table. A table's *type* can be anything you want it to be.
- *columnname* is the name of the column.
- *flags* is the type of column. Valid flags are:
  - `S` for searchable
  - `I` for case insensitive
  - `C` for encrypted
  - `B` for binary data
  - `X` for XDR encoded data
- *access* is the access rights for this column that you specify using the syntax described in "Specifying Access Rights in Commands" on page 276.
- ... indicates that you can specify multiple columns each of the own type and with their own set of rights.
- *tablename* is the fully qualified name of the table you are creating.

To assign a column its own set of rights at table creation time, append access rights to each column's equal sign after the column type and a comma. Separate the columns with a space:

column=type, *rights column=type*, *rights column=type*, *rights*

The example below creates a table named `depts` in the `doc.com` directory, of type `div`, with three columns (`Name`, `Site`, and `Manager`), and adds modify rights for the group to the second and third columns:

```
rootmaster% nistbladm -c div Name=S Site=S,g+m Manager=S,g+m depts.doc.com.
```

For more information about the `nistbladm` and the `-c` option, see Chapter 19.

Adding Rights to an Existing Table Column

The `nistbladm -u` option allows you to add additional column access rights to an existing table column with the `nistbladm` command. To use this option you must have modify rights to the table column. To add additional column rights use:

`nistbladm -u [`*column=access*`,...],`*tablename*

Where:

- *column* is the name of the column.
- *access* is the access rights for this column that you specify using the syntax described in"Specifying Access Rights in Commands" on page 276 .
- ... indicates that you can specify rights for multiple columns.
- *tablename* is the fully qualified name of the table you are creating.

Use one *column=access* pair for each column whose rights you want to update. To update multiple columns, separate them with commas and enclose the entire set with square brackets:

`[`*column=access*`,` *column=access*`,` *column=access*`]`

The full syntax of this option is described inChapter 2 .

The example below adds read and modify rights to the group for the `name` and `addr` columns in the `hosts.org_dir.doc.com.` table.

```
client% nistbladm -u '[name=g+rm,addr=g+rm],hosts.org_dir..doc.com.'
```

Removing Rights to a Table Column

To remove access rights to a column in an NIS+ table, you use the `-u` option as described above in "Adding Rights to an Existing Table Column" on page 286 except that you subtract rights with a minus sign (rather than adding them with a plus sign).

The example below removes group's read and modify rights to the hostname column in the `hosts.org_dir.doc.com.` table.

```
client% nistbladm -u 'name=g-rm,hosts.org_dir.doc.com.'
```

Changing Ownership of Objects and Entries

The `nischown` command changes the owner of one or more objects or entries. To use it, you must have modify rights to the object or entry. The `nischown` command cannot change the owner of a column, since a table's columns belong the table's owner. To change a column's owner, you must change the table's owner.

Changing Object Owner With `nischown`

To change an object's owner, use the following syntax:

`nischown` *new-owner object*

Where:

- *new-owner* is the fully qualified user ID of the object's new owner.
- *object* is the fully qualified name of the object.

Be sure to append the domain name to both the object name and new owner name.

The example below changes the owner of the hosts table in the `doc.com.` domain to the user named lincoln whose home domain is `doc.com.`:

```
client% nischown lincoln.doc.com. hosts.org_dir.doc.com.
```

Changing Table Entry Owner With `nischown`

The syntax for changing a table entry's owner uses an indexed entry to identify the entry, as shown below:

`nischown` *new-owner* `[`*column=value*`,...],`*tablename*

Where:

- *new-owner* is the fully qualified user ID of the object's new owner.

- *column* is the name of the column whose value will identify the particular entry (row) whose owner is to be changed.
- *value* is the data value that identified the particular entry (row) whose owner is to be changed.
- ... indicates that you can specify ownership changes for multiple entries.
- *tablename* is the fully qualified name of the tables containing the entry whose owner is to be changed.

Be sure to append the domain name to both the new owner name and the table name.

The example below changes the owner of an entry in the hosts table of the `doc.com.` domain to `takeda` whose home domain is `doc.com.` The entry is the one whose value in the name column is `virginia`.

```
client% nischown takeda.doc.com. '[name=virginia],hosts.org_dir.doc.com.'
```

Changing an Object or Entry's Group

The `nischgrp` command changes the group of one or more objects or table entries. To use it, you must have modify rights to the object or entry. The `nischgrp` command cannot change the group of a column, since the group assigned to a table's columns is the same as the group assigned to the table. To change a column's group owner, you must change the table's group owner.

Changing an Object's Group With `nischgrp`

To change an object's group, use the following syntax:

`nischgrp` *group object*

Where:

- *group* is the fully qualified name of the object's new group.
- *object* is the fully qualified name of the object.

Be sure to append the domain name to both the object name and new group name.

The example below changes the group of the hosts table in the `doc.com.` domain to `admins.doc.com.`:

```
client% nischgrp admins.doc.com. hosts.org_dir.doc.com.
```

Changing a Table Entry's Group With `nischgrp`

The syntax for changing a table entry's group uses an indexed entry to identify the entry, as shown below (this syntax is fully described in "Syntax for Objects and Table Entries" on page 279).

`nischgrp` *new-group* `[`*column=value*`,...],`*tablename*

Where:

- *new-group* is the fully qualified name of the object's new group.
- *column* is the name of the column whose value will identify the particular entry (row) whose group is to be changed.
- *value* is the data value that identified the particular entry (row) whose group is to be changed.
- *tablename* is the fully qualified name of the tables containing the entry whose group is to be changed.
- ... indicates that you can specify group changes for multiple entries.

Be sure to append the domain name to both the new group name and the table name.

The example below changes the group of an entry in the hosts table of the `doc.com.` domain to `sales.doc.com.` The entry is the one whose value in the host name column is `virginia`.

```
client% nischgrp sales.doc.com. '[name=virginia],hosts.org_dir.doc.com.'
```

CHAPTER 16

Administering Passwords

This chapter describes how to use the `passwd` command from the point of view of an ordinary user (NIS+ principal) and how an NIS+ administrator manages the password system.

Note – Some NIS+ security tasks can be performed more easily with Solstice AdminSuite™ tools if you have them available.

Using Passwords

When logging in to a machine, users must enter both a user name (also known as a *login ID*) and a password. Although login IDs are publicly known, passwords must be kept secret by their owners.

Logging In

Logging in to a system is a two-step process:

1. **Type your login ID at the `Login:` prompt.**
2. **Type your password at the `Password:` prompt.**

   (To maintain password secrecy, your password is not displayed on your screen when you type it.)

   If your login is successful you will see your system's message of the day (if any) and then your command-line prompt, windowing system, or normal application.

The `Login incorrect` Message

The `Login incorrect` message indicates that:

- You have entered the wrong login ID or the wrong password. This is the most common cause of the `Login incorrect` message. Check your spelling and repeat the process. Note that most systems limit to five the number of unsuccessful login tries you can make:
  - If you exceed a number of tries limit, you will get a `Too many failures - try later` message and not be allowed to try again until a designated time span has passed.
  - If you fail to successfully log in within a specified amount of time you will receive a `Too many tries; try again later` message, and not be allowed to try again until a designated time span has passed.
- Another possible cause of the `Login incorrect` message is that an administrator has locked your password and you cannot use it until it is unlocked. If you are sure that you are entering your login ID and password correctly, and you still get a `Login incorrect` message, contact your system administrator.
- Another possible cause of the `Login incorrect` message is that an administrator has expired your password privileges and you cannot use your password until your privileges are restored. If you are sure that you are entering your login ID and password correctly, and you still get a `Login incorrect` message, contact your system administrator.

The `will expire` Message

If you receive a `Your password will expire in` *N* `days` message (where *N* is a number of days), or a `Your password will expire within 24 hours` message, it means that your password will reach its age limit and expire in that number of days (or hours).

In essence, this message is telling you to change your password now. (See "Changing Your Password" on page 293.)

The `Permission denied` Message

After entering your login ID and password, you may get a `Permission denied` message and be returned to the `login:` prompt. This means that your login attempt has failed because an administrator has either locked your password, or terminated your account, or your password privileges have expired. In these situations you cannot log in until an administrator unlocks your password or reactivates your account or privileges. Consult your system administrator.

Changing Your Password

To maintain security, you should change your password regularly. (See "Choosing a Password" on page 294 for password requirements and criteria.)

Note – The `passwd` command now performs all functions previously performed by `nispasswd`. For operations specific to an NIS+ name space, use `passwd -r nisplus` .

Changing your password is a four-step process:

1. **Run the `passwd` command at a system prompt.**
2. **Type your old password at the `Enter login password` (or similar) prompt.**

   Your keystrokes are not shown on your screen.

   - If you receive a `Sorry: less than` *N* `days since the last change` message, it means that your old password has not been in use long enough and you will not be allowed to change it at this time. You are returned to your system prompt. Consult your system administrator to find out the minimum number of days a password must be in use before it can be changed.
   - If you receive a `You may not change this password` message, it means that your network administrator has blocked any change.
3. **Type your new password at the `Enter new password` prompt.**

   Your keystrokes are not shown on your screen.

   At this point the system checks to make sure that your new password meets the requirements:

   - If it does meet the requirements, you are asked to enter it again.
   - If your new password does not meet the system requirements, a message is displayed informing you of the problem. You must then enter a new password that does meet the requirements.

   See "Password Requirements" on page 295 for the requirements a password must meet.
4. **Type your new password again at the `Re-enter new password` prompt.**

   Your keystrokes are not shown on your screen.

   If your second entry of the new password is not identical to your first entry, you are prompted to repeat the process.

Note – When changing root's password, you must always run `chkey -p` immediately after changing the password. (See "Changing Root Keys From Root" on page 252 and "Changing Root Keys From Another Machine" on page 253 for information on using `chkey -p` to change root's keys.) Failure to run `chkey -p` after changing root's password will result in root being unable to properly log in.

If you receive a `Your password has expired` message it means that your password has reached its age limit and expired. In other words, the password has been in use for too long and you must choose a new password at this time. (See "Choosing a Password" on page 294, for criteria that a new password must meet.)

In this case, choosing a new password is a three-step process:

1. **Type your old password at the `Enter login password` (or similar) prompt.**
   Your keystrokes are not shown on your screen.
2. **Type your new password at the `Enter new password` prompt.**
   Your keystrokes are not shown on your screen.
3. **Type your new password again at the `Re-enter new password` prompt.**
   Your keystrokes are not shown on your screen.

Password Change Failures

Some systems limit either the number of failed attempts you can make in changing your password or the total amount of time you can take to make a successful change. (These limits are implemented to prevent someone else from changing your password by guessing your current password.)

If you (or someone posing as you) fails to successfully log in or change your password within the specified number of tries or time limit, you will get a `Too many failures - try later` or `Too many tries: try again later` message. You will not be allowed to make any more attempts until a certain amount of time has passed. (That amount of time is set by your administrator.)

Choosing a Password

Many breaches of computer security involve guessing another user's password. While the `passwd` command enforces some criteria for making sure the password is hard to guess, a clever person can sometimes figure out a password just by knowing something about the user. Thus, a good password is one that is easy for you to remember but hard for someone else to guess. A bad password is one that is so hard

for you to remember that you have to write it down (which you are not supposed to do), or that is easy for someone who knows about you to guess.

Password Requirements

A password must meet the following requirements:

- *Length*. By default, a password must have at least six characters. Only the first eight characters are significant. (In other words, you can have a password that is longer than eight characters, but the system only checks the first eight.) Because the minimum length of a password can be changed by a system administrator, it may be different on your system.
- *Characters*. A password must contain at least two letters (either upper- or lower-case) and at least one numeral or symbol such as `@`, `#`, `%`. For example, you can use `dog#food` or `dog2food` as a password, but you cannot use `dogfood`.
- *Not your login ID*. A password cannot be the same as your login ID, nor can it be a rearrangement of the letters and characters of your login ID. (For the purpose of this criteria, upper and lower case letters are considered to be the same.) For example, if your login ID is `Claire2` you cannot have `e2clair` as your password.
- *Different from old password*. Your new password must differ from your old one by at least three characters. (For the purpose of this criterion, upper- and lower-case letters are considered to be the same.) For example, if your current password is `Dog#fooD` you can change it to `dog#Meat` but you cannot change it to `daT#Food`.

Bad Choices for Passwords

Bad choices for passwords include:

- Any password based on your name
- Names of family members or pets
- Car license numbers
- Telephone numbers
- Social Security numbers
- Employee numbers
- Names related to a hobby or interest
- Seasonal themes, such as Santa in December
- Any word that is in a standard dictionary

Good Choices for Passwords

Good choices for passwords include:

- Phrases plus numbers or symbols (`beam#meup`)

- Nonsense words made up of the first letters of every word in a phrase plus a number or symbol (`swotrb7` for SomeWhere Over The RainBow)
- Words with numbers, or symbols substituted for letters (`sn0opy` for snoopy)

Administering Passwords

This section describes how to administer passwords in an NIS+ namespace. This section assumes that you have an adequate understanding of the NIS+ security system in general, and in particular of the role that login passwords play in that system (see Chapter 11, for this information).

Note – The `passwd` command now performs all functions previously performed by `nispasswd`. For operations specific to an NIS+ namespace, use `passwd -r nisplus` .

`nsswitch.conf` File Requirements

In order to properly implement the `passwd` command and password aging on your network, the `passwd` entry of the `nsswitch.conf` file on every machine must be correct. This entry determines where the `passwd` command will go for password information and where it will update password information.

Only five `passwd` configurations are permitted:

- `passwd: files`
- `passwd: files nis`
- `passwd: files nisplus`
- `passwd: compat`
- `passwd: compat passwd_compat: nisplus`

Caution – All of the `nsswitch.conf` files on all of your network's machines must use one of the `passwd` configurations shown above. If you configure the `passwd` entry in any other way, users may not be able to log in.

The `nispasswd` Command

All functions previously performed by the `nispasswd` command are now performed by the `passwd` command. When issuing commands from the command line, you should use `passwd`, not `nispasswd`.

(The `nispasswd` command is still retained with all of its functionality for the purpose of backward compatibility.)

The `yppasswd` Command

All functions previously performed by the `yppasswd` command are now performed by the `passwd` command. When issuing commands from the command line, you should use `passwd`, not `yppasswd`.

(The `yppasswd` is still retained with all of its functionality for the purpose of backward compatibility.)

The `passwd` Command

The `passwd` command performs various operations regarding passwords. The `passwd` command replaces the `nispasswd` command. You should use the `passwd` command for all activities which used to be performed with the `nispasswd` command. (See the `passwd` command man page for a complete description of all `passwd` flags, options, and arguments.)

The `passwd` command allows users to perform the following operations:

- Change their passwords
- List their password information

Administrators can use the `passwd` command to perform the following operations:

- Force users to change their passwords the next time the log in
- Lock a user's password (prevent it from being used)
- Set a minimum number of days before a user can change passwords
- Specified when a user is warned to change passwords

- Set a maximum number of days a password can be used without being changed

passwd and the nsswitch.conf File

The name service switch determines where the passwd command (and other commands) obtains and stores password information. If the passwd entry of the applicable nsswitch.conf file points to:

- nisplus. Password information will be obtained, modified, and stored in the passwd and cred tables of the appropriate domain.
- nis. Password information will be obtained, modified, and stored in passwd maps.
- files. Password information will be obtained, modified, and stored in the /etc/passwd and /etc/shadow files.

The passwd -r *Option*

When you run the passwd command with the -r nisplus, -r nis , or -r files arguments, those options override the nsswitch.conf file setting. You will be warned that this is the case. If you continue, the -r option will cause the passwd command to ignore the nsswitch.conf file sequence and update the information in the password information storage location pointed to by the -r flag.

For example, if the passwd entry in the applicable nsswitch.conf file reads:

```
passwd: files nisplus
```

files is the first (primary) source, and passwd run without the -r option will get its password information from the /etc/passwd file. If you run the command with the -r nisplus option, passwd will get its information from the appropriate NIS+ passwd table and make its changes to that table, not to the /etc/passwd file.

The -r option should only be used when you cannot use the nsswitch.conf file because the search sequence is wrong. For example, when you need to update password information that is stored in two places, you can use the order specified in the nsswitch.conf file for the first one, but for the second one you have to force the use of the secondary or tertiary source.

The message:

```
Your specified repository is not defined in the nsswitch file!
```

indicates that your change will be made to the password information in the repository specified by the -r option, but that change will not affect anyone until the nsswitch.conf file is changed to point to that repository. For example, suppose the nsswitch.conf file reads passwd: files nis and you use the -r nisplus option to establish password-aging limits in an NIS+ passwd table. Those

password-aging rules will sit in that table unused because the `nsswitch.conf` file is directing everyone to other places for their password information.

The `passwd` Command and "NIS+ Environment"

In this chapter, the phrase *NIS+ environment* refers to situations where the passwd entry of the applicable `nsswitch.conf` file is set to `nisplus`, or the `passwd` command is run with the `-r nisplus` argument.

The `passwd` Command and Credentials

When run in an NIS+ environment (see above), the `passwd` command is designed to function with or without credentials. Users without credentials are limited to changing their own password. Other password operations can only be performed by users who have credentials (are authenticated) and who have the necessary access rights (are authorized).

The `passwd` Command and Permissions

In this discussion of authorization and permissions, it is assumed that everyone referred to has the proper credentials.

By default, in a normal NIS+ environment the owner of the passwd table can change password information at any time and without constraints. In other words, the owner of the passwd table is normally granted full read, modify, create, and destroy authorization (permission) for that table. An owner can also:

- Assign table ownership to someone else with the `nischown` command.
- Grant some or all of read, modify, create, and destroy rights to the table's group, or even to the world or nobody class. (Of course, granting such rights to world or nobody seriously weakens NIS+ security.)
- Change the permissions granted to any class with the `nisdefaults`, `nischmod`, or `nistbladm` commands.

Note – Regardless of what permissions they have, everyone in the world, and nobody classes are forced to comply with password-aging constraints. In other words, they cannot change a password for themselves or anyone else unless that password has aged past its minimum. Nor can members of the group, world, and nobody classes avoid having to change their own passwords when the age limit has been reached. However, age constraints do not apply to the owner of the passwd table.

To use the `passwd` command in an NIS+ environment, you must have the required authorization (access rights) for the operation:

TABLE 16–1 Access Rights for `passwd` Command

This Operation	Requires These Rights	To This Object
Displaying information	read	passwd table entry
Changing Information	modify	passwd table entry
Adding New Information	modify	passwd table

The `passwd` Command and Keys

If you use `passwd` in an NIS+ environment to change a principal's password, it tries to update the principal's private (secret) key in the cred table.

- If you have modify rights to the DES entry in the cred table and if the principal's login and Secure RPC passwords are the same, `passwd` will update the private key in the cred table.
- If you do not have modify rights to the DES entry in the cred table or if the principal's login and Secure RPC passwords are not the same, the `passwd` command will change the password, but not change the private key.

  If you do not have modify rights to the DES entry, it means that the private key in the cred table will have been formed with a password that is now different from the one stored in the passwd table. In this case, the user will have to change keys with the `chkey` command or run `keylogin` after each login.

The `passwd` Command and Other Domains

To operate on the passwd table of another domain, use:

`passwd [`*options*`] -D` *domainname*

The `nistbladm` Command

The `nistbladm` command allows you to create, change, and display information about any NIS+ table, including the `passwd` table.

Caution – To perform password operations using the `nistbladm` command you must apply `nistbladm` to the shadow column of the passwd table. Applying `nistbladm` to the shadow column is complex and tricky. Therefore, you should not use the `nistbladm` command for any operation that can more easily be performed by the `passwd` command or by using the AdminTool or Solstice AdminSuite tools.

You should use the `passwd` command or Solstice AdminSuite tools to perform the following operations:

- Changing a password
- Setting the maximum period that a password can be used (password aging).
- Setting the minimum period that a password must be used.
- Setting the password warning period.
- Turning off password aging

It is possible to use the `nistbladm` command to:

- Create new passwd table entries
- Delete an existing entry
- Change the UID and GID fields in the passwd table
- Change access rights and other security-related attributes of the passwd table
- Set expiration and inactivity periods for a user's account (see "Password Privilege Expiration" on page 313 and "Specifying Maximum Number of Inactive Days" on page 315.)

`nistbladm` and Shadow Column Fields

You use the `nistbladm` command to set password parameters by specifying the values of the different fields in the shadow column. These fields are entered in the format:

```
                              Min      Warn    Expire
                               |        |       |
nistbladm -m shadow=n1 :n2 :n3 :n4 :n5 :n6 :n7 [name=login], passwd.org_dir
                       |       |       |       |
                  Lastchange  Max    Inactive  Unused
```

Where:

- *N1 Lastchange*. The date of the last password change expressed as a number of days since January 1, 1970. The value in this field is automatically updated each time the user changes passwords. (See "`nistbladm` And the Number of Days" on page 304 for important information regarding the number of days.) If the field is blank, or contains a zero, it indicates that there has not been any change in the past.

  Note that the number of days in the lastchange field is the base from which other fields and operations are calculated. Thus, an incorrect change in this field could have unintended consequence in regards to minimum, maximum, warning, and inactive time periods.

- *N2 Min*. The minimum number of days that must pass since the last time the password was changed before the user can change passwords again. For example, if the value in the lastchange field is 9201 (that is, 9201 days since 1/1/70) and the value in the min field is 8, the user is unable to change passwords until after day 9209. See "Setting Minimum Password Life" on page 310 for additional information on password minimums.

  Where *min* is one of the following values:

  - *Zero (0)*. A value of zero in this field (or a blank space) means that there is no minimum period
  - *Greater than zero*. Any number greater than zero sets that number of days as the minimum password life.
  - *Greater than max*. A value in this field that is greater than the value in the max field prevents the user from ever changing passwords. The message: `You may not change this password` is displayed when the user attempts to change passwords.

- *N3 Max*. The maximum number of days that can pass since the last time the password was changed. Once this maximum number of days is exceeded, the user is forced to choose a new password the next time the user logs in. For example, if the value in the lastchange field is 9201 and the value in the max field is 30, after day 9231 (figured 9201+30=9231), the user is forced to choose a new password at the next login. See "Setting a Password Age Limit" on page 310 for additional

information on password maximums.

Where *max* is one of the following values:

- *Zero (0)*. A value of zero (0) forces the user to change passwords the next time the user logs in, and it then turns off password aging.
- *Greater than zero*. Any number greater than zero sets that number of days before the password must be changed.
- *Minus one (-1)*. A value of minus one (-1) turns off password aging. In other words, entering **`passwd -x -1`** *username* cancels any previous password aging applied to that user. A blank space in the field is treated as if it were a minus one.

- *N4 Warn*. The number of days before a password reaches its maximum that the user is warned to change passwords. For example, suppose the value in the lastchange field is 9201, the value in the max field is 30, and the value in the warn field is 5. Then after day 9226 (figured 9201+30-5=9226) the user starts receiving "change your password" type warnings at each longing time. See "Establishing a Warning Period" on page 311 for additional information on password warning times.

  Where *warn* is one of the following values:

  - *Zero (0)*. No warning period.
  - *Greater than zero*. A value of zero (0) sets the warning period to that number of days.

- *N5 Inactive*. The maximum number of days between logins. If this maximum is exceeded, the user is not allowed to log in. For example, if the value of this field is 6, and the user does not log in for six days, on the seventh day the user is no longer allowed to log in. See "Specifying Maximum Number of Inactive Days" on page 315 for additional information on account inactivity.

  Where *inactive* is one of the following values:

  - *Minus one (-1*). A value of minus one (-1) turns off the inactivity feature. The user can be inactive for any number of days without losing login privileges. This is the default.
  - *Greater than zero*. A value greater than zero sets the maximum inactive period to that number of days.

- *N6 Expire*. The date on which a password expires, expressed as a number of days since January 1, 1970. After this date, the user can no longer log in. For example, if this field is set to 9739 (September 1, 1995) on September 2, 1995 GMT, the user will not be able to login and will receive a `Login incorrect` message after each try. See "Password Privilege Expiration" on page 313 for additional information on password expiration.

  Where *expire* is one of the following values:

  - *Minus one (-1)*. A value of minus one (-1) turns off the expiration feature. If a user's password has already expired, changing this value to -1 restores it. If you

do not want to set any expiration date, type a `-1` in this field.

- *Greater than zero*. A value greater than zero sets the expiration date to that number of days since 1/1/70. If you enter today's date or earlier, you immediately deactivate the users password.

- *N7 Unused*. This field is not currently used. Values entered in this field will be ignored.
- *Login* is the user's login ID

Caution – When using `nistbladm` on the shadow column of the password table, all of the numeric fields must contain appropriate values. You cannot leave a field blank, or enter a zero, as a *no change* placeholder.

For example, to specify that the user amy last changed her password on day 9246 (May 1, 1995), cannot change her password until it has been in use for 7 days, must change her password after 30 days, will be warned to change her password after the 25th day, must not remain inactive more than 15 days, and has an account that will expire on day number 9255, you would type:

`nistbladm` And the Number of Days

Most password aging parameters are expressed in number of days. The following principles and rules apply:

- Days are counted from January 1, 1970. That is day zero. January 2, 1970, is day 1.
- NIS+ uses Greenwich mean time (GMT) in figuring and counting days. In other words, the day count changes at midnight GMT.
- When you specify a number of days, you must use a whole number. You cannot use fractions of days.
- When the number of days is used to specify some action, such as locking a password, the change takes effect on the day. For example, if you specify that a user's password privilege expires on day 9125 (January 2, 1995), that is the last day that the user can use the password. On the next day, the user can no longer use the password.

Values are entered in both the `Lastchange` snd the `Expire` fields as a number of days since January 1, 1970. For example:

TABLE 16–2 Number of Days Since 1/1/70

Date	Day Number
January 1, 1970	0

TABLE 16–2 Number of Days Since 1/1/70 *(Continued)*

Date	Day Number
January 2, 1970	1
January 2, 1971	365
January 1, 1997	9863

Related Commands

The `passwd` and `nistbladm` commands provide capabilities that are similar to those offered by other commands. Table 16–3 summarizes their differences.

TABLE 16–3 Related Commands

Command	Description
`yppasswd`	Is now linked to the `passwd` command. Using `yppasswd` simply invokes the `passwd` command.
`nispasswd`	Is now linked to the `passwd` command. Using `nispasswd` simply invokes the `passwd` command.
`niscat`	Can be used to display the contents of the passwd table.

Displaying Password Information

You can use the `passwd` command to display password information about all users in a domain or about one particular user:

For your password information

```
passwd -s
```

For all users in current domain

```
passwd -s -a
```

For a particular user

```
passwd -s username
```

Only the entries and columns for which you have read permission will be displayed. Entries are displayed with the following format:

- Without password aging: *username status*
- With password aging: *username status mm/dd/yy min max warn expire inactive*

TABLE 16–4 NIS+ Password Display Format

Field	Description	For Further Information
username	The user's login name.	
status	The user's password status. PS indicates the account has a password. LK indicates the password is locked. NP indicates the account has no password.	See "Locking a Password" on page 307.
mm/dd/yy	The date, based on Greenwich mean time, that the user's password was last changed.	
min	The minimum number of days since the last change that must pass before the password can be changed again.	See "Setting Minimum Password Life" on page 310.
max	The maximum number of days the password can be used without having to change it.	See "Setting a Password Age Limit" on page 310.
warn	The number of days' notice that users are given before their passwords have to be changed.	See "Establishing a Warning Period" on page 311.
expire	A date on which users loose the ability to log in to their accounts.	See "Password Privilege Expiration" on page 313.
inactive	A limit on the number of days that an account can go without being logged in to. Once that limit is passed without a log in users can no longer access their accounts.	See "Specifying Maximum Number of Inactive Days" on page 315.

To display entries from a passwd table in another domain, use the `-D` option:

For all users in another domain

```
passwd -s -a -D domainname
```

For a particular user

```
passwd -s -D domainname username
```

Changing Passwords

New passwords must meet the criteria described in "Password Requirements" on page 295.

Changing Your Own Password

To change your password, type

```
station1% passwd
```

You will be prompted for your old password and then the new password and then the new password a second time to confirm it.

Changing Someone Else's Password

To change someone else' password, use:

To change another user's password in the same domain

`passwd` *username*

To change another user's password in a different domain

`passwd -D` *domainname username*

When using the `passwd` command in an NIS+ environment (see "The `passwd` Command and "NIS+ Environment"" on page 299) to change someone else's password you must have modify rights to that user's entry in the passwd table (this usually means that you are a member of the group for the passwd table and the group has modify rights). You do not have to enter either the user's old password or your password. You will be prompted to enter the new password twice to make sure that they match. If they do not match, you will be prompted to enter them again.

Changing Root's Password

When changing root's password, you must always run `chkey -p` immediately after changing the password with the `passwd` command. Failure to run `chkey -p` after changing root's password will result in root being unable to properly log in.

To change a root password, follow these steps:

1. **Log in as root.**
2. **Change root's password using** `passwd`**.**
   Do not use `nispasswd`.
3. **Run** `chkey -p`**.**
   You *must* use the `-p` option.

Locking a Password

When operating in an NIS+ environment (see "The `passwd` Command and "NIS+ Environment"" on page 299), an administrator (a group member) with modify rights to a user's entry in the passwd table can use the `passwd` command to lock a

password. An account with a locked password cannot be used. When a password is locked, the user will receive a `Login incorrect` message after each login attempt.

Keep in mind that locked passwords have no effect on users who are already logged in. A locked password only prevents users from performing those operations that require giving a password such as `login`, `rlogin, ftp`, or `telnet`.

Note also that if a user with a locked password is already logged in, and that user uses the `passwd` command to change passwords, the lock is broken.

You can use this feature to:

- Temporarily lock a user's password while that user is on vacation or leave. This prevents anyone from logging in as the absent user.
- Immediately lock one or more user passwords in the case of suspected security problem.
- Quickly lock a dismissed employee out of the system. This is quicker and easier than eliminating that user's account and is an easy way of preserving any data stored in that account.
- If you have assigned passwords to UNIX processes, you can lock those passwords. This allows the process to run, but prevents anyone from logging in as those processes even if they know the process password. (In most cases, processes would not be set up as NIS+ principals, but would maintain their password information in `/etc` files. In such a case you would have to run the `passwd` command in files mode to lock `/etc` stored passwords.)

To lock a password, use:

`passwd -l` *username*

Unlocking a Password

To unlock a user's password, you simply change it. You can "change" it back to the exact same password that it was when it was locked. Or you can change it to something new.

For example, to unlock `jody`'s password, you would enter:

```
station1% passwd jody
```

Managing Password Aging

Password aging is a mechanism you can use to force users to periodically change their passwords.

Password aging allows you to:

- Force a user to choose a new password the next time the user logs in. (See "Forcing Users to Change Passwords" on page 309 for details.)
- Specify a maximum number of days that a password can be used before it has to be changed. (See "Setting a Password Age Limit" on page 310 for details.)
- Specify a minimum number of days that a password has to be in existence before it can be changed. (See "Setting Minimum Password Life" on page 310 for details.)
- Specify that a warning message be displayed whenever a user logs in a specified number of days before the user's password time limit is reached. (See "Establishing a Warning Period" on page 311 for details.)
- Specify a maximum number of days that an account can be inactive. If that number of days pass without the user logging in to the account, the user's password will be locked. (See "Specifying Maximum Number of Inactive Days" on page 315 for details.)
- Specify an absolute date after which a user's password cannot be used, thus denying the user the ability to log on to the system. (See "Password Privilege Expiration" on page 313 for details.)

Keep in mind that users who are already logged in when the various maximums or dates are reached are not affected by the above features. They can continue to work as normal.

Password aging limitations and activities are only activated when a user logs in or performs one of the following operations:

- `login`
- `rlogin`
- `telnet`
- `ftp`

These password aging parameters are applied on user-by-user basis. You can have different password aging requirements for different users. (You can also set general default password aging parameters as described in "Managing Password Aging" on page 308.)

Forcing Users to Change Passwords

There are two ways to force a user to change passwords the next time the user logs in:

Force change keeping password aging rules in effect

```
passwd -f username
```

Force change and turn off password aging rules

```
passwd -x 0 username
```

Setting a Password Age Limit

The `-max` argument to the `passwd` command sets an age limit for the current password. In other words, it specifies the number of days that a password remains valid. After that number of days, a new password must be chosen by the user. Once the maximum number of days have passed, the next time the user tries to login with the old password a `Your password has been expired for too long` message is displayed and the user is forced to choose a new password in order to finish logging in to the system.

The max argument uses the following format:

`passwd -x` *`max username`*

Where:

- *username* is the login ID of the user
- *max* is one of the following values:
  - *Greater than zero*. Any number greater than zero sets that number of days before the password must be changed.
  - *Zero (0)*. A value of zero (0) forces the user to change passwords the next time the user logs in, and it then turns off password aging.
  - *Minus one (-1)*. A value of minus one (-1) turns off password aging. In other words, entering **`passwd -x -1`** *username* cancels any previous password aging applied to that user.

For example, to force the user `schweik` to change passwords every 45 days, you would type the command:

```
station1% passwd -x 45 schweik
```

Setting Minimum Password Life

The *min* argument to the `passwd` command specifies the number of days that must pass before a user can change passwords. If a user tries to change passwords before the minimum number of days has passed, a `Sorry less than N days since the last change` message is displayed.

The *min* argument uses the following format:

`passwd -x` *`max`* `-n` *`min username`*

Where:

- *username* is the login ID of the user
- *max* is the maximum number of days a password is valid as described in the section above

- *min* is the minimum number of days that must pass before the password can be changed.

For example, to force the user `eponine` to change passwords every 45 days, and prevent him from changing it for the first 7 days you would type the command:

```
station1% passwd -x 45 -n 7 eponine
```

The following rules apply to the *min* argument:

- You do not have to use a *min* argument or specify a minimum number of days before a password can be changed.
- If you do use the *min* argument, it must always be used in conjunction with the `-max` argument. In other words, in order to set a minimum value you must also set a maximum value.
- If you set *min* to be greater than *max*, the user is unable to change passwords at all. For example, the command `passwd -x 7 -n 8` prevents the user from changing passwords. If the user tries to change passwords, the `You may not change this password` message is displayed. Setting the *min* value greater than the *max* value has two effects:
  - The user is unable to change password. In this case, only someone with administer privileges could change the password. For example, in situations where multiple users share a common group password, setting the *min* value for that password greater than the *max* value would prevent any individual user from changing the group password.
  - The password is only valid for the length of time set by the *max* value, but the user cannot change it because the *min* value is greater than the *max* value. Thus, there is no way for the user to prevent the password from becoming invalid at the expiration of the *max* time period. In effect, this prevents the user from logging in after the *max* time period unless an administrator intervenes.

Establishing a Warning Period

The *warn* argument to the `passwd` command specifies the number of days before a password reaches its age limit that users will start to seeing a `Your password will expire in N days` message (where *N* is the number of days) when they log in.

For example, if a user's password has a maximum life of 30 days (set with the `-max` argument) and the warn value is set to 7 days, when the user logs in on the 24th day (one day past the warn value) the warning message `Your password will expire in 7 days` is displayed. When the user logs in on the 25th day the warning message `Your password will expire in 6 days` is displayed.

Keep in mind that the warning message is not sent by Email or displayed in a user's console window. It is displayed only when the user logs in. If the user does not log in during this period, no warning message is given.

Keep in mind that the *warn* value is *relative* to the *max* value. In other words, it is figured backwards from the deadline set by the *max* value. Thus, if the *warn* value is set to 14 days, the `Your password will expire in N days` message will begin to be displayed two weeks before the password reaches its age limit and must be changed.

Because the *warn* value is figured relative to the *max* value, it only works if a *max* value is in place. If there is no *max* value, *warn* values are meaningless and are ignored by the system.

The *warn* argument uses the following format:

`passwd -x` *max* `-w` *warn username*

Where:

- *username* is the login ID of the user.
- *max* is the maximum number of days a password is valid as described on "Setting a Password Age Limit" on page 310.
- *warn* is the number of days before the password reaches its age limit that the warning message will begin to be displayed.

For example, to force the user nilovna to change passwords every 45 days, and display a warning message 5 days before the password reaches its age limit you would type the command:

```
station1% passwd -x 45 -w 5 nilovna
```

The following rules apply to the *warn* argument:

- You do not have to use the *warn* argument or specify a warning message. If no *warn* value is set, no warning message is displayed prior to a password reaching its age limit.
- If you do use the *warn* argument, it must always be used in conjunction with the *max* argument. In other words, in order to set a warning value you must also set a maximum value.

Note – You can also use Solstice AdminSuite™ to set a warn value for a user's password.

Turning Off Password Aging

There are two ways to turn off password aging for a given user:

Turn off aging while allowing user to retain current password

`passwd -x -1` *username*

Force user to change password at next login, and then turn off aging

```
passwd -x 0 username
```

This sets the *max* value to either zero or -1 (see "Setting a Password Age Limit" on page 310 for more information on this value).

For example, to force the user `mendez` to change passwords the next time he logs in and then turn off password aging you would type the command:

```
station% passwd -x 0 mendez
```

Note – You can also use Solstice AdminSuite™ to set this parameter for a user's password.

You can also use the `nistbladm` command to set this value. For example, to turn off password aging for the user otsu and allow her to continue using her current password, you would type:

```
station1% nistbladm -m 'shadow=0:0:-1:0:0:0:0' [name=otsu],passwd.org_dir
```

For additional information on using the `nistbladm` command, see "The `nistbladm` Command" on page 301.

Password Privilege Expiration

You can set a specific date on which a user's password privileges expires. When a user's password privilege expires, that user can no longer have a valid password at all. In effect, this locks the user out of the system after the given date because after that date the user can no longer log in.

For example, if you specify an expire date of December 31, 1997, for a user named pete, on January 1, 1998 he will not be able to log in under that user ID regardless of what password he uses. After each login attempt he will receive a `Login incorrect` message.

Password Aging Versus Expiration

Expiration of a user's password privilege is not the same as password aging.

- *Password aging*. A password that has not been changed for longer than the aging time limit is sometimes referred to as an *expired password*. But that password can still be used to log in *one* more time. As part of that last login process the user is forced to choose a new password.
- *Expiration of password privilege*. When a user's password *privilege* expires, the user cannot log in at all with *any* password.) In other words, it is the user's permission

to log in to the network that has expired.

Setting an Expiration Date

Password privilege expiration dates only take effect when the user logs in. If a user is *already* logged in, the expiration date has no affect until the user logs out or tries to use `rlogin` or `telnet` to connect to another machine at which time the user will not be able to log in again. Thus, if you are going to implement password privilege expiration dates, you should require your users to log out at the end of each day's work session.

Note – If you have Solstice AdminSuite™ tools available, do not use `nistbladm` to set an expiration date. Use Solstice AdminSuite™ tools because they are easier to use and provide less chance for error.

To set an expiration date with the `nistbladm` command:

```
nistbladm -m 'shadow=n:n:n:n:n:n6:n' [name=login],passwd.org_dir
```

Where:

- *login* is the user's login ID
- *n* indicates the values in the other fields of the shadow column.
- *n6* is the date on which the user's password privilege expires. This date is entered as a number of days since January 1, 1970 (see Table 16–2). *n6* can be one of the following values:
  - *Minus one (-1)*. A value of minus one (-1) turns off the expiration feature. If a user's password has already expired, changing this value to -1 restores (un-expires) it. If you do not want to set any expiration date, type `-1` in this field.
  - *Greater than zero*. A value greater than zero sets the expiration date to that number of days since 1/1/70. If you enter today's date or earlier, you immediately expire the user's password.

For example, to specify an expiration date for the user `pete` of December 31, 1995 you would type:

```
station1% nistbladm -m 'shadow=n:n:n:n:n:9493:n' [name=pete],passwd.org_dir
```

Caution – All of the fields must be filled in with valid values.

Turning Off Password Privilege Expiration

To turn off or deactivate password privilege expiration, you must use the `nistbladm` command to place a `-1` in this field. For example, to turn off privilege expiration for the user huck, you would type:

```
station1% nistbladm -m 'shadow=n:n:n:n:n:-1:n' [name=huck],passwd.org_dir
```

Or you can use the `nistbladm` command reset the expiration date to some day in the future by entering a new number of days in the *n6* field.

Specifying Maximum Number of Inactive Days

You can set a maximum number of days that a user can go without logging in on a given machine. Once that number of days passes without the user logging in, that machine will no longer allow that user to log in. In this situation, the user will receive a `Login incorrect` message after each login attempt.

This feature is tracked on a machine-by-machine basis, not a network-wide basis. That is, in an NIS+ environment, you specify the number of days a user can go without logging in by placing an entry for that user in the passwd table of the user's home domain. That number applies for that user on all machines on the network.

For example, suppose you specify a maximum inactivity period of 10 days for the user sam. On January 1, sam logs in to both machine-A and machine-B, and then logs off both machines. Four days later on January 4, sam logs in on machine-B and then logs out. Nine days after that on January 13, sam can still log in to machine-B because only 9 days have elapsed since the last time he logged in on that machine, but he can no longer log in to machine-A because thirteen days have passed since his last log in on that machine.

Keep in mind that an inactivity maximum cannot apply to a machine the user has never logged in to. No matter what inactivity maximum has been specified or how long it has been since the user has logged in to some other machine, the user can always log in to a machine that the user has never logged in to before.

Caution – Do not set inactivity maximums unless your users are instructed to log out at the end of each workday. The inactivity feature only relates to logins; it does not check for any other type of system use. If a user logs in and then leaves the system up and running at the end of each day, that user will soon pass the inactivity maximum because there has been no login for many days. When that user finally does reboot or log out, he or she won't be able to log in.

Note – If you have Solstice AdminSuite™ tools available, do not use `nistbladm` to set an inactivity maximum. Use Solstice AdminSuite tools because they are easier to use and provide less chance for error.

To set a login inactivity maximum, you must use the `nistbladm` command in the format:

```
nistbladm -m 'shadow=n:n:n:n:n5:n:n' [name=login],passwd.org_dir
```

Where:

- *login* is the user's login ID
- *n* indicates the values in the other fields of the shadow column.
- *n5* is the number of days the user is allowed to go between logins. *Inactive* can be one of the following values:
  - *Minus one (-1*). A value of minus one (-1) turns off the inactivity feature. The user can be inactive for any number of days without losing login privileges. This is the default.
  - *Greater than zero*. A value greater than zero sets the maximum inactive period to that number of days.

For example, to specify that the user `sam` must log in at least once every seven days, you would type:

```
station1% nistbladm -m 'shadow=n:n:n:n:n:7:n:n' [name=sam],passwd.org_dir
```

To clear an inactivity maximum and allow a user who has been prevented from logging in to log in again, use `nistbladm` to set the inactivity value to -1.

Specifying Password Criteria and Defaults

The following subsections describe various password-related defaults and general criteria that you can specify.

The /etc/defaults/passwd File

The /etc/defaults/passwd file is used to set four general password defaults for users whose nsswitch.conf file points to files. The defaults set by the /etc/defaults/passwd file apply only to those users whose operative password information is taken from /etc files; they do not apply to anyone using either NIS maps or NIS+ tables. An /etc/defaults/passwd file on an NIS+ server only affects local users who happen to be obtaining their password information from those local files. An /etc/defaults/passwd file on an NIS+ server has no effect on the NIS+ environment or users whose nsswitch.conf file points to either nis or nisplus.

The four general password defaults governed by the /etc/defaults/passwd file are:

- Maximum number of weeks the password is valid
- Minimum number of weeks the password is valid
- The number of weeks before the password becomes invalid that the user is warned
- The minimum number of characters that a password must contain

The following principles apply to defaults set with an /etc/defaults/passwd file:

- For users who obtain password information from local /etc files, individual password aging maximums, minimums and warnings set by the password command or Solstice AdminSuite or AdminTool override any /etc/defaults/passwd defaults. In other words, defaults set in the /etc/defaults/passwd file are not only applied to those users who do not have corresponding individual settings in their entries in their passwd table.
- Except for password length, all the /etc/defaults/passwd file defaults are expressed as a number of weeks. (Remember that *individual* password aging times are expressed as a number of days.)
- The MAXWEEKS, MINWEEKS, and WARNWEEKS defaults are all counted forward from the date of the user's last password change. (Remember that *individual warn* values are counted backwards from the maximum date.)

By default, /etc/defaults/passwd files already contain the entries:

```
MAXWEEKS=
MINWEEKS=
PASSLENGTH=
```

To implement an entry, simply type the appropriate number after the equal sign. Entries that do not have a number after the equal sign are inactive and have no affect on any user. Thus, to set a MAXWEEKS default of 4, you would change the /etc/defaults/passwd file to read:

```
MAXWEEKS=4
MINWEEKS=
PASSLENGTH=
```

Maximum weeks

You can use the MAXWEEKS default in the /etc/defaults/passwd file to set the maximum number of weeks that a user's password is valid. To set a default maximum time period, type the appropriate number of weeks after the equal sign in the MAXWEEKS= line:

```
MAXWEEKS=N
```

Where *N* is a number of weeks. For example, MAXWEEKS=9.

Minimum Weeks

You can use the MINWEEKS default in the /etc/defaults/passwd file to set the minimum nuber of weeks that must pass before a user can change passwords. To set a default minimum time period, type the appropriate number of weeks after the equal sign on the MINWEEKS= line:

```
MINWEEKS=N
```

Where *N* is a number of weeks. For example, MINWEEKS=2.

Warning Weeks

You can add a WARNWEEKS default to the /etc/defaults/passwd file set the number of weeks prior to a password becoming invalid due to aging that user is warned. for example, if you have set the MAXWEEKS default to 9, and you want users to be warned two weeks before their passwords become invalid, you would set the MAXWEEKS default to 7.

There is no point in setting the WARNWEEKS default unless you also set a MAXWEEKS default.

Remember that WARNWEEKS are counted forward from the date of the user's last password change, not backwards from the MAXWEEKS expiration date. Thus, WARNWEEKS must always be less than MAXWEEKS and cannot be equal to or greater than MAXWEEKS .

A WARNWEEKS default will not work unless there is also a MAXWEEKS default.

To set the warning time period, type the appropriate number of weeks after the equal sign on the WARNWEEKS= line.

```
WARNWEEKS=N
```

Where *N* is the number of weeks. For example, WARNWEEKS=1.

Minimum Password Length

By default, the `passwd` command assumes a minimum length of six characters. You can use the `PASSLENGTH` default in the `/etc/defaults/passwd` files to change that by setting the minimum number of characters that a user's password must contain to some other number.

To set the minimum number of characters to something other than six, type the appropriate number of characters after the equal sign in the `PASSLENGTH=` line:

```
PASSLENGTH=N
```

Where *N* is the number of characters. For example, `PASSLENGTH=7`.

Password Failure Limits

You can specify a number-of-tries limit or an amount-of-time limit (or both) for a user's attempt to change passwords. These limits are specified by adding arguments when starting the `rpc.nispasswdd` daemon.

Limiting the number of attempts or setting a time frame provides a limited (but not foolproof) defense against unauthorized persons attempting to change a valid password to one that they discover through trial and error.

Maximum Number of Tries

To set the maximum number of times a user can try to change a password without succeeding, use the `-a` *number* argument with `rpc.nispasswdd`, where *number* is the number of allowed tries. (You must have superuser privileges on the NIS+ master server to run `rpc.nispasswdd`.)

For example, to limit users to no more than four attempts (the default is 3), you would type:

```
station1# rpc.nispasswdd -a 4
```

In this case, if a user's fourth attempt at logging in is unsuccessful, the message `Too many failures - try later` is displayed. No further attempts are permitted for that user ID until a specified period of time has passed.

Maximum Login Time Period

To set the maximum amount a time a user can take to successfully change a password, use the `-c` *minutes* argument with `rpc.nispasswdd`, where *minutes* is the number of minutes a user has to log in. (You must have superuser privileges on the NIS+ master server to run `rpc.nispasswdd`.)

For example, to specify that users must successfully log in within 2 minutes, you would type:

```
station1# rpc.nispasswdd -c 2
```

In this case, if a user is unable to successfully change a password within 2 minutes, the message is displayed at the end of the two-minute period. No further attempts are permitted for that user ID until a specified period of time has passed.

CHAPTER 17

Administering NIS+ Groups

This chapter describes NIS+ groups and how to administer them.

Note – Some NIS+ security group tasks can be performed more easily with Solstice AdminSuite tools if you have them available.

Solaris Groups

In a Solaris-NIS+ environment, there are three kinds of groups: UNIX groups, net groups, and NIS+ groups.

- *UNIX groups*. A UNIX group is simply a collection of users who are given additional UNIX access permissions. In an NIS+ namespace, UNIX group information is stored in the group table located in the `org_dir` directory object (`group.org_dir`). See Chapter 14, Administering NIS+ Tables, for information on how to add, modify, or delete members of a UNIX group.
- *Net groups*. A net group is a group of machines and users that have permission to perform remote operations on other machines. In an NIS+ namespace, net groups information is stored in the netgroup table located in the `org_dir` directory object (`netgroup.org_dir`). See Chapter 14, Administering NIS+ Tables, for information on how to add, modify, or delete members of a net groups.
- *NIS+ groups*. An NIS+ group is a set of NIS+ users that are assigned specific access rights to NIS+ objects, usually for the purpose of administering the namespace. NIS+ group information is stored in tables located in the groups_dir directory object.

NIS+ Groups

NIS+ groups are used to assign access rights to NIS+ objects to one or more NIS+ principles. These access rights are described in Chapter 11. Information about NIS+ groups is stored in tables located in the NIS+ `groups_dir` directory object. Information about each group is stored in a table of the same name. For example, information about the `admin` group is stored in `admin.groups_dir`.

It is recommended practice to create at least one NIS+ group called `admin`. The `admin` NIS+ group is normally used to designate those users who are to have NIS+ access rights. You can name this group anything you want, but the NIS+ manual set assumes that the group with NIS+ administrator privileges is named `admin`. You can also create multiple NIS+ groups with different sets of users and different sets of rights.

Note – Always use the `nisgrpadm` command to work with NIS+ group membership. You can also use the `nisls` and `nischgrp` commands on the group table. Do not use the `nistbladm` command on the group table.

For a complete description of NIS+ group-related commands and their syntax and options, see the NIS+ man pages.

Related Commands

The `nisgrpadm` command performs most group administration tasks but several other commands affect groups as well:

TABLE 17–1 Commands That Affect Groups

Command	Description	See
`nissetup`	Creates, among other things, the directory in which a domain's groups are stored: `groups_dir`.	
`nisls`	Lists the contents of the `groups_dir` directory; in other words, all the groups in a domain. For each named groups there will be a table of that name in `groups_dir`.	"Using the `nisls` Command With Directories" on page 332
`nischgrp`	Changes or assigns a group to any NIS+ object.	"Changing an Object or Entry's Group" on page 288

TABLE 17–1 Commands That Affect Groups *(Continued)*

Command	Description	See
`niscat`	Lists the object properties and membership of an NIS+ group.	"Using `niscat` With NIS+ Groups" on page 324
`nisdefaults`	Lists, among other things, the group that will be assigned to any new NIS+ object.	"Displaying NIS+ Defaults—The `nisdefaults` Command" on page 279

For a complete description of these commands and their syntax, and options, see the NIS+ man pages.

Note – Do not use the `nistbladm` command to work with the NIS+ groups table.

NIS+ Group Member Types

NIS+ groups can have three types of members: explicit, implicit, and recursive; and three types of nonmembers, also explicit, implicit, and recursive. These member types are used when adding or removing members of a group as described in "The `nisgrpadm` Command" on page 325.

Member Types

- *Explicit*. An individual principal. Identified by principal name. The name does not have to be fully qualified if entered from its default domain.
- *Implicit*. All the NIS+ principals who belong to an NIS+ domain. They are identified by their domain name, preceded by the `*` symbol and a dot. The operation you select applies to all the members in the group.
- *Recursive.* All the NIS+ principals that are members of another NIS+ group. They are identified by their NIS+ group name, preceded by the @ symbol. The operation you select applies to all the members in the group.

NIS+ groups also accept nonmembers in all three categories: explicit, implicit, and recursive. Nonmembers are principals specifically excluded from a group that they otherwise would be part of.

Nonmember Types

Nonmembers are identified by a minus sign in front of their name:

- *Explicit-nonmember.* Identified by a minus sign in front of the principal name.
- *Implicit-nonmember.* Identified by a minus sign, * symbol, and dot in front of the domain name.
- *Recursive nonmember.* Identified by a minus sign and @ symbol in front of the group name.

Group Syntax

The order in which inclusions and exclusions are entered does not matter. Exclusions always take precedence over inclusions. Thus, if a principal is a member of an included implicit domain and *also* a member of an excluded recursive group, then that principal is not included.

Thus, when using the `nisgrpadm` command, you can specify group members and nonmembers as shown in Table 17–2:

TABLE 17–2 Specifying Group Members and Nonmembers

Type of member	Syntax
Explicit member	*username.domain*
Implicit member	`*` . *domain*
Recursive member	*@groupname.domain*
Explicit nonmember	*-username.domain*
Implicit nonmember	`-*` . *domain*
Recursive nonmember	*@groupname.domain*

Using `niscat` With NIS+ Groups

The `niscat -o`command can be used to list the object properties and membership of an NIS+ group.

Listing the Object Properties of a Group

To list the object properties of a group, you must have read access to the `groups_dir` directory in which the group is stored. Use `niscat -o` and the group's fully qualified name, which must include its `groups_dir` subdirectory:

`niscat -o` *group-name*`.groups_dir.`*domain-name*

For example:

```
rootmaster# niscat -o sales.groups_dir.doc.com.
Object Name : sales
Owner : rootmaster.doc.com.
Group : sales.doc.com.
Domain : groups_dir.doc.com.
Access Rights : ----rmcdr---r---
Time to Live : 1:0:0
Object Type : GROUP
Group Flags :
Group Members : rootmaster.doc.com.
  topadmin.doc.com.
  @.admin.doc.com.
  *.sales.doc.com.
```

Note – A better list of members is provided by the `nisgrpadm -l` command.

Several of the group's properties are inherited from the `NIS_DEFAULTS` environment variable, unless they were overridden when the group was created. The group flags field is currently unused. In the list of group members, the * symbol identifies member domains and the @ symbol identifies member groups.

The `nisgrpadm` Command

The `nisgrpadm` command creates, deletes, and performs miscellaneous administration operations on NIS+ groups. To use `nisgrpadm`, you must have access rights appropriate for the operation,

TABLE 17–3 Rights Required for nisgrpadm Command

This Operation	Requires This Access Right	To This Object
Create a group	Create	`groups_dir` directory
Destroy a group	Destroy	`groups_dir` directory

TABLE 17–3 Rights Required for nisgrpadm Command *(Continued)*

This Operation	Requires This Access Right	To This Object
List the Members	Read	the group object
Add Members	Modify	the group object
Remove Members	Modify	the group object

The nisgrpadm has two main forms, one for working with groups and one for working with group members.

To create or delete a group, or to lists its members use these forms:

```
nisgrpadm -c group-name.domain-name
nisgrpadm -d group-name
nisgrpadm -l group-name
```

To add or remove members, or determine if they belong to the group use this form (where *member...* can be any combination of the six membership types listed in Table 17–2):

```
nisgrpadm -a group-name member...
nisgrpadm -r group-name member...
nisgrpadm -t group-name member...
```

All operations except create (`-c`) accept a partially qualified *group-name*. However, even for the `-c` option, `nisgrpadm` does not require the use of `groups_dir` in the *group-name* argument. In fact, it won't accept it.

Creating an NIS+ Group

To create an NIS+ group, you must have create rights to the `groups_dir` directory of the group's domain. Use the `-c` option and a fully qualified group name:

```
nisgrpadm -c group-name.
domainname
```

When you create a group, an NIS+ groups table with the name you have given is created in `groups_dir`. You can use `nisls` to confirm that the new group table now exists in `groups_dir`, and `niscat` to list the groups members listed in the table.

A newly created group contains no members. See "Adding Members to an NIS+ Group" on page 328 for information on how to specify who belongs to a group.

The example below creates three groups named admin. The first is in the `doc.com.` domain, the second in `sales.doc.com.`, and the third in `manf.doc.com.` All three are created on the master server of their respective domains.

```
rootmaster# nisgrpadm -c admin.doc.com.
Group admin.doc.com. created.
salesmaster# nisgrpadm -c admin.sales.doc.com.
Group admin.sales.doc.com. created.
manfmaster# nisgrpadm -c admin.manf.doc.com.
Group admin.manf.doc.com. created.
```

The group you create will inherit all the object properties specified in the `NIS_DEFAULTS` variable; that is, its owner, owning group, access rights, time-to-live, and search path. You can view these defaults by using the `nisdefaults` command (described in Chapter 15). Used without options, it provides this output:

```
rootmaster# nisdefaults
Principal Name : rootmaster.doc.com.
Domain Name : doc.com.
Host Name : rootmaster.doc.com.
Group Name :
Access Rights : ----rmcdr---r---
Time to live : 12:0:0
Search Path : doc.com.
```

The owner is listed in the Principal Name: field. The owning group is listed only if you have set the `NIS_GROUP` environment variable. For example, assuming a C-shell, to set `NIS_GROUP` to `fns_admins.doc.com`:

```
rootmaster# setenv NIS_GROUP fns_admins.doc.com
```

You can override any of these defaults at the time you create the group by using the `-D` option:

```
salesmaster# nisgrpadm -D group=special.sales.doc.com.-c
admin.sales.doc.com. Group admin.sales.doc.com. created.
```

Deleting an NIS+ Group

To delete an NIS+ group, you must have destroy rights to the `groups_dir` directory in the group's domain. Use the `-d` option:

```
nisgrpadm -d group-name
```

If the default domain is set properly, you don't have to fully-qualify the group name. However, you should check first (use `nisdefaults`), because you could unintentionally delete a group in another domain. The example below deletes the `test.sales.doc.com.` group.

```
salesmaster% nisgrpadm -d test.sales.doc.com.
Group 'test.sales.doc.com.' destroyed.
```

Adding Members to an NIS+ Group

To add members to an NIS+ group you must have modify rights to the group object. Use the `-a` option:

`nisgrpadm -a` *group-name members. . .*

As described in "NIS+ Group Member Types" on page 323, you can add principals (explicit members), domains (implicit members), and groups (recursive members). You don't have to fully qualify the name of the group or the name of the members who belong to the default domain. This example adds the NIS+ principals panza and valjean, both from the default domain, `sales.doc.com.`, and the principal `makeba`, from the `manf.doc.com.` domain, to the group `top-team.sales.doc.com.`

```
client% nisgrpadm -a Ateam panza valjean makeba.manf.doc.com.
Added panza.sales.doc.com to group Ateam.sales.doc.com
Added valjean.sales.doc.com to group Ateam.sales.doc.com
Added makeba.manf.doc.com to group Ateam.sales.doc.com
```

To verify the operation, use the `nisgrpadm -l` option. Look for the members under the Explicit members heading.

This example adds all the NIS+ principals in the `doc.com.` domain to the `staff.doc.com.` group. It is entered from a client in the `doc.com.` domain. Note the `*` symbol and the dot in front of the domain name.

```
client% nisgrpadm -a Staff *.doc.com.
Added *.doc.com. to group Staff.manf.doc.com.
```

This example adds the NIS+ group `admin.doc.com.` to the `admin.manf.doc.com.` group. It is entered from a client of the `manf.doc.com.` domain. Note the @ symbol in front of the group name.

```
client% nisgrpadm -a admin @admin.doc.com.
Added @admin.doc.com. to group admin.manf.doc.com.
```

Listing the Members of an NIS+ Group

To list the members of an NIS+ group, you must have read rights to the group object. Use the `-l` option:

`nisgrpadm -l` *group-name*

This example lists the members of the `admin.manf.doc.com.` group. It is entered from a client in the `manf.doc.com.` group:

```
client% nisgrpadm -l admin
Group entry for admin.manf.doc.com. group:
 No explicit members
 No implicit members:
```

```
Recursive members:
@admin.doc.com.
No explicit nonmembers
No implicit nonmembers
No recursive nonmembers
```

Removing Members From an NIS+ Group

To remove members from an NIS+ group, you must have modify rights to the group object. Use the `-r` option:

`nisgrpadm -r` *group-name members*`. . .`

This example removes the NIS+ principals `allende` and `hugo.manf.doc.com.` from the `Ateam.sales.doc.com` group. It is entered from a client in the `sales.doc.com. domain`:

```
client% nisgrpadm -r Ateam allende hugo.manf.doc.com.
Removed allende.sales.doc.com. from group Ateam.sales.doc.com.
Removed hugo.manf.doc.com. from group Ateam.sales.doc.com.
```

This example removes the `admin.doc.com.` group from the `admin.manf.doc.com.` group. It is entered from a client in the `manf.doc.com.` domain:

```
client% nisgrpadm -r admin @admin.doc.com.
Removed @admin.doc.com. from group admin.manf.doc.com.
```

Testing for Membership in an NIS+ Group

To find out whether an NIS+ principal is a member of a particular NIS+ group you must have read access to the group object. Use the `-t` option:

`nisgrpadm -t` *group-name members*`. . .`

This example tests whether the NIS+ principal topadmin belongs to the `admin.doc.com.` group. It is entered from a client in the `doc.com.` domain.

```
client% nisgrpadm -t admin topadmin
topadmin.doc.com. is a member of group admin.doc.com.
```

This example tests whether the NIS+ principal jo, from the `sales.doc.com.` domain, belongs to the admin.`sales.doc.com.` group. It is entered from a client in the `doc.com.` domain.

```
client% nisgrpadm -t admin.sales.doc.com. jo.sales.doc.com.
jo.sales.doc.com. is a member of group admin.sales.doc.com.
```

CHAPTER 18

Administering NIS+ Directories

This chapter describes NIS+ directory objects and how to administer them.

NIS+ Directories

NIS+ directory objects are used to store information related to an NIS+ domain. For each NIS+ domain, there is a corresponding NIS+ directory structure. See Chapter 4, The NIS+ Namespace, for more information about NIS+ directories.

For a complete description of NIS+ directory-related commands and their syntax and options, see the NIS+ man pages.

Using the `niscat` Command With Directories

The `niscat -o` command can be used to list the object properties of an NIS+ directory. To use it, you must have read access to the directory object itself.

Listing the Object Properties of a Directory

To list the object properties of a directory, use `niscat -o` and the directory's name:

`niscat -o` *directory-name*

For example:

```
rootmaster# niscat -o doc.com.
Object Name : doc
Owner : rootmaster.doc.com.
Group :
Domain : Com.
Access Rights : r---rmcdr---r---
Time to Live : 24:0:0
Object Type : DIRECTORY
.
.
```

Using the `nisls` Command With Directories

The `nisls` command lists the contents of an NIS+ directory. To use it, you must have read rights to the directory object.

To display in terse format, use:

`nisls [-dgLmMR]` *directory-name*

To display in verbose format, use:

`nisls -l [-gm] [-dLMR]` *directory-name*

TABLE 18–1 Options for the `nisls` Command

Option	Purpose
`-d`	Directory object. Instead of listing a directory's contents, treat it like another object.
`-L`	Links. If the directory name is actually a link, the command follows the link and displays information about the linked directory.
`-M`	Master. Get the information from the master server only. Although this provides the most up-to-date information, it may take longer if the master server is busy.

TABLE 18–1 Options for the `nisls` Command *(Continued)*

Option	Purpose
`-R`	Recursive. List directories recursively. That is, if a directory contains other directories, their contents are displayed as well.
`-l`	Long. Display information in long format. Long format displays an object's type, creation time, owner, and access rights.
`-g`	Group. When displaying information in long format, display the directory's group owner instead of its owner.
`-m`	Modification time. When displaying information in long format, display the directory's modification time instead of its creation time.

Listing the Contents of a Directory—Terse

To list the contents of a directory in the default short format, use one or more of the options listed below and a directory name. If you don't supply a directory name, NIS+ will use the default directory.

`nisls [-dLMR]` *directory-name*

or

`nisls [-dLMR]`

For example, this instance of `nisls` is entered from the root master server of the root domain `doc.com.`:

```
rootmaster% nisls doc.com.:
org_dir
groups_dir
```

Here is another example entered from the root master server:

```
rootmaster% nisls -R sales.doc.com.
sales.doc.com.:
org_dir
groups_dir
groups_dir.sales.doc.com.:
admin
org_dir.sales.doc.com.:
auto_master
auto_home
bootparams
cred
.
```

Listing the Contents of a Directory—Verbose

To list the contents of a directory in the verbose format, use the `-l` option and one or more of the options listed below. The `-g` and `-m` options modify the attributes that are displayed. If you don't supply a directory name, NIS+ will use the default directory.

```
nisls -l [-gm] [-dLMR] directory-name
```

or

```
nisls -l [-gm] [-dLMR]
```

Here is an example, entered from the master server of the root domain `doc.com.`:

```
rootmaster% nisls -l
doc.com.
D r---rmcdr---r--- rootmaster.doc.com. date org_dir
D r---rmcdr---r--- rootmaster.doc.com. date groups_dir
```

The `nismkdir` Command

Note – This section describes how to add a nonroot server to an existing domain using the `nismkdir` command. An easier way to do this is with the `nisserver` script as described in Chapter 4

The `nismkdir` command creates a nonroot NIS+ directory and associates it with a master server. (To create a root directory, use the `nisinit -r` command, described in "The `nisinit` Command" on page 342. The `nismkdir` command can also be used to add a replica to an existing directory.

There are several prerequisites to creating an NIS+ directory, as well as several related tasks.

To create a directory, use:

```
nismkdir [-m master-server] \
 directory-name
```

To add a replica to an existing directory, use:

```
nismkdir -s replica-server \
 directory-name
nismkdir -s replica-server \
 org_dir.directory-name
```

```
nismkdir -s replica-server \
 groups_dir.directory-name
```

Creating a Directory

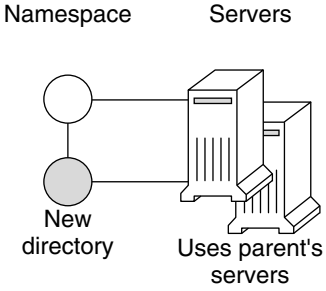
To create a directory, you must have create rights to its parent directory on the domain master server. First use the `-m` option to identify the master server and then the `-s` option to identify the replica, use:

```
nismkdir -m master directory
nismkdir -s replica directory
```

Caution – Always run `nismkdir` on the master server. Never run `nismkdir` on the replica machine. Running `nismkdir` on a replica creates communications problems between the master and the replica.

This example creates the `sales.doc.com.` directory and specifies its master server, `smaster.doc.com.` and its replica, `rep1.doc.com.`. It is entered from the root master server.

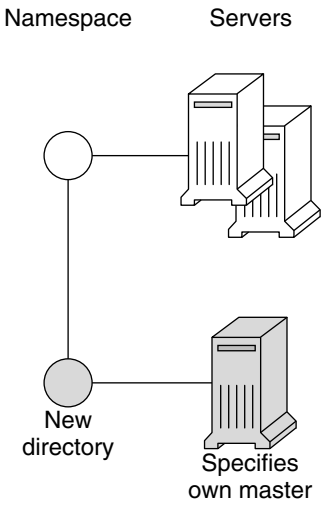
```
rootmaster% nismkdir -m smaster.doc.com. sales.doc.com.
rootmaster% nismkdir -m smaster.doc.com. org_dir.sales.doc.com.
rootmaster% nismkdir -m smaster.doc.com. groups_dir.sales.doc.com.
rootmaster% nismkdir -s rep1.doc.com. sales.doc.com.
rootmaster% nismkdir -s rep1.doc.com. org_dir.sales.doc.com.
rootmaster% nismkdir -s rep1.doc.com. groups_dir.sales.doc.com.
```



The `nismkdir` command allows you to use the parent directory's servers for the new directory instead of specifying its own. However, this should not be done except in the case of small networks. Here are two examples:

- The first example creates the `sales.doc.com.` directory and associates it with its parent directory's master and replica servers.

```
rootmaster% nismkdir sales.doc.com
```



The second example creates the `sales.doc.com.` **directory and specifies its own master server,** `smaster.doc.com.`

```
rootmaster% nismkdir -m smaster.doc.com. sales.doc.com.
```

Since no replica server is specified, the new directory will have only a master server until you use `nismkdir` again to assign it a replica. If the `sales.doc.com.` domain already existed, the `nismkdir` command as shown above would have made `salesmaster.doc.com.` its new master server and would have relegated its old master server to a replica.

Adding a Replica to an Existing Directory

This section describes how to add a replica server to an existing system using the nismkdir command. An easier way to do this is with the `nisserver` script.

Keep in mind the following principles:

- Root domain servers reside in (are part of) the root domain.
- Subdomain servers reside in (are part of) the parent domain immediately above the subdomain in the hierarchy. For example, if a namespace has one root domain named `prime` and a subdomain named `sub1`:
  - The master and replica servers that serve the `prime` domain are themselves part of the `prime` domain because `prime` is the root domain.

- The master and replica servers that serve the `sub1` subdomain are also part of the `prime` domain because `prime` is the parent of `sub1`.

- While it is possible for a master or replica server to serve more than one domain, doing so is not recommended.

To assign a new replica server to an existing directory, use `nismkdir` on the master server with the `-s` option and the name of the existing directory, `org_dir`, and `groups_dir`:

```
nismkdir -s replica-server existing-directory-name
nismkdir -s replica-server org_dir. existing-directory-name
nismkdir -s replica-server groups_dir. existing-directory-name
```

The `nismkdir` command realizes that the directory already exists, so it does not recreate it. It only assigns it the additional replica. Here is an example with `rep1` being the name of the new replica machine:

```
rootmaster% nismkdir -s rep1.doc.com. doc.com.
rootmaster% nismkdir -s rep1.doc.com. org_dir.doc.com.
rootmaster% nismkdir -s rep1.doc.com. groups_dir.doc.com.
```

Caution – Always run `nismkdir` on the master server. Never run `nismkdir` on the replica machine. Running `nismkdir` on a replica creates communications problems between the master and the replica.

After running the three iterations of `nismkdir` as shown above, you need to run `nisping` from the master server on the three directories:

```
rootmaster# nisping doc.com.
rootmaster# nisping org_dir.doc.com.
rootmaster# nisping group_dir.doc.com.
```

You should see results similar to these:

```
rootmaster# nisping doc.com.
Pinging replicas serving directory doc.com. :
Master server is rootmaster.doc.com.
 Last update occurred at Wed Nov 18 19:54:38 1995
Replica server is rep1.doc.com.
 Last update seen was Wed Nov 18 11:24:32 1995
 Pinging ... rep1.doc.com
```

It is good practice to include `nisping` commands for each of these three directories in the master server's `cron` file so that each directory is "pinged" at least once every 24 hours after being updated.

The `nisrmdir` Command

The `nisrmdir` command can remove a directory or simply dissociate a replica server from a directory. (When a directory is removed or disassociated from a replica server, that machine no longer functions as an NIS+ replica server for that NIS+ domain.)

When it removes a directory, NIS+ first disassociates the master and replica servers from the directory, and then removes the directory.

- To remove the directory, you must have destroy rights to its parent directory.
- To dissociate a replica server from a directory, you must have modify rights to the directory.

If problems occur, see "Removal or Disassociation of NIS+ Directory from Replica Fails" on page 437.

Removing a Directory

To remove an entire directory and dissociate its master and replica servers, use the `nisrmdir` command without any options:

`nisrmdir` *directory-name*
`nisping` *domain*

This example removes the `manf.doc.com.` directory from beneath the `doc.com.` directory:

```
rootmaster% nisrmdir manf.doc.com.
rootmaster% nisping doc.com.
```

Disassociating a Replica From a Directory

To disassociate a replica server from a directory, you must first remove the directory's `org_dir` and `groups_dir` subdirectories. To do this, use the `nisrmdir` command with the `-s` option. After each of the subdirectories are removed, you must run `nisping` on parent domain.

`nisrmdir -s` *replicaname*`org_dir.`*domain*
`nisrmdir -s` *replicaname*`groups_dir.`*domain*
`nisrmdir -s` *replicaname domain*
`nisping` *domain*

This example disassociates the `manfreplica1` server from the `manf.doc.com.` directory:

```
rootmaster% nisrmdir -s manfreplica1 org_dir.manf.doc.com.
rootmaster% nisrmdir -s manfreplica1 groups_dir.manf.doc.com.
rootmaster% nisrmdir -s manfreplica1 manf.doc.com.
rootmaster% nisping manf.doc.com.
```

If the replica server you are trying to dissociate is down or out of communication, the `nisrmdir -s`command returns a `Cannot remove replica`*name*`: attempt to remove a non-empty table` error message. In such cases, you can run `nisrmdir -f -s` *replicaname* on the master to force the dissociation. Note, however, that if you use `nisrmdir -f -s` to dissociate an out-of-communication replica, you *must* run `nisrmdir -f -s` *again* as soon as the replica is back on line in order to clean up the replica's `/var/nis` file system. If you fail to rerun `nisrmdir -f -s` *replicaname* when the replica is back in service, the old out-of-date information left on the replica could cause problems.

The `nisrm` Command

The `nisrm` command is similar to the standard `rm` system command. It removes any NIS+ object from the namespace, except directories and nonempty tables. To use the `nisrm` command, you must have destroy rights to the object. However, if you don't, you can use the `-f` option, which tries to force the operation in spite of permissions.

You can remove group objects with the `nisgrpadm -d` command (see "Deleting an NIS+ Group" on page 327), and you can empty tables with `nistbladm -r` or `nistbladm -R` (see "Deleting a Table" on page 360).

To remove a nondirectory object, use:

`nisrm [-if]` *object-name*

TABLE 18–2 `nisrm` Syntax Options

Option	Purpose
`-i`	Inquire. Asks for confirmation prior to removing an object. If the *object-name* you provide is not fully qualified, this option is used automatically.
`-f`	Force. Attempts to force a removal even if you don't have the proper permissions. It attempts to change the permission by using the `nischmod` command, and then tries to remove the object again.

Removing Nondirectory Objects

To remove nondirectory objects, use the `nisrm` command and provide the object names:

`nisrm` *object-name*`...`

This example removes a group and a table from the namespace:

```
rootmaster% nisrm -i admins.doc.com. groups.org_dir.doc.com.
Remove admins.doc.com.? y
Remove groups.org_dir.doc.com.? y
```

The `rpc.nisd` Command

The `rpc.nisd` command starts the NIS+ daemon. The daemon can run in NIS-compatibility mode, which enables it to answer requests from NIS clients as well. You don't need any access rights to start the NIS+ daemon, but you should be aware of all its prerequisites and related tasks. They are described in "Prerequisites to Running `rpc.nisd`" on page 109.

By default, the NIS+ daemon starts with security level 2.

To start the daemon, use:

```
rpc.nisd
```

To start the daemon in NIS-compatibility mode, use:

```
rpc.nisd -Y [-B]
```

To start an NIS-compatible daemon with DNS forwarding capabilities, use:

```
rpc.nisd -Y -B
```

TABLE 18–3 Other `rpc.nisd` Syntax Options

Option	Purpose
`-S` *security-level*	Specifies a security level, where `0` means no NIS+ security and `2` provides full NIS+ security. (Level 1 is not supported.)
`-F`	Forces a checkpoint of the directory served by the daemon. This has the side effect of emptying the directory's transaction log and freeing disk space.

To start the NIS+ daemon on any server, use the command without options:

```
rpc.nisd
```

The daemon starts with security level 2, which is the default.

To start the daemon with security level 0, use the `-S` flag:

```
rpc.nisd -S 0
```

Starting an NIS-Compatible Daemon

You can start the NIS+ daemon in NIS-compatibility mode in any server, including the root master. Use the `-Y` (uppercase) option:

```
rpc.nisd -Y
```

If the server is rebooted, the daemon will not restart in NIS-compatibility mode unless you also uncomment the line that contains `EMULYP=Y` in the server's `/etc/init.d/rpc` file.

Starting a DNS-Forwarding NIS-Compatible Daemon

You can add DNS forwarding capabilities to an NIS+ daemon running in NIS-compatibility mode by adding the `-B` option to `rpc.nisd`:

```
rpc.nisd -Y -B
```

If the server is rebooted, the daemon will not restart in DNS-forwarding NIS-compatibility mode unless you also uncomment the line that contains `EMULYP=-Y` in the server's `/etc/init.d/rpc` file and change it to:

```
EMULYP -Y -B
```

Stopping the NIS+ Daemon

To stop the NIS+ daemon, whether it is running in normal or NIS-compatibility mode, kill it as you would any other daemon: first find its process ID, then kill it:

```
rootmaster# ps -e | grep rpc.nisd
root 1081 1 61 16:43:33 ? 0:01 rpc.nisd -S 0
root 1087 1004 11 16:44:09 pts/1 0:00 grep rpc.nisd
rootmaster# kill 1081
```

The `nisinit` Command

This section describes how to initialize a machine client using the `nisinit` command. An easier way to do this is with the `nisclient` script as described in "Setting Up NIS+ Client Machines" on page 104.

The `nisinit` command initializes a machine to be an NIS+ client or server. As with the `rpc.nisd` command, you don't need any access rights to use the `nisinit` command, but you should be aware of its prerequisites and related tasks. These are described in ."Initializing an NIS+ Client" on page 154

Initializing a Client

You can initialize a client in three different ways:

- By host name
- By broadcast
- By cold-start file

Each way has different prerequisites and associated tasks. For instance, before you can initialize a client by host name, the client's `/etc/hosts` or `/etc/inet/ipnodes` file must list the host name you will use and `nsswitch.conf` file must have `files` as the first choice on the `hosts` line. For IPv6 addresses, specify `ipnodes` as the first choice on the `hosts` line. Following is a summary of the steps that use the `nisinit` command.

To initialize a client by host name, use the `-c` and `-H` options, and include the name of the server from which the client will obtain its cold-start file:

```
nisinit -c -H hostname
```

To initialize a client by cold-start file, use the `-c` and `-C` options, and provide the name of the cold-start file:

```
nisinit -c -C filename
```

To initialize a client by broadcast, use the `-c` and `-B` options:

```
nisinit -c -B
```

Initializing the Root Master Server

To initialize the root master server, use the `nisinit -r`command:

```
nisinit -r
```

You will need the following information

- The superuser password of the machine that will become the root master server.
- The name of the new root domain. The root domain name must have at least two elements (labels) and end in a dot (for example, *something* `.com`.). The last element must be either an Internet organizational name (as shown in Table 18–4), or a two or three character geographic identifier such as `.jp`. for Japan.

TABLE 18–4 Internet Organizational Domains

Domain	Purpose
com	Commercial organizations
edu	Educational institutions
gov	Government institutions
mil	Military groups
net	Major network support centers
org	Nonprofit organizations and others
int	International organizations

The `nis_cachemgr` Command

The `nis_cachemgr` command starts the NIS+ cache manager program, which should run on all NIS+ clients. The cache manager maintains a cache of location information about the NIS+ servers that support the most frequently used directories in the namespace, including transport addresses, authentication information, and a time-to-live value.

At start-up the cache manager obtains its initial information from the client's cold-start file, and downloads it into the `/var/nis/NIS_SHARED_DIRCACHE` file.

The cache manager makes requests as a client machine. Make sure the client machine has the proper credentials, or instead of improving performance, the cache manager will degrade it.

Starting and Stopping the Cache Manager

To start the cache manager, enter the `nis_cachemgr` command (with or without the `-i` option):

```
client% nis_cachemgr
client% nis_cachemgr -i
```

Without the `-i` option, the cache manager is restarted but it retains the information in the `/var/nis/NIS_SHARED_DIRCACHE` file. The information in the cold-start file is simply appended to the existing information in the file. The `-i` option clears the cache file and re-initializes it from the contents of the client's cold-start file.

To stop the cache manager, kill it as you would any other process.

The `nisshowcache` Command

The `nisshowcache` command displays the contents of a client's directory cache.

Displaying the Contents of the NIS+ Cache

The `nisshowcache` command is located in `/usr/lib/nis`. It displays only the cache header and the directory names. Here is an example entered from the root master server:

```
rootmaster# /usr/lib/nis/nisshowcache -v
Cold Start directory:
Name : doc.com.
Type : NIS
Master Server :
 Name : rootmaster.doc.com.
 Public Key : Diffie-Hellman (192 bits)
 Universal addresses (3)
 . .
Replicate:
 Name : rootreplica1.doc.com.
 Public Key : Diffie-Hellman (192 bits)
 Universal addresses (3)
 .
 .
 .
Time to live : 12:0:0
Default Access Rights :
```

Pinging and Checkpointing

When a change is made to the NIS+ data set, that change is made in the memory of the master server for the NIS+ domain (or subdomain). A record of the change is also logged in the master server's transaction log (`/var/nis/data/trans.log`).

Normally, the master server transfers a change in the NIS+ data set to the domain's replica servers 120 seconds (2 minutes) after the change was made. This transfer process is called *pinging*. When the master server pings a replica, it updates the replica's data set with the change. The changed NIS+ data now resides in memory of the master and replica servers.

If the automatic ping process fails to update one or more replica servers, you need to manually force a ping as described in "Forcing a Ping" on page 346. If you suspect that a replica has not been correctly updated with the most current NIS+ data, you can check when the replica was last updated as described in "Displaying When Replicas Were Last Updated" on page 345.

Changes to the NIS+ data set stored in server memory and recorded in the transaction log need to be written into the NIS+ tables stored on disk. The process of updating the NIS+ tables is called *checkpointing*.

Checkpointing is not an automatic process. You must issue the checkpoint command as described in "Checkpointing a Directory" on page 347.

The `nisping` Command

The `nisping` command is used to:

- Display when a replica was last pinged as described in "Displaying When Replicas Were Last Updated" on page 345.
- Force the master server to ping a replica if the automatic ping cycle has not been successful as described in "Forcing a Ping" on page 346.
- Checkpoint servers as described in "Checkpointing a Directory" on page 347

Displaying When Replicas Were Last Updated

When used with the `-u` option, the `nisping` command displays the update times for the master and replicas of the local domain.

```
/usr/lib/nis/nisping -u [domain]
```

To display the last updates in some other domain, specify the domain name in the command line. Note that when used with the `-u` option, the `nisping` command does not actually ping any replicas.

For example, to display the most recent replica update times for the local `doc.com.` domain, you would enter:

```
rootmaster# /usr/lib/nisping -u
Last updates for directory doc.com.:
Master server is rootmaster.doc.com.
 Last update occurred at Wed Nov 25 10:53:37 1992
Replica server is rootreplica1.doc.com.
 Last update seen was Wed Nov 25 10:53:37 1992
```

Forcing a Ping

If the `nisping -u` command reveals that a replica has not been properly updated, you can use the `nisping` command to force the master server to ping all the replicas in a domain, or one replica in particular.

To ping all the replicas, use the `nisping` command without options:

```
/usr/lib/nis/nisping
```

This forces the master server to ping all the replicas in the domain. Here is an example that pings all the replicas of the local `doc.com.` domain:

```
rootmaster# /usr/lib/nis/nisping
Pinging replicas serving directory doc.com.:
Master server is rootmaster.doc.com.
 Last update occurred at Wed Nov 25 10:53:37 1992
Replica server is rootreplica1.doc.com.
 Last update seen was Wed Nov 18 11:24:32 1992
 Pinging ... rootreplica1.doc.com.
```

To ping all the replicas in a domain other than the local domain, append a domain name:

`/usr/lib/nis/nisping` *domainname*

You can also ping all the tables in all the directories on a single specified host. To ping all the tables in all the directories of a particular host, us the `-a` option:

`/usr/lib/nis/nisping -a` *hostname*

Checkpointing a Directory

Each domain and subdomain should be checkpointed at least once every 24 hour, or more often if the transaction log grows too large in relationship to swap space or total disk space.

Note – Checkpointing large domains, or any domain with a large transaction log, is a time-consuming process which ties up NIS+ servers and slows NIS+ service. While a server is checkpointing, it will still answer requests for service, but it will be unavailable for updates. If possible, checkpoint operations should be scheduled for times when system use is low. You can use the `cron` file to schedule checkpoint operations.

To perform a checkpoint operation, run `nisping -C` on the domain's master server. It is good practice to first ping all replicas before checkpointing. This ensures that the replicas are checkpointing data that is current and up to date.

- To checkpoint a particular directory, run the `nisping` command with the `-C` *directoryname* option. For example,

  ```
  rootmaster# /usr/lib/nis/nisping
  rootmaster# /usr/lib/nis/nisping -C org_dir
  ```

- To checkpoint *all* the directories in the local domain, run the `nisping` command with the `-C -a` options. For example,

```
rootmaster# /usr/lib/nis/nisping
rootmaster# /usr/lib/nis/nisping -C -a
```

Once a server has transferred information from the server's transaction log to the appropriate NIS+ tables, the transactions in the log file are erased to conserve disk space.

For example, to checkpoint all of the directories in the `doc.com.` domain, you would enter:

```
rootmaster# /usr/lib/nis/nisping -C -a
Checkpointing replicas serving directory doc.com. :
Master server is rootmaster.doc.com.
 Last update occurred at Wed May 25 10:53:37 1995
Master server is rootmaster.doc.com.
checkpoint has been scheduled with rootmaster.doc.com.
Replica server is rootreplica1.doc.com.
 Last update seen was Wed May 25 10:53:37 1995
Replica server is rootreplica1.doc.com.
checkpoint has been scheduled with rootmaster.doc.com.
```

The `nislog` Command

The `nislog` command displays the contents of the transaction log.

```
/usr/sbin/nislog
/usr/sbin/nislog -h [number]
/usr/sbin/nislog -t [number]
```

TABLE 18–5 Options for the `nislog` Command

Option	Purpose
`-h [num]`	Display transactions starting with the head (beginning) of the log. If the number is omitted, the display begins with the first transaction. If the number 0 is entered, only the log header is displayed
`-t [num]`	Display transactions starting backward from the end (tail) of the log. If the number is omitted, the display begins with the last transaction. If the number 0 is entered, only the log header is displayed
`-v`	Verbose mode

Displaying the Contents of the Transaction Log

Each transaction consists of two parts: the particulars of the transaction and a copy of an object definition.

Here is an example that shows the transaction log entry that was made when the `doc.com.` directory was first created. "XID" refers to the transaction ID.

```
rootmaster# /usr/sbin/nislog -h 1
NIS Log printing facility.
NIS Log dump:
 Log state : STABLE
Number of updates : 48
Current XID : 39
Size of log in bytes : 18432
***UPDATES***
@@@@@@@@@@@@@@@TRANSACTION@@@@@@@@@@@@@@@
#00000, XID : 1
Time : Wed Nov 25 10:50:59 1992
Directory : doc.com.
Entry type : ADD Name
Entry timestamp : Wed Nov 25 10:50:59 1992
Principal : rootmaster.doc.com.
Object name : org_dir.doc.com.
...................Object.....................
Object Name : org_dir
```

```
Owner : rootmaster.doc.com.
Group : admin.doc.com.
Domain : doc.com.
Access Rights : r---rmcdr---r---
Time to Live : 24:0:0
Object Type : DIRECTORY
Name : 'org_dir.doc.com.'
Type: NIS
Master Server : rootmaster.doc.com.
.
.
.........................................
@@@@@@@@@@@@@@TRANSACTION@@@@@@@@@@@@@@@
#00000, XID : 2
```

The `nischttl` Command

The `nischttl` command changes the time-to-live value of objects or entries in the namespace. This time-to-live value is used by the cache manager to determine when to expire a cache entry. You can specify the time-to-live in total number of seconds or in a combination of days, hours, minutes, and seconds.

The time-to-live values you assign objects or entries should depend on the stability of the object. If an object is prone to frequent change, give it a low time-to-live value. If it is steady, give it a high one. A high time-to-live is a week; a low one is less than a minute. Password entries should have time-to-live values of about 12 hours to accommodate one password change per day. Entries in tables that don't change much, such as those in the RPC table, can have values of several weeks.

To change the time-to-live of an object, you must have modify rights to that object. To change the time-to-live of a table entry, you must have modify rights to the table, entry, or columns you wish to modify.

To display the current time-to-live value of an object or table entry, use the `nisdefaults -t` command, described in Chapter 15.

To change the time-to-live value of objects, use:

`nischttl` *time-to-live object-name*

or

`nischttl [-L]` *time-to-live object-name*

To change the time-to-live value of entries, use:

```
nischttl time-to-live \
 [column=value,...], \
 table-name
```

or

```
nischttl [-ALP] time-to-live \
 [column=value,...], \
 table-name
```

Where *time-to-live* is expressed as:

- *Number of seconds.* A number with no letter is interpreted as a number of seconds. Thus, `1234` for TTL would be interpreted as 1,234 seconds. A number followed by the letter `s` is also interpreted as a number of seconds. Thus, `987s` for TTL would be interpreted as 987 seconds. When seconds are specified in combination with days, hours, or minutes, you *must* use the letter `s` to identify the seconds value.
- *Number of minutes.* A number followed by the letter `m` is interpreted as a number of minutes. Thus, `90m` for TTL would be interpreted as 90 minutes.
- *Number of hours.* A number followed by the letter `h` is interpreted as a number of hours. Thus, `9h` for TTL would be interpreted as 9 hours.
- *Number of days.* A number followed by the letter `d` is interpreted as a number of days. Thus, `7d` for TTL would be interpreted as 7 days.

These values may be used in combination. For example, a TTL value of `4d3h2m1s` would specify a time to live of four days, three hours, two minutes, and one second.

The following flags may also be used with the `nischttl` command:

TABLE 18–6 `nischttl` Syntax Options

Option	Purpose
`A`	All. Apply the change to all the entries that match the *column=value* specifications that you supply.
`L`	Links. Follow links and apply the change to the linked object rather than the link itself.
`P`	Path. Follow the path until there is one entry that satisfies the condition.

Changing the Time-to-Live of an Object

To change the time-to-live of an object, type the `nischttl` command with the *time-to-live* value and the *object-name*. You can add the `-L` command to extend the change to linked objects.

```
nischttl -L time-to-live object-name
```

You can specify the *time-to-live* in seconds by typing the number of seconds. Or you can specify a combination of days, hours, minutes, and seconds by using the suffixes `s`, `m` , `h` , and `d` to indicate the number of seconds, minutes, days, and hours. For example:

```
client% nischttl 86400 sales.doc.com.
client% nischttl 24h sales.doc.com.
client% nischttl 2d1h1m1s sales.doc.com.
```

The first two commands change the time-to-live of the `sales.doc.com.` directory to 86,400 seconds, or 24 hours. The third command changes the time-to-live of all the entries in a hosts table to 2 days, 1 hour, 1 minute, and 1 second.

Changing the Time-to-Live of a Table Entry

To change the time-to-live of entries, use the indexed entry format. You can use any of the options, `-A`, `-L` , or `-P` .

```
nischttl [-ALP] time-to-live \
 [column=value,...], \
 table-name
```

Note – C-shell users should use quotes to prevent the shell from interpreting the square brackets ([]) around the column value as a meta character.

These examples are similar to those above, but they change the value of table entries instead of objects:

```
client% nischttl 86400 '[uid=99],passwd.org_dir.doc.com.'
client% nischttl 24h `[uid=99],passwd.org_dir.doc.com.'
client% nischttl 2d1h1m1s `[name=fred],hosts.org_dir.doc.com.'
```

CHAPTER 19

Administering NIS+ Tables

This chapter describes NIS+ tables and how to administer them. (See Table 10–1, for detailed descriptions of the default NIS+ tables.)

NIS+ Tables

Information used by NIS+ is stored in NIS+ tables. (See Appendix C, Information in NIS+ Tables, for a description of each default NIS+ system tables supplied in Solaris operating environment.)

For a complete description of NIS+ table-related commands and their syntax and options, see the NIS+ man pages.

The `nistbladm` Command

Note – Some NIS+ table administration tasks can be performed more easily with Solstice AdminSuite™ tools if you have them available.

The `nistbladm` command is the primary NIS+ table administration command. The `nistbladm` command is for use on NIS+ tables stored in an NIS+ directory object. With it, you can create, modify, and delete NIS+ tables and entries. To create a table, its directory must already exist. To add entries to the table, the table and columns must already be defined.

To create a table, you must have create rights to the directory under which you will create it. To delete a table, you must have destroy rights to the directory. To modify the contents of a table, whether to add, change, or delete entries, you must have modify rights to the table or the entries.

`nistbladm` Syntax Summary

The general syntax of the `nistbladm` command is:

```
nistbladm options \
  [columspec | columnvalue] \
  [tablename | indexedname]
```

Where:

- *columnspec* is a specification defining a column to be created in a table as described in "Specifying Table Columns" on page 359.
- *columnvalue* identifies a particular cell value in the table identified by *tablename* as described in "`nistbladm` and Column Values" on page 355.
- *tablename* is the name of the table. For example, `hosts.org_dir.doc.com.`
- *indexedname* identifies a particular cell value in a certain table as described in "`nistbladm` and Column Values" on page 355. In essence *indexedname* is the equivalent of *columnvalue* plus *tablename*.

TABLE 19–1 `nistbladm` Options

Option	Description
`-a` | `-A`	Add an entry to an existing NIS+ table. The `-a` option returns an error if execution of the command would result in overwritting any existing entry. The `-A` option forces execution of the command even if it results in overwriting an existing entry. (See "Adding Entries to a Table" on page 361.)
`-D` *defaults*	Specify a different set of default properties when creating an object. (See the `nistbladm` man page for details.)
`-d`	Destroy a table. (See "Deleting a Table" on page 360.)
`-c`	Create a table. (See "Creating a New Table" on page 358.)
`-r` | `-R`	Remove one or more entries from an existing NIS+ table. The `-r` option returns an error if execution of the command would result in removal of more than one entry. The `-R` option forces execution of the command even if it results in removing multiple entries. (See "Removing Table Entries" on page 366.)

TABLE 19–1 `nistbladm` Options *(Continued)*

Option	Description
`-m`	An obsoleted option for modifying table entries that is still supported for backwards compatibility. The `-e` and `-E` options are the preferred method for editing entries.
`-e | -E`	Edit an entry in an existing NIS+ table. The `-e` option returns an error if execution of the command would affect more than one entry. The `-A` option forces execution of the command even if it results in changing an existing entry in such a way as to overwrite a different entry. (See "Modifying Table Entries" on page 364.)

`nistbladm` and Column Values

Column values are used to identify individual entries in tables using the format:

```
columname="value", \
 columnname="value", ...
```

Where:

- *columname* is the name of a table column
- *value* is the contents of a particular cell within a column. That value is what identifies a table row. (When using *column=value* to create or modify table data, always enclose the *value* element in quotes.)

For example, suppose you had a `hosts` table that listed machine names and IP addresses:

TABLE 19–2 Example Hosts Table

IP address	name	aliases
`129.146.168.4`	`altair`	
`129.146.168.119`	`deneb`	mail
`129.146.168.120`	`regulus`	`dnsmaster`
`129.146.168.121`	`regulus`	`dnsmaster`
`129.146.168.11`	`sirius`	

In this example, your could identify the `altair` entry (row) in three different ways using the *column=value* of:

- `name=altair`
- `address=129.146.168.4`
- `name=altair,address=129.146.168.4.`

But notice in the table above that the machine `regulus` is multi-homed and has *two* IP addresses. In that case, the *column=value* of `host=regulus` identifies two rows. To identify just the first `regulus` row, you would enter either:

- `address=129.146.168.120` or
- `address=129.146.168.120.,name=regulus,dnsmaster`

Note – Some `nistbladm` operations require that you enter a *column=value* pair for *every* column in the table.

`nistbladm`, Searchable Columns, Keys, and Column Values

When an NIS+ table is created, one or more columns are designated *searchable* with either the `S` or the `I` flags as described in "Specifying Table Columns" on page 359. You can use the `niscat -o` *tablename* command to display a list of a table's columns and their characteristics.

A table is *keyed* on its searchable columns. This means that each row in the table must have a unique combination of values in the searchable columns. For example, if a table has one searchable column, each table row must have a unique value in that column, no two rows can contain the same value.

For example, suppose you had a table containing one searchable column named `city` and a non-searchable column named `country`. The following rows would all be permitted:

City	Country
San Francisco	United States
Santa Fe	United States
Santiago	Chile

But you could not have two rows like:

City	Country
London	Canada
London	England

If a table has multiple searchable columns, it is the *combination* of values that must be unique. For example, suppose you had a table containing two searchable columns, `Lastname`, `Firstname` and a non-searchable column named `city`. The following rows would all be permitted:

Lastname	Firstname	City
Kuznetsov	Sergei	Odessa
Kuznetsov	Rima	Odessa
Sergei	Alex	Odessa

But you could not have two rows like this:

Lastname	Firstname	City
Kuznetsov	Rima	Odessa
Kuznetsov	Rima	Chelm

NIS+ commands use the values in the searchable columns to identify specific table rows.

`nistbladm` and Indexed Names

In the context of table administration, an NIS+ *indexed name* is a name that combines a table name with column value search criteria to identify and select particular entries in a table. Indexed names use the format:

[*search_criteria*],*tablename*.*directory*

Note that search_criteria must be enclosed in square brackets `[ ]`. The *search_criteria* use the format:

columnname=value, \
columnname=value, . . .

Where *columnname=value* pairs are column values from the table's searchable columns as described in "`nistbladm` and Column Values" on page 355.

For example, to identify the `altair` entry in Table 19–2 you could use the indexed name:

```
[addr=129.146.168.4,cname=altair],hosts.org_dir.doc.com.
```

The `nistbladm -R` command allows you to remove all the entries in a table by using the two square brackets with nothing between them `[ ]` as a wildcard specifying all table rows.

`nistbladm` and Groups

In a Solaris-NIS+ environment, there are three types of groups:

- UNIX groups. Information about UNIX groups is stored in the `groups.org_dir` table. Use `nistbladm` to administer UNIX group information.
- Netgroups. Information about net groups is stored in the `netgroups.org_dir` table. Use `nistbladm` to administer net group information.
- NIS+ groups. Information about NIS+ groups is stored in one or more tables in the `groups_dir` directory object. Use `nisgrpadm` to administer NIS+ group information.

Note – Do not use `nistbladm` to administer NIS+ groups.

(See "Solaris Groups" on page 321 for more information on the different types of groups and how to work with them.)

Creating a New Table

An NIS+ table must have at least one column and at least one of its columns must be searchable. To create an NIS+ table, use the `nistbladm` command with the `-c` option:

```
nistbladm -c tabletype columnspec \
 ... tablename
```

Where:

- *Tabletype* is simply a name that identifies a class of tables to which this table belongs. You can use any name you choose.
- A *columnspec* specifies the name and characteristics of each column in a new table. Enter one *columnspec* for each column you want in your new table. Separate the *columnspecs* with spaces:

```
 nistbladm -c tabletype columnspec columnspec \
columnspec tablename
```

Columnspec formats are described in "Specifying Table Columns" on page 359, below.

Specifying Table Columns

Each *columnspec* entry has two to four components in the format:

name=type,rights :

TABLE 19–3 Table Column Components

Component	Description
name	Name of the column
=	An equal sign which is required.
type	[Optional] The type of column specified by the letters `S`, `I` or `C` (see Table 19–4). This component is optional. If no *type* is specified, the column becomes the default type.
rights	[Optional] Access rights. These access rights are over and above those granted to the table as a whole or to specific entries. If no *access* is specified, the column's access rights are those granted to the table as a whole, or to the entry. The syntax for access rights is described in "Specifying Access Rights in Commands" on page 276.

A column can be one of the following types:

TABLE 19–4 Table Column Types

Type	Description
	No column type specified after the = sign. The column is neither searchable nor encrypted.
`S`	Searchable.
`I`	Searchable, but case-insensitive. When NIS+ commands search through the column, they will ignore case.
`C`	Encrypted.

NIS+ commands search through the column and identify individual table rows based on the contents of the searchable columns. Searchable columns are designated with either the `S` or the `I` option. In database terminology, a searchable column is a key. The first column in each table must be searchable. The remaining columns do not have to be searchable. Because the table is keyed on the searchable columns, if you have more than one searchable column, they must be the first and subsequent columns and not skip any columns. For example, if only one column in a table is searchable, it has to be the first column. If two columns are searchable, they must be the first two columns. (see "`nistbladm`, Searchable Columns, Keys, and Column Values" on page 356 for more information on searchable columns.)

If you specify only access rights, you don't need to use a comma. If you include one or more of the `-S`, `-I` , or `-C` flags, add a comma before the access rights.

In the example below, a table is created with the addition of column-specific access rights applied to the first two columns:

```
master% nistbladm -c depts Name=I,w+m Site=w+m Name=C \
 divs.mydir.doc.com.
```

For more information about specifying column access rights when creating a table, see "Setting Column Rights When Creating a Table" on page 285.

Note – NIS+ assumes that all column entries are null terminated. Applications and routines that write information to NIS+ tables must be configured to null terminate each column entry.

Creating Additional Automount Table

If you are creating an automount table, the table can have only two columns. The first column must be named `key` and the second column must be named `value`. For example, to create an automount table named `auto1`, you would enter:

```
master% nistbladm -c key-value key=S value= auto1.org_dir.doc.com.
```

Deleting a Table

To delete a table, use the `-d` option and enter the table name:

```
nistbladm -d tablename
```

The table must be empty before you can delete it (see "Removing Table Entries" on page 366). This example deletes the divs table from the `doc.com.` directory:

```
rootmaster% nistbladm -d divs.doc.com.
```

Adding Entries to a Table

To add new entries (rows) to a table, use `nistbladm` with either the `-a` or `-A` options followed by either one or more column=value pairs and the table name or an indexed name as described in "`nistbladm` and Indexed Names" on page 357.

```
nistbladm [-a | -A] indexedname
nistbladm [-a | -A] column="value" \
column="value" \
... tablename
```

When adding new entry rows to a table with either `-a` or `-A` :

- Always enclose the *value* element in quotes. For example, to add an entry where the value of the `cname` column is `deneb`, the *column=value* pair would look like: `cname="deneb"`
- You *must* specify a value for *every* column in the table.
- To specify that a column in the entry row you are adding is empty use *column*`=" "`. In other words, for the *value*, enclose a space between the quote marks.

Note – NIS+ is a naming service and its tables are designed to store references to objects, not the objects themselves. NIS+ is optimized to support 10,000 objects with a combined total size of all tables not more than 10M bytes. NIS+ does not support individual tables where the sum of field sizes in a single column are greater than approximately 7k. If a table is too large, `rpc.nisd` may fail.

Adding a Table Entry With the `-a` Option

The `-a` option adds an entry to a table unless the entry already exists, in which case it returns an error. An entry is defined as *existing* if its values in the searchable columns exactly match the values in the new entry's searchable columns. (The values in non-searchable columns are not taken into account.)

To use the `-a` option, you must specify a value for every column in the table:

```
nistbladm -a column="value" \
 column="value" \
 ... tablename
nistbladm -a indexedname
```

(To list the names and characteristics of table columns, use the `niscat -o` *tablename* command.)

For example, to add a new row to a table named `depts` using column=value pairs, you would enter:

```
rootmaster% nistbladm -a Name='R&D' Site='SanFran' \
 Name='vattel' depts.doc.com.
```

To add the same entry using an indexed name, you would enter:

```
rootmaster% nistbladm -a [Name='R&D',Site='SanFran',\
 Name='vattel'],depts.doc.com.
```

Both examples would produce a table row that looked like this:

Dept	Site	Name
R&D	SanFran	vattel

C-shell users should also use quotes to set off expressions using square brackets.

You can only add one entry with each instance of the `nistbladm` command. You must run `nistbladm` once for each entry row you want to add.

If a table row already exists with values in each column that are identical to the entry you are trying to create, `nistbladm -a` will return an error. You cannot have two identical entry rows in a table. In this context, rows are considered *identical* if the values in the *searchable* columns are identical, the values in none search able columns are not considered.

For example, if the `Dept` and `Site` columns are searchable, and the `Name` column is not searchable, `nistbladm` considers the following two rows to be identical:

Dept (searchable)	Site (searchable)	Name (not searchable)
Sales	Vancouver	Hosteen
Sales	Vancouver	Lincoln

In this example, nistbladm `-a` would not allow you to create the `Sales Vancouver Lincoln` row.

However if just *some* of the searchable columns have values identical to the entry you are trying to create, `nistbladm -a` will create a new entry as specified. For example, you could run the following commands to create two similar, but not identical, rows in a `depts` table:

```
rootmaster% nistbladm -a Dept='Sales' \
   Site='Vancouver' Name='hosteen' staff.doc.com.
rootmaster% nistbladm -a Dept='Sales' \
   Site='SanFran' Name='lincoln' staff.doc.com.
```

Which would produce rows that had some, but not all identical values in the searchable columns:

Dept	Site	Name
Sales	Vancouver	hosteen
Sales	SanFran	lincoln

Adding a Table Entry With the `-A` Option

The `-A` option is designed for applications where you need to force `nistbladm` to overwrite an existing entry. Like the `-a` option, `-A` adds a new entry to a table. However, if the entry already exists, instead of exiting with an error, it overwrites the existing entry row.

When using the `-A` option, you must specify all columns in the entry.

For example, suppose the following table exists and the `Dept` and `Site` columns are searchable:

Dept (searchable)	Site (searchable)	Name
Sales	SanFran	Lincoln

Now you run the following command:

```
rootmaster% nistbladm -A Name=Sales Site=SanFran \
 Name=Tsosulu depts.doc.com.
```

The `-a` option would have returned an error, since the entry specified by `Name=Sales Site=SanFran` already exists. But the `-A` option allows you to overwrite the existing row.

Dept	Site	Name
Sales	`SanFran`	`Tsosulu`

Modifying Table Entries

Existing table entries are edited (modified) using either the `-e` or `-E` options. The Solaris operating environment release also supports use of the `-m` option for backwards compatibility with earlier releases. (All new applications and command line operations should use either the `-e` or `-E` options.)

To edit an existing entry (row) in a table, use `nistbladm` with either the `-e` or `-E` options followed by one or more column=value pairs that specify the new values and ending with an indexed name that identifies a particular row in a table as described in "`nistbladm` and Indexed Names" on page 357.

```
nistbladm [-e | -E] column="value" \
 column="value" \
 ... indexedname
```

When adding new entry rows to a table with either `-e` or `-E` :

- Always enclose the *value* element in quotes. For example, to change the value of the `cname` column to `deneb`, the *column=value* pair would look like: `cname="deneb"`
- You can only edit values in searchable columns one entry (row) at a time.
- To specify that a column in the entry row that you are editing be empty, use *column*`=" "`. In other words, for the *value*, enclose a space between the quote marks.

Editing a Table Entry With the `-e` Option

The `-e` option edits an entry in a table unless doing so would result in changing values in searchable columns in more than one entry row, in which case it returns an error. (The values in non-searchable columns are not taken into account.)

```
nistbladm column="value" \
 column="value" \
 ... indexedname
```

To use the `-e` option, you only need to specify the column values you are changing.

For example, suppose you had the table:

Dept	Site	Name
Sales	SanFran	Tsosulu

To change the value of the `Name` column to `Chandar`, you would enter:

```
master% nistbladm -e Name="Chandar" [Dept='Sales',Site='SanFran'],\
 depts.doc.com.
```

Now the table looks like this:

Dept	Site	Name
Sales	SanFran	Chandar

(Note that in the example above, the indexed name did not need to include the `Name` column because in these examples that column is not searchable.)

C-shell users should also use quotes to set off expressions using square brackets.

You can use the `-e` option to edit the values in searchable columns so long as the new values you specify affect only the single row identified by the indexed name. For example, to change the department to `Manf`, you would enter:

```
master% nistbladm -e Dept="Manf" [Dept='Sales',Site='SanFran'],\
 depts.doc.com.
```

Dept (searchable)	Site (searchable)	Name
Manf	SanFran	Chandar

However, if an entry row already existed with `Manf` and `SanFran` in the searchable columns, the `-e` option would return an error.

You can specify changes to multiple columns so long as they all apply to a single entry row. For example, to change both the Dept and Name values, you would enter:

```
master% nistbladm -e Dept="Manf" Name="Thi" \
 [Dept='Sales',Site='SanFran'],depts.doc.com.
```

Dept (searchable)	Site (searchable)	Name
Manf	SanFran	Thi

Editing a Table Entry With the `-E` Option

The `-E` option is designed for applications where you need to force `nistbladm` to overwrite an existing entry even if doing so will affect more than one entry.

For example, suppose your table had the following rows:

Dept (searchable)	Site (searchable)	Name
Sales	SanFran	Chandar
Sales	Alameda	Achmed

Now you run the following command:

```
master% nistbladm -E Site="Alameda" Mgr="Chu" \
[Div='Sales',Site='SanFran'],depts.doc.com.
```

Which would change the `Sales SanFran Chandar` row to `Sales Alameda Chu`. But `Sales Alameda` are the key values identifying the `Sales Alameda Achmed` row, so that row would also be changed. The result would be a single row where once there had been two rows:

Dept (searchable)	Site (searchable)	Name
Sales	Alameda	Chu

The `-e` option would have returned an error, since the edit would affect more than one row. But the `-E` option allows you to affect more than one entry row.

Removing Table Entries

- To remove a single entry from a table, use the `-r` option as described in "Removing Single Table Entries" on page 366.
- To remove multiple entries from a table, use the `-R` option as described in "Removing Multiple Entries From a Table" on page 367

Removing Single Table Entries

To remove a single entry from a table, use the `-r` option:

```
nistbladm -r indexed-name
```

This example removes the `Manf-1` entry from the `depts` table:

```
rootmaster% nistbladm -r [Dept=Manf-1,Site=Emeryville,Name=hosteen],\
depts.doc.com.
```

You can specify as few column values as you wish. If NIS+ finds duplicates, it does not remove any entry and returns an error message instead. Thus, you could have removed the `Manf-1` by specifying only the `Site` column value, as in this example:

```
rootmaster% nistbladm -r [Site=Emeryville],depts.doc.com.
```

However, you could *not* have removed the `Sales` entry by specifying only the `Site` column value (`SanFran`), because two entries have that same value (`R&D` and `Sales`):

Dept	Site	Name
R&D	SanFran	kuznetsov
Sales	SanFran	jhill
Manf-1	Emeryville	hosteen
Manf-2	Sausalito	lincoln

Removing Multiple Entries From a Table

To remove multiple entries from a table, use the `-R` option:

```
nistbladm -R indexedname
```

As with the `-r` option, you can specify as few column values as you wish. Unlike the `-r` option, however, if NIS+ finds duplicates, it removes all of them. You can find the name of a table's column by using the `niscat -o` command. This example removes all entries in which the `Site` is `SanFran`:

```
rootmaster% nistbladm -R [Site=SanFran],depts.doc.com.
```

Dept	Site	Name
Manf-1	Emeryville	hosteen
Manf-2	Sausalito	lincoln

You can use the `-R` option to remove all the entries from a table. Simply do not specify any column values between the square brackets, as in this example:

```
rootmaster% nistbladm -R [],depts.doc.com.
```

When used with the `nistbladm -R` command, an empty set of square brackets is interpreted as a wildcard specifying all table rows.

The `niscat` Command

The `niscat` command displays the contents of an NIS+ table. However, you can also use it to display the object properties of the table. You must have read rights to the table, entries, or columns that you wish to display.

Syntax

To display the contents of a table, use:

```
niscat [-hM] tablename
```

To display the object properties of a table, use:

```
niscat -o tablename
niscat -o entry
```

TABLE 19–5 `niscat` Options

Option	Description
`-h`	Header. Displays a header line above the table entries, listing the name of each column.
`-M`	Master. Displays only the entries of the table stored on the Master server. This ensures you get the most up-to-date information and should be used only for debugging.
`-o`	Object. Displays object information about the table, such as column names, properties, and servers.

Displaying the Contents of a Table

To display the contents of a table, use `niscat` with a table name:

```
niscat tablename
```

This example displays the contents of the table named `depts`.

```
rootmaster% niscat -h depts.doc.com.
#Name:Site:Name
R&D:SanFran:kuznetsov
Sales:SanFran:jhill
```

```
Manf-1:Emeryville:hosteen
Manf-2:Sausalito:lincoln
```

Note – The symbol `*NP*` indicates that you do not have permission to view that entry. Permissions are granted on a table, column, or entry (row) basis. For more on access permissions, see Chapter 15.

Displaying the Object Properties of a Table or Entry

To list the object properties of a table, use `niscat -o` and the table's name:

`niscat -o` *tablename*`.org_dir`

To display the object properties of a table entry, use `niscat -o` and specify the entry with an indexed name:

`entry ::=`*column=value* `\`
` ...` *tablename* `|\`
` [`*column=value*`,...],\`
tablename

Here are two examples, one for a table and one for a table entry:

Table

```
rootmaster# niscat -o hosts.org_dir.doc.com.
Object Name : hosts
Owner : rootmaster.doc.com.
Group : admin.doc.com.
Domain : org_dir.doc.com.
Access Rights : ----rmcdr---r---
Time to Live : 12:0:0
Object Type : TABLE
Table Type : hosts_tbl
Number of Columns : 4
Character Separator :
Search Path :
Columns :
 [0] Name : cname
 Attributes : (SEARCHABLE, TEXTUAL DATA, CASE INS
 Access Rights: ----------------
 [1] Name : name
 Attributes : (SEARCHABLE, TEXTUAL DATA, CASE INS
 Access Rights: ----------------
 [2] Name : addr
```

```
 Attributes : (SEARCHABLE, TEXTUAL DATA, CASE INS
 Access Rights: ----------------
 [3] Name : comment
 Attributes : (TEXTUAL DATA)
 Access Rights: ----------------
```

Table entry

```
rootmaster# niscat -o [name=rootmaster],hosts.org_dir.doc.com.
Object Name : hosts
Owner : rootmaster.doc.com.
Group : admin.doc.com.
Domain : org_dir.doc.com.
Access Rights : ----rmcdr---r---
Time to Live : 12:0:0
Object Type : ENTRY
 Entry data of type hosts_tbl
 Entry has 4 columns.
 .
#
```

The `nismatch` and `nisgrep` Commands

The `nismatch` and `nisgrep` commands search through NIS+ tables for entries that match a particular string or regular expression, respectively. They display either the entries themselves or a count of how many entries matched. The differences between the `nismatch` and `nisgrep` commands are highlighted in Table 19–6 below.

TABLE 19–6 Characteristics of `nismatch` and `nisgrep`

Characteristics	nismatch	nisgrep
Search criteria	Accepts text only	Accepts regular expressions
Speed	Faster	Slower
Searches through	Searchable columns only	All columns, whether searchable or not
Syntax of search criteria	*column=string* `...` *tablename* `[` *column= string*`,...],` *tablename*	*column=exp* `...` *tablename*

The tasks and examples in this section describe the syntax for both commands.

To use either command, you must have read access to the table you are searching through.

The examples in this section are based on the values in the following table, named `depts.doc.com`. Only the first two columns are searchable.

Name (S)	Site (S)	Name
R&D	SanFran	kuznetsov
Sales	SanFran	jhill
Manf-1	Emeryville	hosteen
Manf-2	Sausalito	lincoln
Shipping-1	Emeryville	tsosulu
Shipping-2	Sausalito	katabami
Service	Sparks	franklin

About Regular Expressions

Regular expressions are combinations of text and symbols that you can use to search for special configurations of column values. For example, the regular expression `'Hello'` searches for a value that begins with `Hello`. When using a regular expression in the command line, be sure to enclose it in quotes, since many of the regular expression symbols have special meaning to the Bourne and C shells. For example:

```
rootmaster% nisgrep -h greeting='Hello' phrases.doc.com.
```

The regular expression symbols are summarized in Table 19–7, below.

TABLE 19–7 Regular Expression Symbols

Symbol	Description
^*string*	Find a value that begins with *string.*
string $	Find a value that ends with *string*.
.	Find a value that has a number characters equal to the number of periods.
[*chars*]	Find a value that contains any of the characters in the brackets.
**expr*	Find a value that has zero or more matches of the *expr.*
+	Find something that appears one or more times.

TABLE 19–7 Regular Expression Symbols *(Continued)*

Symbol	Description
`?`	Find any value.
`\'`*`s-char`*`'`	Find a special character, such as ? or $.
`x | y`	Find a character that is either `x` or `y`.

Syntax

To search through the first column, use:

```
nismatch string tablename
nisgrep reg-exp tablename
```

To search through a particular column, use:

```
nismatch column=string tablename
nisgrep column=reg-exp tablename
```

To search through multiple columns, use:

```
nismatch column=string tablename ...\
nismatch [column=string,...],tablename
nisgrep column=reg-exp ... \
    tablename
```

TABLE 19–8 `nismatch` and `nisgrep` Options

Option	Description
`-c`	Count. Instead of the entries themselves, displays a count of the entries that matched the search criteria.
`-h`	Header. Displays a header line above the entries, listing the name of each column.
`-M`	Master. Displays only the entries of the table stored on the master server. This ensures you get the most up-to-date information and should be used only for debugging.

Searching the First Column

To search for a particular value in the first column of a table, simply enter the first column value and a *tablename*. In `nismatch`, the value must be a string. In `nisgrep`, the value must be a regular expression.

```
nismatch [-h] string tablename
nisgrep [-h] reg-expression tablename
```

This example searches through the `depts` table for all the entries whose first column has a value of `R&D`:

```
rootmaster% nismatch -h 'R&D' depts.doc.com.
rootmaster% nisgrep -h 'R&D' depts.doc.com.
```

Note – Quotes are used in the 'R&D' expression above to prevent the shell from interpreting the ampersand (`&`) as a metacharacter.

Searching a Particular Column

To search through a particular column other than the first, use the following syntax:

```
nismatch column=string tablename
nisgrep column=reg-expression tablename
```

This example searches through the depts table for all the entries whose second column has a value of `SanFran`:

```
rootmaster% nismatch -h Site=SanFran depts.doc.com.
rootmaster% nisgrep -h Site=SanFran depts.doc.com.
```

Searching Multiple Columns

To search for entries with matches in two or more columns, use the following syntax:

```
nismatch [-h] [column=string, ... \
 column=string,...],tablename
nisgrep [-h] column=reg-exp ... \
 tablename
```

This example searches for entries whose second column has a value of `SanFran` and whose third column has a value of `jhill`:

```
rootmaster% nismatch -h [Site=SanFran,Name=jhill], depts.doc.com.
rootmaster% nisgrep -h Site=SanFran Name=jhill depts.doc.com.
```

The `nisln` Command

The `nisln` command creates symbolic links between NIS+ objects such as tables and directories. All NIS+ administration commands accept the `-L` flag, which directs them to follow links between NIS+ objects.

Note – Do not link table entries. Tables may be linked to other tables, but do not link an entry in one table to an entry in another table.

To create a link to another object (table or directory), you must have modify rights to the source object; that is, the one that will point to the other object or entry.

Caution – Never link a `cred` table. Each `org_dir` directory should have its own `cred` table. Do not use a link to some other `org_dir cred` table.

Syntax

To create a link, use:

`nisln` *source target*

TABLE 19–9 `nisln` Options

Option	Description
`-L`	Follow links. If the *source* is itself a link, the new link will not be linked to it, but to that link's original source.
`-D`	Defaults. Specify a different set of defaults for the linked object. Defaults are described in "Specifying Nondefault Security Values at Creation Time" on page 283.

Creating a Link

To create a link between objects such as tables and directories, specify both object names: first the *source*, and then the *target*. Do not link table entries.

`nisln` *source-object target-object*

The `nissetup` Command

The `nissetup` command expands an existing NIS+ directory object into a domain by creating the `org_dir` and `groups_dir` directories, and a full set of NIS+ tables. It does not, however, populate the tables with data. For that, you will need the `nisaddent` command, described in "The `nisaddent` Command" on page 376. Expanding a directory into a domain is part of the process of setting up a domain.

Note – When setting up a new NIS+ domain, the `nisserver`script is easier to use than the `nissetup` command. See"Setting Up NIS+ Root Servers" on page 92 for a full description of using nisserver.

The `nissetup` command can expand a directory into a domain that supports NIS clients as well.

To use `nissetup`, you must have modify rights to the directory under which you'll store the tables.

Expanding a Directory Into an NIS+ Domain

You can use the `nissetup` command with or without a directory name. If you don't supply the directory name, it uses the default directory. Each object that is added is listed in the output.

```
rootmaster# /usr/lib/nis/nissetup doc.com.
org_dir.doc.com. created
groups_dir.doc.com. created
auto_master.org_dir.doc.com. created
auto_home.org_dir.doc.com. created
bootparams.org_dir.doc.com. created
cred.org_dir.doc.com. created
ethers.org_dir.doc.com. created
group.org_dir.doc.com. created
hosts.org_dir.doc.com. created
mail_aliases.org_dir.doc.com. created
sendmailvars.org_dir.doc.com. created
netmasks.org_dir.doc.com. created
netgroup.org_dir.doc.com. created
networks.org_dir.doc.com. created
passwd.org_dir.doc.com. created
protocols.org_dir.doc.com. created
rpc.org_dir.doc.com. created
services.org_dir.doc.com. created
timezone.org_dir.doc.com. created
```

Expanding a Directory Into an NIS-Compatible Domain

To expand a directory into a domain that supports NIS+ and NIS client requests, use the `-Y` flag. The tables are created with read rights for the nobody class so that NIS clients requests can access them.

```
rootmaster# /usr/lib/nis/nissetup -Y Test.doc.com.
```

The `nisaddent` Command

The `nisaddent` command loads information from text files or NIS maps into NIS+ tables. It can also dump the contents of NIS+ tables back into text files. If you are populating NIS+ tables for the first time, see the instructions in . It describes all the prerequisites and related tasks.

You can use `nisaddent` to transfer information from one NIS+ table to another (for example, to the same type of table in another domain), but not directly. First, you need to dump the contents of the table into a file, and then load the file into the other table. Be sure, though, that the information in the file is formatted properly. Chapter 10 , describes the format required for each table.

When you load information into a table, you can use any of three options: replace, append, or merge. The append option simply adds the source entries to the NIS+ table. With the replace option, NIS+ first deletes all existing entries in the table and then adds the entries from the source. In a large table, this adds a large set of entries into the table's `.log` file (one set for removing the existing entries, another for adding the new ones), taking up space in `/var/nis` and making propagation to replicas time consuming.

The merge option produces the same result as the replace option but uses a different process, one that can greatly reduce the number of operations that must be sent to the replicas. With the merge option, NIS+ handles three types of entries differently:

- Entries that exist only in the source are *added* to the table
- Entries that exist in both the source and the table are *updated* in the table
- Entries that exist only in the NIS+ table are *deleted* from the table

When updating a large table with a file or map whose contents are not greatly different from those of the table, the merge option can spare the server a great many operations. Because the merge option deletes only the entries that are not duplicated in the source (the replace option deletes *all* entries, indiscriminately), it saves one delete and one add operation for every duplicate entry.

If you are loading information into the tables for the first time, you must have create rights to the table object. If you are overwriting information in the tables, you must have modify rights to the tables.

Syntax

To load information from text files, use:

```
/usr/lib/nis/nisaddent -f filename table-type\[domain]
/usr/lib/nis/nisaddent -f filename \
 -t tablename table-type [domain]
```

To load information from NIS maps, use:

```
/usr/lib/nis/nisaddent -y NISdomain table-type\
  [domain]
/usr/lib/nis/nisaddent -y NISdomain -t tablename table-type [domain]
/usr/lib/nis/nisaddent -Y map table-type [domain]
/usr/lib/nis/nisaddent -Y map -t tablename table-type [domain]
```

To dump information from an NIS+ table to a file, use:

```
/usr/lib/nis/nisaddent -d [-t tablename tabletype] \
 > filename
```

Loading Information From a File

You can transfer the contents of a file into an NIS+ table in several different ways:

- The `-f` option with no other option *replaces* the contents of *table-type* in the local domain with the contents of *filename*.

```
nisaddent -f filename table-type
```

- With the `-a` option, `-f` *appends* the contents of *filename* to *table-type*.

```
nisaddent -a -f filename table-type
```

- With the `-m` option, `-f` *merges* the contents of *filename* into the contents of *table-type*.

```
nisaddent -m -f filename table-type
```

The following two examples load the contents of a text file named `/etc/passwd.xfr` into the NIS+ Passwd table. The first is into a table in the local domain, the second into a table in another domain:

```
rootmaster# /usr/lib/nis/nisaddent -f /etc/passwd.xfr passwd
rootmaster# /usr/lib/nis/nisaddent -f /etc/shadow.xfr shadow
rootmaster# /usr/lib/nis/nisaddent -f /etc/passwd.xfr passwd sales.doc.com.
```

```
rootmaster# /usr/lib/nis/nisaddent -f /etc/shadow.xfr shadow sales.doc.com.
```

Note – When creating an NIS+ passwd table from `/etc` files, you must run `nisaddent` twice; once on the `/etc/passwd` file and once on the `/etc/shadow` file.

To merge entries from the `/etc/inet/ipnodes` file (IPv6 addresses) into the `ipnodes.org_dir` table, use the `-v` and `-f` options.

```
rootmaster# /usr/lib/nis/nisaddent -m -f /etc/inet/ipnodes ipnodes
```

Another way is to use `stdin` as the source. However, you cannot use the `-m` option with `stdin`. You can use redirect (`->`) or pipe (`-|`), but you cannot pipe into another domain.

Task	Command
Redirect	`cat` *filename* `> nisaddent` *table-type*
Redirect with append option	`cat` *filename* `> nisaddent -a` *table-type*
Redirect with append into another domain	`cat` *filename* `> nisaddent -a` *table-type NIS+ domain*
Pipe	`cat` *filename* `| nisaddent` *table-type*
Pipe with append option	`cat` *filename* `| nisaddent -a` *table-type*

If the NIS+ table is an automounter table or a nonstandard table, add the `-t` option and the complete name of the NIS+ table.

```
master# nisaddent -f /etc/auto_home.xfr \
  -t auto_home.org_dir.doc.com.key-value
master# nisaddent -f /etc/auto_home.xfr \
  -t auto_home.org_dir.doc.com. key-value sales.doc.com.
```

Loading Data From an NIS Map

You can transfer information from an NIS map in two different ways; either by specifying the NIS domain or by specifying the actual NIS map. If you specify the domain, NIS+ will figure out which map file in `/var/yp/`*nisdomain* to use as the source, based on the *table-type*. Note that `/var/yp/`*nisdomain* must be *local* files.

NIS+ Table Type	NIS Map Name
Hosts	hosts.byaddr
Nodes	ipnodes.byaddr
Passwd	passwd.byname
Group	group.byaddr
Ethers	ethers.byname
Netmasks	netmasks.byaddr
Networks	networks.byname
Protocols	protocols.byname
RPC	rpc.bynumber
Services	services.byname

To transfer by specifying the NIS domain, use the `-y` (lowercase) option and provide the NIS domain in addition to the NIS+ table type.

Table replacement

`nisaddent -y` *nisdomain table-type*

Table append

`nisaddent -a -y` *nisdomain table-type*

Table merge

`nisaddent -m -y` *nisdomain table-type*

By default, `nisaddent` replaces the contents of the NIS+ table with the contents of the NIS map. Use the `-a` and `-m` options to append or merge. Here is an example that loads the NIS+ passwd table from its corresponding NIS map (`passwd.byname`) in the old-doc domain:

```
rootmaster# /usr/lib/nis/nisaddent -y old-doc passwd
```

This example does the same thing, but for the `sales.doc.com.` domain instead of the local domain, `doc.com.`

```
rootmaster# /usr/lib/nis/nisaddent -y old-doc passwd sales.doc.com.
```

If the NIS+ table is an automounter table or a nonstandard table, add the `-t` option and the complete name of the NIS table, just as you would if the source were a file.

```
rootmaster# nisaddent -y old-doc \
  -t auto_home.org_dir.doc.com. key-value
rootmaster# nisaddent -y old-doc \
```

```
  -t auto_home.org_dir.doc.com. key-value sales.doc.com.
```

If instead of using the map files for a domain, you prefer to specify a particular NIS map, use the `-Y` (uppercase) option and specify the map name.

```
rootmaster# nisaddent -Y hosts.byname hosts
rootmaster# nisaddent -Y hosts.byname hosts sales.doc.com.
```

If the NIS map is an automounter map or a non standard map, combine the `-Y` option with the `-t` option:

```
rootmaster# nisaddent -Y auto_home
 -t auto_home.org_dir.doc.com. key-value
rootmaster# nisaddent -Y auto_home
 -t auto_home.org_dir.doc.com. key-value sales.doc.com.
```

Dumping the Contents of an NIS+ Table to a File

To dump the contents of an NIS+ table into a file, use the `- d` and `-t` options. The `-d` options tells the command to dump, and the `-t` option specifies the NIS+ table:

```
rootmaster# nisaddent -d auto_home
 -t auto_home.org_dir.doc.com. key-value
rootmaster# nisaddent -d auto_home
 -t auto_home.org_dir.doc.com.  key-value sales.doc.com.
```

CHAPTER 20

Server-Use Customization

This chapter describes how to customize and control which servers NIS+ clients use.

NIS+ Servers and Clients

When client machines, users, applications, or processes need NIS+ information, they seek an active NIS+ server (master or replica) from which to get the needed data. On large networks, networks with many subnets, and networks that span wide-area links, you may be able to improve NIS+ performance by customizing server usage.

Default Client Search Behavior

By default, if no server preferences have been set with the `nisprefadm` command, a client will first try to obtain the information it needs from an NIS+ server on the client's local subnet. If the client finds an active server on the local subnet, it obtains the information it needs from the first local server that responds. If no server is available on the local subnet, the client searches outside the local subnet, and obtains the NIS+ information it needs from the first remote server that responds.

On large, busy networks, this default search behavior may reduce NIS+ performance for one of two reasons:

- When multiple servers on a subnet are serving a large number of clients, the random nature of the client's default search pattern may result in some servers being over worked while others are under used.
- When a client has to seek an NIS+ server beyond the local subnet, it will obtain its information from the first server that responds even if that server is overworked, or

linked to the client's subnet by a slower Wide Area Network connection such as a modem or a dedicated line that is already carrying heavy traffic.

Designating Preferred Servers

The Solaris operating environment contains a new feature—server-use customization—that allows you to control the order in which clients search for NIS+ servers. With this new feature you can balance and customize server usage by:

- Specifying that clients prefer (search for) certain servers over others.
- Specify whether or not clients are permitted to use remote servers if no local servers are available.

The search criteria that you specify can be applied to all clients within a domain, all clients on a subnet, or to individual clients on a machine-by-machine basis.

Note – When server-use preferences are set for a particular machine, those preferences apply to all users, applications, processes, or other clients running on that machine. You cannot set different server-use patterns for different clients on the *same* machine.

NIS+ Over Wide Area Networks

Server-use customization is particularly valuable for large networks with many subnets and networks that span multiple geographic sites connected by modems or leased lines. To maximize network performance, you want to minimize network traffic between subnets, and between sites linked by slower connections. You can do that by specifying which NIS+ servers the clients can use, and their order of server preference. In this way you confine as much NIS+ network traffic as possible to the local subnet.

Optimizing Server-Use—Overview

This section provides an overview of server-use customization.

nis_cachemgr is Required

Server-use customization requires that a client be running nis_cachemgr. If a client machine is not running nis_cachemgr, it cannot make use of server-use customization. If there is no nis_cachemgr running on a client machine, that client will use the first server it identifies as described in "Default Client Search Behavior" on page 381.

Global Table or Local File

Depending on how you use the nisprefadm command, it creates either a local client_info file or a domain client_info table:

- *File*. You can use nisprefadm to create a local, machine-specific client_info file that is stored in the machine's /var/nis directory. A local file specifies server preferences for that machine only. When a machine has a local /var/nis/client_info file, it ignores any server preferences contained in a domain client_info.org_dir table. To create a local client_info file, you run nisprefadm with the -L option.
- *Table*. You can use nisprefadm to create an NIS+ client_info table which is stored in each domain's org_dir NIS+ directory object. This table can specify server preferences for:
  - Individual machines. (If a machine has a local /var/nis/client_info file, any preferences for that machine that happen to be in the domain client_info table are ignored.)
  - All the machines on a particular subnet. (If a machine on the subnet has a local /var/nis/client_info file or individual preferences set for it in the table it ignores subnet preferences.)

  To create a global client_info table that applies to all machine on a subnet, you run nisprefadm with the -G and -C options as described in "Specifying Global Server Preferences" on page 390.

  Note that if a machine has its own local client_info file as described below, it will ignore all server preferences set for it in a global client_info table. If a machine has either a local client_info file or a machine-specific entry for it in the global client_info table, it will ignore preferences set for its subnet.

Caution – Use only the `nisprefadm` command to make changes to `client_info` files and tables. Never use other NIS+ commands such as `nistbladm`.

When working with `client_info` tables or files, you *must* use either the `-G` or the `-L` option to specify that your command apply to either the global table (`-G`) or local file (`-L`) of the machine you are running the command on.

Preference Rank Numbers

Server preferences are controlled by giving each server a *preference rank number*. Clients search for NIS+ servers in order of numeric preference, querying servers with lower preference rank numbers before seeking servers with higher numbers.

Thus, a client will first try to obtain namespace information from NIS+ servers with a preference of zero. If there are no preference=0 servers available, then the client will query servers whose preference=1. If no 1's are available, it will try to find a 2, and then a 3, and so on until it either gets the information it needs or runs out of servers.

Preference rank numbers are assigned to servers with the `nisprefadm` command as described in "Specifying Global Server Preferences" on page 390.

Server preference numbers are stored in `client_info` tables and files. If a machine has its own `/var/nis/client_info` file, it uses the preference numbers stored in that file. If a machine does not have its own `client_info` file, it uses the preference numbers stored in the domain's `client_info.org_dir` table. These `client_info` tables and files are called "preferred server lists" or simply *server lists*.

You customize server usage by controlling the server preferences of each client. For example, suppose a domain has a client machine named `mailer` that makes heavy use of namespace information and the domain has both a master server (`nismaster`) and a replica server (`replica1`). You could assign a preference number of `1` to `nismaster` and a number of `0` to `replica1` for the `mailer` machine. The `mailer` machine would then always try to obtain namespace information from `replica1` before trying `nismaster`. You could then specify that for all the other machines on the subnet the `nismaster` server had a preference number of zero and `replica1` the number `1`. This would cause the other machine to always try `nismaster` first.

You can give the same preference number to more than one server in a domain. For example, you could assign both `nismaster1` and `replica2` a preference number of `0`, and assign `replica3`, `replica4`, and `replica5` a preference number of `1`.

Default Server Preferences

If there is no `client_info` file or table, the cache manager automatically assigns all servers on the local subnet a default preference number of zero (0) and all servers outside the local subnet a preference of infinite. The purpose of `nisprefadm` is to change these default preference numbers to what you want them to be.

Efficiency and Server Preference Numbers

A client must seek all servers with a given preference number before searching for servers with the next higher number. It requires 5 or more seconds for a client to search for all the servers with a given preference number. This means that if you have a master server and 4 replicas in a domain, and you give each one a *different* preference number from 0 to 4, it could take a client more than 25 seconds to run through all of those preference levels.

To maximize performance, you should not use more than two or three levels of server preference. For example, in the case described above, it is better to give one of those five servers a preference=`0` and all the others a preference of `1`, or give two of them a preference of `1` and the remaining three a preference of `2`.

Preferred Only Servers Versus All Servers

Server lists also specify what a client does if it cannot find *any* preferred servers. A *preferred server* is any server with a preference of zero, or any server that you have assigned a preference number with `nisprefadm`.

By default, if a client fails to reach a preferred server, it will then seek out any server it can find anywhere on the network using the search mode described in “Default Client Search Behavior” on page 381. You can change this default behavior with the `nisprefadm -o` option to specify that a client can only use preferred servers and if no servers are available it cannot go to non-preferred servers. See “Specifying Preferred-Only Servers” on page 395 for details.

Note – This option is ignored when the machine’s domain is not served by *any* preferred servers.

Viewing Preferences

To view the server preferences currently in effect for a particular client machine, you run `nisprefadm` with the `-l` option as described in “Viewing Current Server Preferences” on page 388.

Server and Client Names

When specifying server or client machines, keep in mind the following points:

- Server and client names do *not* need to be fully qualified so long as they are in the same NIS+ domain and uniquely identify the object. You can simply use the machine name by itself.
- If a server or subnet is in another NIS+ domain, you need to include enough of the domain name to uniquely identify that machine. For example, if you are in the `sales.doc.com` domain and you need to specify the `nismaster2` machine in the `manf.doc.com` domain, you need only enter `nismaster2.manf`.

Server Preferences

To specify a server preference for:

- *Individual client machine*, use the `-L` option to create a local `client_info` file for the machine you are running the `nisprefadm` on. Use the `-G -C` *machine* options to create machine-specific preferences in the global `client_info` table.
- *All machines on a subnet*, use the `-G -C` *subnetnumber* option.
- *All machines in the current domain that do not have machine-specific or subnet-specific preferences,* use the `-G` option.

When Server Preferences Take Effect

Changes you make to a machine or subnet's server preferences normally do not take effect on a given machine until that machine updates it `nis_cachemgr` data. When the `nis_cachemgr` of a machine updates its server-use information depends on whether the machine is obtaining its server preferences from a global `client_info` table or a local `/var/nis/client_info` file (see "Global Table or Local File" on page 383).

- *Global table*. The cache managers of machines obtaining their server preferences from global tables update their server preferences whenever the machine is booted or whenever the Time-to-live (TTL) value expires for the `client_info` table. By default, this TTL value is 12 hours, but you can change that as described in "Changing the Time-to-Live of an Object" on page 350.
- *Local file*. The cache managers of machines obtaining their server preferences from local files update their server preferences every 12 hours or whenever you run `nisprefadm` to change a server preference. (Rebooting the machine does not update the cache manager's server preference information.)

However, you can force server preference changes to take effect immediately by running `nisprefadm` with the `-F` option. The `-F` option forces `nis_cachemgr` to immediately update its information. See "How to Immediately Implement Preference Changes" on page 399 for details.

Using the `nisprefadm` Command

The following sections describe how to use the `nisprefadm` command to set, modify, and delete server preferences.

The `nisprefadm` command is used to specify the servers that clients are to prefer.

The `nisprefadm` command has the following syntax:

```
nisprefadm -a|-m|-r|-u|-x|-l -L|-G [-o type] \
 [-d domain] \
 [-C machine] \
 servers
nisprefadm -F
```

TABLE 20–1 `nisprefadm` Command Options

Option	Description
`-G`	Create a global client_info table stored in the domain's `org_dir` directory. In other words, create a global preferred server list. This option must be used with either `-C` *subnet* to specify preferences for all the machines on a given subnet, or `-C` *machine* to specify preferences for an individual machine.
`-L`	Create a local `client_info` file stored in the local machine's `/var/nis` directory. In other words, create a preferred server list that applies only to the machine you are running the command on.
`-o` *type*	Specify an option. The valid options are: `pref_type=all`, which specifies that clients can use non-preferred servers if no preferred servers can be contacted, and `pref_type=pref_only`, which specifies that clients may only use the designated preferred servers.
`-d` *domain*	Create a global preferred server client_info table for the specified domain or subdomain.
`-C` *subnet*	The number of a subnet to which the preferences will apply.
`-C` *machine*	The name of a client machine.
servers	One or more NIS+ servers. These are the servers that are to be preferred.

TABLE 20–1 `nisprefadm` Command Options *(Continued)*

Option	Description
`-a`	Add the specified servers to the server list.
`-m`	Modify the server list. For example, you can use the `-m` option to change the preference number given to one or more servers.
`-r`	Remove the specified servers from the server list.
`-u`	Clear the server list, and then add the specified servers. (In other words, replace the current server list with a new list of preferred servers.)
`-x`	Remove the server list completely.
`-l`	List (display) the current preferred server information.
`-F`	Force changes to a preferred server list to take effect immediately.

Note – The `-C` machine option should not be used with the `-L` (local) flag because it has no effect. For example, suppose you are running `nisprefadm` on the `altair` machine. You use the `-L` flag to specify that the preferences you are specifying be written into `altair`'s local `client_info` file. You also use a `-C` vega option to specify that the preferences you are creating be applied to the `vega` machine. The `nisprefadm`command then write your preferences for `vega` into `altair`'s file. But `vega` will never see them because `vega` will always get its server preferences from either its own local `client_info` file or the domain's global `client_info` table. Thus, it only makes sense to use the `-C` option when running `nisprefadm` with the `-G` (global) flag

Viewing Current Server Preferences

To view current server preferences, run `nisprefadm` with the `-l` option.

How to View Preferences for a Machine

- **Run `nisprefadm` with the `-L` and `-l` options on the machine.**

```
sirius# nisprefadm -L -l
```

This displays any server preferences defined in the machine's local `/var/nis/client_info` file. If there is no local file, no information is displayed and you are returned to your shell prompt.

How to View Global Preferences for Single Machine

- **Run `nisprefadm` with the `-l`, `-G` and `-C` *machinename* options.**

  ```
  sirius# nisprefadm -G -l -C machinename
  ```

  Where *machinename* is the IP address (number) of the machine.

  This displays the preferences set in the domain's global `client_info` table for that machine.

How to View Global Preferences for a Subnet

- **Run `nisprefadm` with the `-l`, `-G` and `-C` *subnet* options.**

  ```
  sirius# nisprefadm -G -l -C subnet
  ```

  Where *subnet* is the IP address (number) of the subnet.

  This displays the preferences set in the domain's global `client_info` table for that machine.

How to Specify Preference Rank Numbers

By default, all servers listed after the `-a` option are given a preference number of zero. To specify a different preference number, enclose the number in parentheses immediately after the server name like this: `-a` *name*`(`*n*`)`. Where *name* is the name of the server and *n* is the preference number.

For example, assign the `replica2` server a preference number of 3:

```
# nisprefadm -G -a replica2(3)
```

Note – With some shells you may have to enclose the element in quotes like this: `"name(n)"`.

See "Preference Rank Numbers" on page 384 for background information on the server preference rank numbers.

Specifying Global Server Preferences

You can set global server preferences for a local or remote domain. Preferences may be set for individual machines and all the machines on a subnet.

The procedures in this section describe how to specify server preferences in a global `client_info` table residing on the NIS+ domain's master server. Once the table exists on the master server, NIS+ replicates it on to any existing replica servers for the domain.

- See "Specifying Local Server Preference" on page 392 for information on how to create a local `client_info` file on an individual machine.
- See "Global Table or Local File" on page 383 for an explanation of the difference between a global `client_info` table and a local `client_info` file.

To assign server preference numbers, run `nisprefadm` with either the:

- `-a` option to add new or additional preferred servers.
- `-u` option to delete existing server preferences and create new ones.

How to Set Global Preferences for a Subnet

To assign server preferences in the global table for all the machines on a subnet:

- **Run `nisprefadm` with the `-G` and `-C` *subnet* options.**

```
#nisprefadm -G -a -C subnet servers (preferences)
```

Where:

- `-C` *subnet* identifies the IP number of the subnet the preferences will apply to.
- *servers(preferences)* are one or more servers with optional preference ranking numbers.

  For example, to specify that the subnet `123.123.123.123` use the `nismaster` and `replica3` servers with default preference number s of zero and the

manf.replica6 server with a preference number of 1:

```
polaris# nisprefadm -a -G -C 123.123.123.123 nismaster1 \
replica3 "manf.replica6(1)"
```

How to Set Global Preferences for an Individual Machine

- **Run** `nisprefadm` **with the** `-G`**, and** `-C` *machine* **options.**

  `#nisprefadm -G -a -C` *machine servers* `(`*preferences*`)`

  Where:

  - `-C` *machine* identifies the machine the preferences will apply to. (Depending on the shell you are using, you may need to enclose *machine* in quotes.)
  - *servers(preferences)* are one or more servers with optional preference ranking numbers.

    For example, to replace the current preferences for the machine `cygnus` with `replica7` and `replica9` both with a default preference number of zero:

  ```
  polaris# nisprefadm -u -G -C cygnus replica7 replica9
  ```

How to Set Global Preferences for a Remote Domain

To assign server preferences for an individual machine in a remote domain or all the machines on a subnet in a remote domain:

- **Run** `nisprefadm` **with the** `-C`**,** `-G` **, and** `-d` **options.**

  ```
  #nisprefadm -a -G -C name \
   -d domain servers(preferences)
  ```

  Where:

  - *name* is the IP number of a subnet or the name of a machine. The modifications you make with this command apply to the subnet or machine that you name.
  - *domainname* is the name of the remote domain.
  - *servers(preferences)* are one or more servers with optional preference ranking numbers.

  For example, to add the `nismaster2` server with a default preference number of zero to the preferred server list of the `111.11.111.11` subnet in the remote `sales.doc.com` domain:

```
polaris# nisprefadm -a -G -C 111.11.111.11 -d sales.doc.com. nismaster2
```

Specifying Local Server Preference

These procedures explain how to create or change a local `client_info` file that specifies server preferences for the machine on which it resides.

If a machine has a local `/var/nis/client_info` file, that machine takes its server preferences from its local file rather than the global `client_info` tables on NIS+ servers. In other words, a local file overrides any global table.

- See "Specifying Global Server Preferences" on page 390 for information on how to create a global `client_info` tables for NIS+ servers.
- See "Global Table or Local File" on page 383 for an explanation of the difference between a global `client_info` table and a local `client_info` file.

To assign server preferences, run `nisprefadm` with either the:

- `-a` option to add new or additional preferred servers.
- `-u` option to delete existing server preferences and create new ones.

How to Set Preferences on a Local Machine

To assign server preferences for the local machine that you are running the `nisprefadm` command on:

- **Run `nisprefadm` with the `-L` option and either the `-a` or `-u` options.**

```
#nisprefadm -a -L servers(preferences)
```

Where *servers(preferences)* are one or more servers with optional preference ranking numbers.

For example, to specify that the `deneb` machine first seek NIS+ information from the `replica3` server with a default preference number of zero and then from the `replica6` server (with a preference number of 1) in the `manf.doc.com` domain:

```
deneb# nisprefadm -a -L replica3 replica6.manf(1)
```

Modifying Server Preferences

You can change a server's preference number and switch (replace) the preference numbers assigned to different servers.

To change preferred servers or the preference number assigned to a server, run `nisprefadm` with the `-m` *oldserver-=newserver*`(`*n*`)` option.

How to Change a Server's Preference Number

- **Run** `nisprefadm` **with the** `-m` *server=server(new)* **option.**

  `#nisprefadm -L|-G -C name -m` *oldserver=newserver*`(n)`

  Where:

  - `-L|-G` determines whether you are modifying a local file or a global table.
  - `-C` *name* is the IP number of a subnet or the name of a machine. This option is only used when you are also using the `-G` option. The modifications you make with this command apply to the subnet or machine that you name.
  - `-m` is the modify server list option.
  - *old server* is the name of the server whose preference number you want to change.
  - *new server(n)* is the server name and its new preference number.

  For example, on the `deneb` machine, to change the number given to the `replica6.manf` server to 2 in `deneb`'s local `client_info` file:

  ```
  deneb# nisprefadm -L -m replica6.manf=replica6.manf(2)
  ```

How to Replace One Server With Another in a Preference List

To change one server for another in a preference list:

- **Run** `nisprefadm` **with the** `-m` *oldserver=newserver* **option.**

  `#nisprefadm -L|-G -C` *name* `-m \`
  oldserver=newserver`(`*prefnumber*`)`

  Where:

  - `-L|-G` determine whether you are modifying a local or a domain-wide server list.

- `-C` *name* is the IP number of a subnet or the name of a machine. This option is only used in when you are also using the `-G` option. The modifications you make with this command apply to the subnet or machine that you name.
- `-m` is the modify-server-list option.
- *oldserver* is the old server you are replacing.
- *newserver(prefnumber)* is the new server (with an optional preference number) that is taking the old server's place in the preferred server list.

Keep in mind that when you replace a server in a global `client_info` table using the `-G` option, the replacement only applies to the subnet or machine identified by the `-C` option. Other listings of the replaced server are not affected.

For example, suppose you have a domain with three subnets, and the `replica1` server is listed as a preferred server for two of those subnets. If `replica1` is obsolete and you take it out of service, you then run `nisprefadm -m` to replace it with the new server for the first subnet. Until you do the same for the second subnet, `replica1` is still listed as a preferred server for that subnet. The same principle applies to preferred servers for individual machines.

For example, to replace the `replica3` server with the `replica6` server for subnet `123.12.123.12` in the domain's global `client_info` table and assign `replica6` a preference number of 1:

```
nismaster# nisprefadm -G -C 123.12.123.12 -m replica3 replica6(1)
```

How to Remove Servers From Preference Lists

To remove one or more servers from a preference list:

- **Run `nisprefadm` with the `-r` option.**

```
#nisprefadm -L|-G -C name -r servers
```

Where:

- `-L|-G` determines whether you are modifying a local or a domain-wide server list.
- `-C` *name* is the IP number of a subnet or the name of a machine. This option is only used when you are also using the `-G` option. The preferred servers you remove with this command apply to the subnet or machine that you name.
- `-r` removes the named *servers* from the list.

For example, in the domain's global `client_info` table, to remove the `replica3` and `replica6.manf` servers for the machine `polaris`:

```
polaris# nisprefadm -G -C polaris -r replica3 replica6.manf
```

How to Replace an Entire Preferred Server List

To replace an entire list of preferred servers for a subnet or machine in either a global `client_info` table or a machine in its local `client_info` file, run `nisprefadm` with the `-u` option.

The `-u` option operates the same way as the `-a` option, except that `-u` first deletes any existing server preferences for the machine or subnet before adding the new ones that you specify. (If there are existing preferences, the `-a` option adds the new ones to the old list.)

See "How to Set Global Preferences for an Individual Machine" on page 391 for an example using the `-u` option.

Specifying Preferred-Only Servers

You can specify what clients do when no preferred servers are available.

By default, if a client cannot reach a preferred server, it uses whatever other server it can find. You can specify that clients may only use preferred servers by setting the preferred-only option. See "Preferred Only Servers Versus All Servers" on page 385 for background information on the preferred-only and all servers options.

To specify what clients do when no preferred servers are available, run `nisprefadm` with the `-o` *value* option.

How to Specify Preferred-Only Servers

To specify that clients using a server list may only obtain NIS+ information from servers named in the list:

- **Run** `nisprefadm` **with the** `-o pref_only` **option.**

```
#nisprefadm -L|-G -o pref_only
```

Where:

- `-L| -G` determines whether you are modifying a local or a domain-wide server list.
- `-o -pref_only` specifies that clients can only obtain NIS+ information from servers on the list.

Note – This option is ignored for domains that are not served by *any* preferred servers.

For example, to specify in `altair`'s local `client_info` file that `altair` must always use preferred servers and cannot use any server not on `altair`'s preferred server list:

```
altair# nisprefadm -L -o pref_only
```

How to Revert to Using Non-Preferred Servers

To specify that clients using a server list may obtain NIS+ information from servers not named in the list if no preferred servers are available:

- **Run** `nisprefadm` **with the** `-o all` **option.**

```
#nisprefadm -L|-G -o all
```

Where:

- `-L|-G` determines whether you are modifying a local or a domain-wide server list.
- `-o -all` specifies that clients may obtain NIS+ information from servers not on the list if no preferred servers are available.

Note – This is the default behavior. You only need to use the `-o all` option if you have previously specified preferred-only servers with the `-o pref_only` option.

For example, to specify in `altair`'s local `client_info` file that `altair` can now use non-preferred servers if no preferred servers can be reached:

```
altair# nisprefadm -L -o all
```

Ending Use of Server Preferences

You can stop using server-use customization and revert to the obtaining NIS+ information as described in "Default Client Search Behavior" on page 381.

To end server preferences, run `nisprefadm` with the `-x` option.

Note – When you end server preferences, clients do not stop using server preferences until the normal course of events as described "When Server Preferences Take Effect" on page 386. You can force an immediate end to server preferences as described in"Putting Server Preferences Into Immediate Effect" on page 399.

How to Eliminate Global Server Preferences

- **Run `nisprefadm` with the `-G` and `-x` options.**

  ```
  #nisprefadm -G -x
  ```

  This eliminates global server preferences.

  - Client machines that do not have local server preferences will obtain NIS+ information as described in "Default Client Search Behavior" on page 381.
  - Client machines that do have local server preferences set by a local `/var/nis/client_info` file will continue to use servers as specified in that file.

How to Eliminate Local Server Preferences

Ending local preferences can mean one of three different things:

- That you want the machine to stop using its local `client_info` file for its server preferences and start using the preferences set for its subnet in the domain's global `client_info` table.
- That you want this machine to stop using its local `client_info` file for its server preferences and start using the preferences set for it specifically in the domain's global `client_info` table.
- That you do not want the machine to use server preferences at all. When a machine does not use server preferences, it obtains NIS+ information as described in "Default Client Search Behavior" on page 381.

How to Switch From Local to Global Subnet Preferences

- **Remove the machine's** `/var/nis/client_info` **file.**

  ```
  # rm /var/nis/client_info
  ```

  This causes the machine to use the preferences specified for the machine's subnet in the domain's global `client_info` table.

How to Switch From Local to Machine-Specific Global Preferences

1. **Remove the machine's** `/var/nis/client_info` **file.**

   ```
   # rm /var/nis/client_info
   ```

2. **Specify preferences for the machine in the global table using the** `-G` **and** `-C` **options.**

   See "How to Set Global Preferences for an Individual Machine" on page 391.

How to Stop a Machine From Using Any Server Preferences

1. **Remove the machine's** `/var/nis/client_info` **file.**

   ```
   # rm /var/nis/client_info
   ```

   If the machine's domain does not have a global `client_info` table, this step is all you have to do. If the domain does have a `client_info` table, continue on to the next step.

2. **Create an empty** `/var/nis/client_info` **file.**

   ```
   # touch /var/nis/client_info
   ```

   When a machine has its own `/var/nis/client_info` file, it does not use global preferences from any `client_info` table. If the machine has an empty `/var/nis/client_info` file, it will not use any preferences at all and will obtain NIS+ information, as described in "Default Client Search Behavior" on page 381.

Putting Server Preferences Into Immediate Effect

Server-use changes normally go into effect whenever the client machine is rebooted or updates its cache manager.

When you use `nisprefadm` to set or change server preferences on a local machine using a local `client_info` file (the `-L` option), your changes go into effect immediately.

For machines obtaining their server preferences from a global `client_info` table (the `-G` option) you can force server preference changes into immediate effect by running `nisprefadm` a particular with the `-F` option.

```
# nisprefadm -F
```

The `-F` option forces the machine's cache manager to immediately update its server preference information from the domain's global `client_info` table. (If the machine on which you run `nisprefadm -F` has its own local `client_info` file in `/var/nis`, running nisprefadm `-F` on it will have no effect.)

Note – You cannot use the `-F` option with any other `nisprefadm` options. The `nisprefadm -F` command must always be run by itself on the machine you want it to apply to. You cannot use the `-G` option to update the cache managers of all machines in a domain. The `nisprefadm -F` command must be run on each machine individually.

How to Immediately Implement Preference Changes

To force a newly created or modified server list into immediate effect on a given machine:

- **Run `nisprefadm` with the `-F` option on that machine.**

```
# nisprefadm -F
```

For example, to force immediate implementation of changes to `vega`'s preferred server list (whether local or global):

```
vega# nisprefadm -F
```

CHAPTER 21

NIS+ Backup and Restore

This chapter describes how to back up and restore an NIS+ namespace.

The NIS+ backup and restore capabilities provide a quick and easy method of preserving and reinstalling your NIS+ namespace. These features can also be used to simplify creation of new replica servers and reduce the time it takes to bring them online. These tasks are performed by two commands:

- `nisbackup`. Backs up NIS+ directory objects
- `nisrestore`. Restores NIS+ directory objects.

Backing Up Your Namespace With `nisbackup`

The `nisbackup` command backs up one or more NIS+ directory objects or an entire namespace to a specified UNIX file system directory.

Note – The `nisbackup` command is always run on a master server. Never run it on a replica server.

The `nisbackup` command copies the NIS+ namespace data set as of the time the backup command is run. This recording includes all current NIS+ data *and also* any changes entered into the NIS+ namespace by an authorized network administrator but not yet checkpointed (posted) to the NIS+ tables. The backup operation does not check or correct NIS+ data. If data in a table is corrupt, the corrupt data is backed up as if it were valid data.

The `nisbackup` command only backs up those directory objects that the machine is master server for. In other words, you can only use `nisbackup` on a master server. You cannot use `nisbackup` on a replica server.

- If a machine is a master server for both a domain and a subdomain's NIS+ directory objects, you can run `nisbackup` on that machine to back up both domain and subdomain directory objects.
- However, if a machine is a master server for one directory object, and a replica server for a different directory object, you can run `nisbackup` to back up the directory object that the machine is master server for, but it will not back up any objects that the machine is only a replica server for.

If the backup process is interrupted or unable to successfully complete its operation, it halts and restores all previous backup files that were stored in the target directory.

`nisbackup` Syntax

The `nisbackup` command uses the following syntax:

`nisbackup [-v][-a]` *backupdir objects*

Where:

- *Backupdir* is the target directory where the backup files are to be stored. For example, `/var/master1_bakup`.
- *Objects* are the NIS+ directory objects that you want to back up. For example, `org_dir.doc.com`. Multiple NIS+ directory objects can be listed separated by spaces.

The `nisbackup` command takes the following options:

TABLE 21–1 Options for the `nisbackup` Command

Option	Purpose
`-v`	Verbose mode. This mode provides additional information
-a	All. Backs up all NIS+ directory objects that the server is master of. This includes any sub-domain directory objects that this server is the master for. Note that directory objects of subdomains that have their own master servers will not be backed up.

The `nisbackup` command must be run on the master server for the NIS+ directory objects you are backing up.

When specifying NIS+ directory objects to be backed up, you can use full or partially qualified directory names.

When you back up multi-level directories, the backup files for lower level directories are automatically placed in subdirectories of the target backup directory.

What `nisbackup` Backs Up

When using nisbackup, keep in mind that `nisbackup` is server specific. Regardless of whether or not you use the `-a` option, `nisbackup` only backs up those directories that the server you are running it on is master of. NIS+ directory objects that have some other master server will not be backed up.

For example, suppose the `submaster1` server is master server for the `sales.doc.com.` directory objects and also a replica for the `west.sales.doc.com.` directory objects. When you run `nisbackup` on `submaster1`, only the `sales.doc.com.` directory objects will be backed up.

Some of the implications of this server specific principle are:

- *Entire NIS+ namespace*. If you want to perform an NIS+ back up for an entire multi-domain namespace, *and* your root master server is *also* the master server of all subdomains, you can run `nisbackup` on the root master with the `-a` option. However, if the root master server is *not* the master server of all subdomains, you must also run `nisbackup` on each of the other master servers in order to obtain a complete back up of your entire namespace.
- *Sub-domains*. If you are performing an NIS+ back up for one or more sub-domains, you must run `nisbackup` on the subdomain's master server. If one machine, such as the root master, is also master of one or more subdomains, you can run `nisbackup` on that machine with the `-a` option.
- *FNS ctx_dir*. If you are running FNS, `nisbackup` will only back up your `ctx_dir` directories if you run it on the `ctx_dir` master server and either specify that the `ctx_dir` be backed up or use the `-a` option. If, as is common practice, your `ctx_dir` and NIS+ directory objects are served by different master servers, you must run `nisbackup` on both machines to back up all directories.

The Backup Target Directory

While the backup target directory must be available to the server being backed up, it is good practice to use a target directory that is not physically mounted on the server. That way you ensure that if the server is damaged the backup directory is still available.

A separate target directory must be used for each master server being backed up. It is good practice to avoid confusion by including the master server's machine name in the target directory name. For example, the target directory for a `nisbackup` run on the `master1` machine might be named `/var/master1_bakup`

Caution – Never back up more than one master server to a given target directory. Always use different target directories for different master servers. This is because each time you backup one or more NIS+ directory objects to a given target directory, previous backup files for those NIS+ directory objects in that directory are overwritten.

Maintaining a Chronological Sequence of NIS+ Backups

There are at least two ways to maintain an historic sequence of backup files:

- *Different target directories*. You can maintain separate target directories for each date's backup. For example, `/var/master1_bakup/July14`, and `/var/master1_bakup/July15`, and so on. While this method is simple it wastes disk storage space.
- *File system backup*. The most common method of maintaining an historical sequence of NIS+ backups is to simply include the backup target directory in whatever regular file system backup method that you use. To facilitate this, the `nisbackup` command can be run from a `crontab` file, or from within the Solstice backup routine. See your Solstice documentation for information on how to specify that commands like `nisbackup` be automatically run as part of the system backup procedure.

Backing Up Specific NIS Directories

To back up specific NIS+ directory objects, you list those directories after the target backup directory.

For example, to backup the three `org_dir` directory objects for the root, sales, and manf domains to a `/master1_bakup` directory, you would run `nisbackup` on the `master1` machine as follows:

```
master1# nisbackup /var/master1_bakup org_dir org_dir.sales org_dir.manf
```

Backing Up an Entire NIS+ Namespace

To back up an entire NIS+ namespace you run the `nisbackup` command on the root master server with the `-a` option.

When you use the `-a` option, you do not specify the NIS+ directory objects to be backed up. All NIS+ directory objects on the server and all those of subdomains below it will be automatically backed up.

For example, to backup the `doc.com.` namespace to a `/master1_bakup` directory, you would run `nisbackup` on the root master as follows:

```
rootmaster# nisbackup -a /var/master1_bakup
```

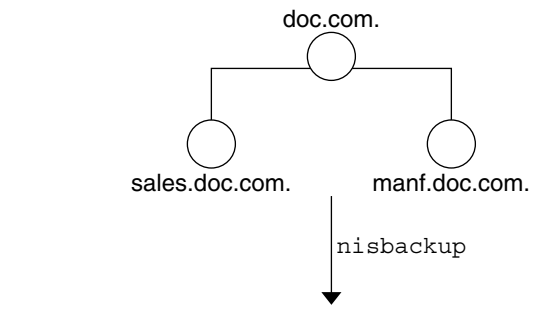
Backup Directory Structure

When you perform a back up on a domain, a subdirectory for each NIS+ directory object is created in the backup target directory. The names of these subdirectories match the fully qualified NIS+ directory object name including the trailing period.

If you perform a full backup of an entire NIS+ object using the `-a` option, then all three of the associated directory objects (*domain.* `org_dir`.*domain.*, and `groups_dir`.*domain.*) are backed up and three target subdirectories are created. If you are backing up multiple objects, subdirectories are created for every object that you are backing up.

Note that the backup subdirectories for multiple NIS+ directory object are all subdirectories of the parent target backup directory regardless of whether or not they are subdomains. In other words, `nisbackup` does not reproduce a domain hierarchy under the parent backup target directory, instead all of the back up subdirectories are simple subddirectories of the target directory.

For example, if you backed up the root, sales, and manf directory objects of `doc.com.` to a `/var/master1_bakup` directory, nine subdirectories would be created in the `/var/master1_bakup` directory as shown in Figure 21–1:




```
/var/master1_bakup
    /master1_bakup/doc.com./
    /master1_bakup/groups_dir.doc.com./
    /master1_bakup/org_dir.doc.com.
    /master1_bakup/sales.doc.com./
    /master1_bakup/groups_dir.sales.doc.com./
    /master1_bakup/org_dir.sales.doc.com./
    /master1_bakup/manf.doc.com./
    /master1_bakup/groups_dir.manf.doc.com./
    /master1_bakup/org_dir.manf.doc.com./
```

FIGURE 21–1 Example directories created by `nisbackup`

Backup Files

The backup target directory contains a `backup_list` file that lists the NIS+ directory objects most recently backed up to this target directory.

Each of the subdirectories contain two files and a `/data` subdirectory. The three files are:

- `data.dict`. An XDR encoded file containing an NIS+ data dictionary for the NIS+ directory objects backed up to this directory.
- `last.upd`. A binary file containing time-stamp information about the NIS+ directory object backed up to this directory.

Each of the `/data` subdirectories contain one or more of the following files:

- `root.object`. An XDR encoded data file containing a description of the NIS+ root directory object. For example, `/master1_bakup/doc.com/data/root.object`.
- `root_dir`. An XDR encoded file containing a description of NIS+ objects contained in the root directory and server information for those objects. For example, `/master1_bakup/doc.com/data/root_dir`.
- *table.directory*. An XDR encoded file containing the data that was present in an NIS+ table at the time the backup was performed *and also* any data contained in

any associated NIS+ log files. If there is an NIS+ table in the NIS+ directory object being backed up, a corresponding *table.directory* backup file will be created in the `/data` subdirectory for that directory object.

For example, every NIS+ `org_dir` directory contains a `hosts` table so there will be a `hosts.org_dir` file in each *target*`/org_dir.`*domain*`/data` subdirectory. For example, `/master1_bakup/org_dir.doc.com./data/hosts.org_dir`

User-created NIS+ tables present in a given directory object are backed up in the same way as the standard NIS+ tables.

- `groups_dir`. An XDR encoded file containing NIS+ groups information. This file is stored in the corresponding NIS+ `groups_dir` target directory.

Restoring Your NIS+ Namespace With `nisrestore`

The `nisrestore` command recreates NIS+ directory objects to match the data stored in backup files created with the `nisbackup` command. This command can be used to restore NIS+ servers, replace directory objects that have become corrupted, or down load NIS+ data on to a new NIS+ server.

Prerequisites to Running `nisrestore`

In order to use `nisrestore` the target machine that will be receiving the NIS+ data from `nisrestore` must have already been set up as an NIS+ server. (See Chapter 4for a detailed description of setting up NIS+ servers.) This means that:

- The machine must have already been initialized as an NIS+ client.
- If the machine will be running in NIS-compatibility mode and support DNS forwarding, it must have a properly configured `/etc/resolv.conf` file.
- If you are using `nisrestore` on a server while other servers in the namespace are up and running, `nisrestore` will verify with those other servers that this server is configured to serve the backed up NIS+ objects that you are restoring to it. If no other servers are up and running in your namespace, then you must run `nisrestore` with the `-f` option. In other words, if there are other servers that `nisrestore` can check with, you do not need to use the `-f` option. If no other servers are available, for example if you are restoring a single master server and there are no functioning replica servers, then you must use the `-f` option.

Caution – In addition to the three pre-requisites listed above, the `rpc.nisd` daemon must *not* be running on the machine. If necessary, you must kill `rpc.nisd` before running `nisrestore`.

`nisrestore` Syntax

The `nisrestore` command uses the following syntax:

```
nisrestore [-fv][-a][-t] backupdir [directory_objects]
```

Where:

- *Backupdir* is the directory containing the backup files to be used to restore the NIS+ objects. For example, `/var/master1_bakup`.
- *Directory_objects* are the NIS+ directory objects that you want to restore. For example, `org_dir.doc.com`. Multiple NIS+ directory objects can be listed separated by spaces. (If you run `nisrestore` with the `-a` option, you do not specify specific directory objects.)

The `nisrestore` command takes the following options:

TABLE 21–2 Options for the `nisbackup` Command

Option	Purpose
`-a`	All. Restores all of the NIS+ directory objects contained in the backup directory.
`-f`	Forces the restoration without validating that the server is listed in the directory object's serving list. This option must be used when restoring a root master server or if you get an "unable to lookup object" type of error.
`-v`	Verbose mode. This mode provides additional information
`-t`	This option lists all of the NIS+ directory objects stored in the backup directory. No restoration of objects takes place.

Using `nisrestore`

To restore NIS+ data from NIS+ backup files, use the `nisrestore` command.

For example, to restore the `org_dir.doc.com.` directory object on the `replica1` server, you would log in as root on `replica1`, make sure that the prerequisites described in "Prerequisites to Running `nisrestore`" on page 407 have been met and then run `nisrestore` as shown below:

```
replica1# nisrestore /var/master1_bakup org_dir.doc.com.
```

The following points apply to `nisrestore`:

- *Damaged namespace*. To restore a damaged or corrupted NIS+ namespace, the `nisrestore` command must be run on all of the servers for the NIS+ directory objects you are restoring.
- *Lookup error*. If you get an error message telling you that `nisrestore` cannot verify or look up needed data, then you must use the `-f` option.

  For example, to reload NIS+ data on a root master server named `master1`, you would enter:

```
master1# nisrestore -f -a /var/master1_bakup
```

- *Directory names*. When specifying the NIS+ directory objects to be restored, you can use full or partially qualified directory names.

Using Backup/Restore to Set Up Replicas

The NIS+ backup and restore features can be used to quickly down load NIS+ data on to a new replica server. For large namespaces this is much faster than `nisping` to obtain data from the master server.

To use `nisbackup` and `nisrestore` to set up a new replica, perform the following:

1. **Run `nisserver` on the master to create the new replica.**
2. **Kill `rpc.nisd` on the new replica server.**

   This interrupts the automatic transfer for namespace data from the master to the replica using the `nisping` command.
3. **Run `nisbackup` on the master server.**
4. **Run `nisrestore` on the new replica to down load the NIS+ data.**
5. **Restart `rpc.nisd` on the new replica**

Replacing Server Machines

You can use `nisbackup` and `nisrestore` to quickly replace a machine that you are using as a server with another machine. For example, you want to improve network performance by replacing an older server with a newer, faster machine.

Machine Replacement Requirements

To replace a machine being used as an NIS+ server with another machine, you *must*:

- Assign the new machine the same IP address as the older machine it is replacing.
- Assign the new machine the same machine name as the older machine it is replacing.
- Connect the new machine to the same subnet as the older machine it is replacing.

How to Replace Server Machines

To replace a server machine, follow these steps:

1. **Run `nisbackup` on the master server for the domain that the old server serves.**
   See "Backing Up an Entire NIS+ Namespace" on page 404. (Note that the old server you are replacing could be the master server for the domain, in which case you would run `nisbackup` on this old master server.)
2. **Copy the old server's `/var/nis/NIS_COLD_START` file to the backup directory.**
3. **Copy the old server's `/etc/.rootkey` file to the backup directory.**
4. **Disconnect the old server from the network.**
5. **Connect the new server to the network.**
6. **Assign the new server the same IP address (number) as the old server.**
7. **Assign the new server the same machine name as the old server.**
8. **If necessary, kill `rpc.nisd` on the new server.**
9. **Run `nisrestore` on the new server to down load the NIS+ data.**
   See "Restoring Your NIS+ Namespace With `nisrestore`" on page 407.
10. **Copy the `.rootkey` file from the backup directory to `/etc` on the new server.**

11. **Copy the `NIS_COLD_START` file from the backup directory to `/var/nis` on the new server.**

12. **Reboot the new server.**

CHAPTER 22

Removing NIS+

This chapter describes how to use the NIS+ directory administration commands to remove NIS+ from clients, servers, and the namespace as a whole.

For information on disassociating an NIS+ replica server from a directory so that it no longer acts as a replica for that domain, see "The `nisrmdir` Command" on page 338.

Removing NIS+ From a Client Machine

This section described how to remove NIS+ from a client machine. Keep in mind that removing NIS+ from a client machine does not remove the NIS+ name service from your network. See "Removing the NIS+ Namespace" on page 415 for information on removing the NIS+ name service from a network and returning to either NIS or `/etc` files for name purposes.

Removing NIS+ That Was Installed Using `nisclient`

To remove NIS+ from a client machine that was set up as an NIS+ client using the `nisclient -i` script as described in Chapter 4, simply run `nisclient` with the `-r` option:

```
client# nisclient -r
```

`nisclient -r` simply undoes the most recent iteration of `nisclient -i`; it restores the previous naming system used by the client, such as NIS or `/etc` files.

Removing NIS+ That Was Installed Using NIS+ Commands

To remove NIS+ from a client machine that was set up as an NIS+ client using the `nisaddcred`, `domainname`, and `nisinit` commands as described in Chapter 4, perform the following steps:

1. **Remove the `.rootkey` file.**

```
client# rm -f /etc/.rootkey
```

2. **Locate and kill the `keyserv`, `nis_cachemgr`, and `nscd` processes.**

```
client# ps -ef | grep keyserv
 root 714 1 67 16:34:44 ? keyserv
client# kill -9 714
client# ps -ef | grep nis_cachemgr
 root 123 1 67 16:34:44 ? nis_cachemgr
client# kill -9 123
client# ps -ef | grep nscd
 root 707 1 67 16:34:44 ? nscd
client# kill -9 707
```

3. **Remove the `/var/nis` directory and files.**

```
clientmachine# rm -rf /var/nis/*
```

Removing NIS+ From a Server

This section describes how to remove NIS+ from an NIS+ server.

Keep in mind that removing NIS+ from a server does not remove the NIS+ name service from your network. See "Removing the NIS+ Namespace" on page 415 for information on removing the NIS+ name service from a network and returning to either NIS or `/etc` files for naming purposes.

Note – You can replace a machine that you are using as an NIS+ server with another machine. See "Replacing Server Machines" on page 410.

To remove NIS+ from a server, follow these steps:

1. **Perform the steps necessary to remove NIS+ from a client.**

   An NIS+ server is also an NIS+ client. This means that you must first remove the client-related part of NIS+. You can use `nisclient -r` as described in "Removing

NIS+ That Was Installed Using `nisclient`" on page 413 or the NIS+ command set as described in "Removing NIS+ That Was Installed Using NIS+ Commands" on page 414.

2. **Remove the server's `groups_dir` and `org_dir` directories.**

```
server# nisrmdir -f groups_dir.domainname
server# nisrmdir -f org_dir.domainname
```

3. **Locate and kill the `keyserv`, `rpc.nisd`, `nis_cachemgr`, and `nscd` processes on the server.**

```
server# ps -ef | grep rpc.nisd
 root 137 1 67 16:34:44 ? rpc.nisd
server# kill -9 137
server# ps -ef | grep keyserv
 root 714 1 67 16:34:44 ? keyserv
server# kill -9 714
server# ps -ef | grep nis_cachemgr
 root 123 1 67 16:34:44 ? nis_cachemgr
server# kill -9 123
server# ps -ef | grep nscd
 root 707 1 67 16:34:44 ? nscd
server# kill -9 707
```

4. **Remove the `/var/nis` directory and files.**

```
rootmaster# rm -rf /var/nis/*
```

Removing the NIS+ Namespace

To remove the NIS+ namespace and return to using either NIS or `/etc` files for name services, follow these steps:

1. **Remove the `.rootkey` file from the root master.**

```
rootmaster# rm -f /etc/.rootkey
```

2. **Remove the `groups_dir` and `org_dir` subdirectories from the root master root domain.**

```
rootmaster# nisrmdir -f groups_dir.domainname
rootmaster# nisrmdir -f org_dir.domainname
```

Where *domainname* is the name of the root domain, for example, `doc.com`.

3. **Remove the root domain.**

```
rootmaster# nisrmdir -f domainname
```

Where *domainname* is the name of the root domain, for example, `doc.com`.

4. **Locate and kill the `keyserv`, `rpc.nisd`, `nis_cachemgr`, and `nscd` processes.**

```
rootmaster# ps -ef | grep rpc.nisd
 root 137 1 67 16:34:44 ? rpc.nisd
rootmaster# kill -9 137
rootmaster# ps -ef | grep keyserv
 root 714 1 67 16:34:44 ? keyserv
rootmaster# kill -9 714
rootmaster# ps -ef | grep nis_cachemgr
 root 123 1 67 16:34:44 ? nis_cachemgr
rootmaster# kill -9 123
rootmaster# ps -ef | grep nscd
 root 707 1 67 16:34:44 ? nscd
rootmaster# kill -9 707
```

5. **Create a new domain.**

```
rootmaster# domainname name
```

Where *name* is the name of the new domain; for example, the name of the domain before you installed NIS+.

6. **Remove the existing `/etc/defaultdomain` file.**

```
rootmaster# rm /etc/defaultdomain
```

7. **Recreate the `/etc/defaultdomain` file with the new domain name.**

```
rootmaster# domainname > /etc/defaultdomain
```

8. **Replace the original `nsswitch.conf` file.**

If you set up this server with `nisserver -r`, you can use:

```
rootmaster# cp /etc/nsswitch.conf.no_nisplus /etc/nsswitch.conf
```

Alternatively, you can copy over one of the default switch template files. To use the default NIS switch file template, you would type:

```
rootmaster# cp /etc/nsswitch.nis etc/nsswitch.conf
```

To use the default `/etc` files switch file template, you would type:

```
rootmaster# cp /etc/nsswitch.files etc/nsswitch.conf
```

9. **Restart the `keyserv` process.**

```
rootmaster# keyserv
```

10. **Remove the `/var/nis` directory and files.**

```
rootmaster# rm -rf /var/nis/*
```

11. **Now restart your other name service (NIS or `/etc` files).**

CHAPTER 23

Information in NIS+ Tables

This appendix summarizes the information stored in the default NIS+ tables supplied in the Solaris operating environment, as is also documented in the cooresponding manpages.

NIS+ Tables

In an NIS+ environment, most namespace information is stored in NIS+ tables.

Without a name service, most network information would be stored in `/etc` files and almost all NIS+ tables have corresponding `/etc` files. With the NIS service, you stored network information in NIS maps that also mostly corresponded with `/etc` files.

Note – This appendix describes only those that are distributed as part of NIS+. Users and application developers frequently create NIS+ compatible tables for their own purposes. For information about tables created by users and developers, you must consult the documentation that they provide.

All NIS+ tables are stored in the domain's `org_dir` NIS+ directory object except the admin and groups tables that are stored in the `groups_dir` directory object.

Note – Do not link table entries. Tables can be linked to other tables, but do not link an entry in one table to an entry in another table.

NIS+ Tables and Other Name Services

In the Solaris environment the name service switch file (`nsswitch.conf`) allows you to specify one or more sources for different types of namespace information. In addition to NIS+ tables, sources can be NIS maps, DNS zone files, or `/etc` tables. The order in which you specify them in the switch file determines how the information from different sources is combined. (See Chapter 1 for more information on the switch file.)

NIS+ Table Input File Format

If you are creating input files for any of these tables, most tables share two formatting requirements:

- You must use one line per entry
- You must separate columns with one or more spaces or Tabs.

If a particular table has different or additional format requirements, they are described under the heading, "Input File Format."

`auto_home` Table

The `auto_home` table is an indirect automounter map that enables an NIS+ client to mount the home directory of any user in the domain. It does this by specifying a mount point for each user's home directory, the location of each home directory, and mount options, if any. Because it is an indirect map, the first part of the mount point is

specified in the auto_master table, which is, by default, /home. The second part of the mount point (that is, the subdirectory under /home) is specified by the entries in the auto_home map, and is different for each user.

The auto_home table has two columns:

TABLE 23–1 auto_home Table

Column	Content	Description
Key	Mount point	The login name of every user in the domain
Value	Options & location	The mount options for every user, if any, and the location of the user's home directory

For example:

```
costas barcelona:/export/partition2/costas
```

The home directory of the user costas, which is located on the server barcelona, in the directory /export/partition2/costas, would be mounted under a client's /home/costas directory. No mount options were provided in the entry.

auto_master Table

The auto_master table lists all the automounter maps in a domain. For direct maps, the auto_master table provides a map name. For indirect maps, it provides both a map name and the top directory of its mount point. The auto_master table has two columns:

TABLE 23–2 auto_master Table

Column	Content	Description
Key	Mount point	The top directory into which the map will be mounted. If the map is a direct map, this is a dummy directory, represented with /—.
Value	Map name	The name of the automounter map

For example, assume these entries in the auto_master table:

```
/home auto_home
 /-auto_man
 /programs auto_programs
```

The first entry names the auto_home map. It specifies the top directory of the mount point for all entries in the auto_home map: /home. (The auto_home map is an indirect map.) The second entry names the auto_man map. Because that map is a direct map, the entry provides only the map name. The auto_man map will itself provide the topmost directory, as well as the full path name, of the mount points for each of its entries. The third entry names the auto_programs map and, since it provides the top directory of the mount point, the auto_programs map is an indirect map.

All automounter maps are stored as NIS+ tables. By default, the Solaris environment provides the auto_master map, which is mandatory, and the auto_home map, which is a great convenience.

You can create more automounter maps for a domain, but be sure to store them as NIS+ tables and list them in the auto_master table. When creating additional automount maps to supplement auto_master (which is created for you), the column names must be key and value. For more information about the automounter consult your automounter or NFS file system documentation.

bootparams Table

The bootparams table stores configuration information about every diskless machine in a domain. A diskless machine is a machine that is connected to a network, but has no hard disk. Since it has no internal storage capacity, a diskless machine stores its files and programs in the file system of a server on the network. It also stores its configuration information—or *boot parameters*—on a server.

Because of this arrangement, every diskless machine has an initialization program that knows where this information is stored. If the network has no name service, the program looks for this information in the server's /etc/bootparams file. If the network uses the NIS+ name service, the program looks for it in the bootparams table, instead.

The bootparams table can store any configuration information about diskless machines. It has two columns: one for the configuration key, another for its value. By default, it is set up to store the location of each machine's root, swap, and dump partitions.

The default bootparams table has only two columns that provide the following items of information:

TABLE 23–3 `bootparams` Table

Column	Content	Description
Key	Hostname	The diskless machine's official host name, as specified in the hosts table
Value	Configuration	Root partition: the location (server name and path) of the machine's root partition
		Swap partition: the location (server name and path) of the machine's swap partition
		Dump partition: the location (server name and path) of the machine's dump partition
		Install partition.
		Domain.

Input File Format

The columns are separated with a TAB character. Backslashes (\) are used to break a line within an entry. The entries for root, swap, and dump partitions have the following format:

client-name `root=`*server:path* \
`swap=`*server:path* \
`dump=`*server:path* \
`install=`*server:path* \
`domain=`*domainname*

Here is an example:

```
buckarooroot=bigriver:/export/root1/buckaroo \
 swap=bigriver:/export/swap1/buckaroo \
 dump=bigriver:/export/dump/buckaroo \
 install=bigriver:/export/install/buckaroo \
 domain=sales.doc.com
```

Additional parameters are available for x86-based machines. See the `bootparams` man page for additional information.

`client_info` Table

The `client_info` table is an optional internal NIS+ table used to store server preferences for the domain in which it resides. This table is created and maintained with the `nisprefadm` command.

Caution – Only use `nisprefadm` to work with this table. Do not use any other NIS+ commands on this table.

`cred` Table

The `cred` table stores credential information about NIS+ principals. Each domain has one `cred` table, which stores the credential information of client machines that belong to that domain and client users who are allowed to log into them. (In other words, the principals of that domain.) The `cred` tables are located in their domains' `org_dir` subdirectory.

Note – Do not link a `cred` table. Each `org_dir` directory should have its own `cred` table. Do not use a link to some other `org_dir` `cred` table.

The `cred` table has five columns:

TABLE 23–4 `cred` Table

NIS+ Principal Name	Authentication Type	Authentication Name	Public Data	Private Data
Principal name of a principal user	LOCAL	UID	GID list	
Principal name of a principal user or machine	DES	Secure RPC netname	Public key	Encrypted private key

The second column, authentication type, determines the types of values found in the other four columns.

- *LOCAL*. If the authentication type is LOCAL, the other columns contain a principal user's name, UID, and GID; the last column is empty.
- *DES*. If the authentication type is DES, the other columns contain a principal's name, Secure RPC netname, public key, and encrypted private key. These keys are used in conjunction with other information to encrypt and decrypt a DES credential.

See Chapter 12, for additional information on credentials and the `cred` table.

ethers Table

The ethers table stores information about the 48-bit Ethernet addresses of machines on the Internet. It has three columns:

TABLE 23–5 ethers Table

Column	Content	Description
Addr	Ethernet-address	The 48-bit Ethernet address of the machine
Name	Official-host-name	The name of the machine, as specified in the hosts table
Comment	Comment	An optional comment about the entry

An Ethernet address has the form:

n : *n* : *n* : *n* : *n* : *n hostname*

where *n* is a hexadecimal number between 0 and FF, representing one byte. The address bytes are always in network order (most significant byte first).

group Table

The group table stores information about UNIX user groups. The group table has four columns:

TABLE 23–6 group Table

Column	Description
Name	The group's name
Passwd	The group's password
GID	The group's numerical ID
Members	The names of the group members, separated by commas

Earlier Solaris releases used a +/- syntax in local /etc/group files to incorporate or overwrite entries in the NIS group maps. Since the Solaris environment uses the name service switch file to specify a machine's sources of information, this is no longer

necessary. All you have to do in Solaris Release 2x systems is edit a client's `/etc/nsswitch.conf` file to specify `files`, followed by `nisplus` as the sources for the `group` information. This effectively adds the contents of the `group` table to the contents of the client's `/etc/group` file.

`hosts` Table

The `hosts` table associates the names of all the machines in a domain with their IP addresses. The machines are usually also NIS+ clients, but they don't have to be. Other tables, such as `bootparams`, `group`, and `netgroup`, rely on the network names stored in this table. They use them to assign other attributes, such as home directories and group memberships, to individual machines. The `hosts` table has four columns:

TABLE 23–7 `hosts` Table

Column	Description
Addr	The machine's IP address (network number plus machine ID number)
Cname	The machine's official name
Name	A name used in place of the host name to identify the machine
Comment	An optional comment about the entry

`mail_aliases` Table

The `mail_aliases` table lists the domain's mail aliases recognized by `sendmail`. It has four columns:

TABLE 23–8 `mail_aliases` Table

Column	Description
Alias	The name of the alias
Expansion	A list containing the members that receive mail sent to this alias; members can be users, machines, or other aliases
Comment	An optional comment about the entry

TABLE 23–8 `mail_aliases` Table *(Continued)*

Column	Description
Options	(See man page for options)

Input File Format

Each entry has the following format:

`alias-name:`*member*`[,`*member*`]...`

To extend an entry over several lines, use a backslash.

`netgroup` Table

The `netgroup` table defines network wide groups used to check permissions for remote mounts, logins, and shells. The members of net groups used for remote mounts are machines; for remote logins and shells, they are users.

Note – Users working on a client machine being served by an NIS+ server running in compatibility mode cannot run `ypcat` on the `netgroup` table. Doing so will give you results as if the table were empty even if it has entries.

The `netgroup` table has six columns:

TABLE 23–9 `netgroup` Table

Column	Content	Description
Name	groupname	The name of the network group
Group	groupname	Another group that is part of this group
Host	hostname	The name of a host
User	username	A user's login name
Domain	domainname	A domain name
Comment	Comment	An optional comment about the entry

Input File Format

The input file consists of a group name and any number of members:

groupname member-list . . .

The member list can contain the names of other net groups or an ordered member list with three fields or both:

member-list : : =*groupname* | (*hostname*, *username*, *domainname*)

The first field of the member list specifies the name of a machine that belongs to the group. The second field specifies the name of a user that belongs to the group. The third field specifies the domain in which the member specification is valid.

A missing field indicates a wildcard. For example, the `netgroup` specification shown below includes all machines and users in all domains:

```
everybody ( , , )
```

A dash in a field is the opposite of a wildcard; it indicates that no machines or users belong to the group. Here are two examples:

```
(host1, -,doc.com.) (-,joe,doc.com.)
```

The first specification includes one machine, `host1`, in the `doc.com.` domain, but excludes all users. The second specification includes one user in the `doc.com.` domain, but excludes all machines.

`netmasks` Table

The `netmasks` table contains the network masks used to implement standard Internet subnetting. The table has three columns:

TABLE 23–10 `netmasks` Table

Column	Description
Addr	The IP number of the network
Mask	The network mask to use on the network
Comment	An optional comment about the entry

For network numbers, you can use the conventional IP dot notation used by machine addresses, but leave zeros in place of the machine addresses. For example, this entry

```
128.32.0.0 255.255.255.0
```

means that class B network 128.32.0.0 should have 24 bits in its subnet field, and 8 bits in its host field.

networks Table

The networks table lists the networks of the Internet. This table is normally created from the official network table maintained at the Network Information Control Center (NIC), though you might need to add your local networks to it. It has four columns:

TABLE 23–11 networks Table

Column	Description
Cname	The official name of the network, supplied by the Internet
Addr	The official IP number of the network
Name	An unofficial name for the network
Comment	An optional comment about the entry

passwd Table

The passwd table contains information about the accounts of users in a domain. These users generally are, but do not have to be, NIS+ principals. Remember though, that if they are NIS+ principals, their credentials are not stored here, but in the domain's cred table. The passwd table usually grants read permission to the world (or to nobody).

Note – The passwd table should not have an entry for the user root (user ID 0). Root's password information should be stored and maintained in the machine's /etc files.

The information in the passwd table is added when users' accounts are created.

The passwd table contains the following columns:

TABLE 23–12 passwd Table

Column	Description
Name	The user's login name, which is assigned when the user's account is created; the name can contain no uppercase characters and can have a maximum of eight characters

TABLE 23–12 `passwd` Table *(Continued)*

Column	Description
Passwd	The user's encrypted password
UID	The user's numerical ID, assigned when the user's account is created
GID	The numerical ID of the user's default group
GCOS	The user's real name plus information that the user wishes to include in the From: field of a mail-message heading; an "&" in this column simply uses the user's login name
Home	The path name of the user's home directory.
Shell	The user's initial shell program; the default is the Bourne shell: `/usr/bin/sh`.
Shadow	(See Table 23–13.)

The `passwd` table shadow column stores restricted information about user accounts. It includes the following information:

TABLE 23–13 `passwd` Table Shadow Column

Item	Description
Lastchg	The number of days between January 1, 1970, and the date the password was last modified
Min	The minimum number of days recommended between password changes
Max	The maximum number of days that the password is valid
Warn	The number of days' warning a user receives before being notified that his or her password has expired
Inactive	The number of days of inactivity allowed for the user
Expire	An absolute date past which the user's account is no longer valid
Flag	Reserved for future use: currently set to 0.

Earlier Solaris releases used a `+/-` syntax in local `/etc/passwd` files to incorporate or overwrite entries in the NIS password maps. Since the Solaris Release 2x environment uses the name service switch file to specify a machine's sources of information, this is no longer necessary. All you have to do in Solaris Release 2x systems is edit a client's `/etc/nsswitch.conf` file to specify `files`, followed by `nisplus` as the sources for the passwd information. This effectively adds the contents of the passwd table to the contents of the `/etc/passwd` file.

However, if you still want to use the +/- method, edit the client's `nsswitch.conf` file to add `compat` as the `passwd` *source* if you are using NIS. If you are using NIS+, add `passwd_compat: nisplus`.

`protocols` Table

The `protocols` table lists the protocols used by the Internet. It has four columns:

TABLE 23–14 `protocols` Table

Column	Description
Cname	The protocol name
Name	An unofficial alias used to identify the protocol
Number	The number of the protocol
Comments	Comments about the protocol

`rpc` Table

The `rpc` table lists the names of RPC programs. It has four columns:

TABLE 23–15 `rpc` Table

Column	Description
Cname	The name of the program
Name	Other names that can be used to invoke the program
Number	The program number
Comments	Comments about the RPC program

Here is an example of an input file for the `rpc` table:

```
#
# rpc file
#
rpcbind    00000    portmap    sunrpc    portmapper
```

```
rusersd    100002    rusers
nfs    100003    nfsprog
mountd    100005    mount    showmount
walld    100008    rwall    shutdown
sprayd    100012    spray
llockmgr    100020
nlockmgr    100021
status    100024
bootparam    100026
keyserv    100029    keyserver
nisd    100300    rpc.nisd
#
```

`services` Table

The `services` table stores information about the Internet services available on the Internet. It has five columns:

TABLE 23–16 `services` Table

Column	Description
Cname	The official Internet name of the service
Name	The list of alternate names by which the service can be requested
Proto	The protocol through which the service is provided (for instance, 512/tcp)
Port	The port number
Comment	Comments about the service

`timezone` Table

The `timezone` table lists the default timezone of every machine in the domain. The default time zone is used during installation but can be overridden by the installer. The table has three columns:

TABLE 23–17 `timezone` Table

Field	Description
Name	The name of the domain
Tzone	The name of the time zone (for example, US/Pacific)
Comment	Comments about the time zone

Additional Default Tables

For information the other default tables:

- audit_user
- auth_attr
- exec_attr
- prof_attr
- user_attr

Refer to the appropriate section (4) man pages.

CHAPTER 24

NIS+ Troubleshooting

In this chapter, problems are grouped according to type. For each problem there is a list of common symptoms, a description of the problem, and one or more suggested solutions.

In addition, Appendix D contains an alphabetic listing of the more common NIS+ error messages.

NIS+ Debugging Options

The `NIS_OPTIONS` environment variable can be set to control various NIS+ debugging options.

Options are specified after the `NIS_OPTIONS` command separated by spaces with the option set enclosed in double quotes. Each option has the format *name=value*. Values can be integers, character strings, or filenames depending on the particular option. If a value is not specified for an integer value option, the value defaults to 1.

`NIS_OPTIONS` recognizes the following options:

TABLE 24–1 `NIS_OPTIONS` Options and Values

Option	Values	Actions
`debug_file`	*filename*	Directs debug output to specified file. If this option is not specified, debug output goes to `stdout`.
`debug_bind`	*Number*	Displays information about the server selection process.

TABLE 24–1 `NIS_OPTIONS` Options and Values *(Continued)*

Option	Values	Actions
`debug_rpc`	*1* or *2*	If the value is 1, displays RPC calls made to the NIS+ server and the RPC result code. If the value is 2, displays both the RPC calls and the contents of the RPC and arguments and results.
`debug_calls`	*Number*	Displays calls to the NIS+ API and the results that are returned to the application.
`pref_srvr`	*String*	Specifies preferred servers in the same format as that generated by the `nisprefadm` command (see Table 20–1). This will over-ride the preferred server list specified in `nis_cachemgr`.
`server`	*String*	Bind to a particular server.
`pref_type`	*String*	Not currently implemented.

For example, (assuming that you are using a C-Shell):

- To display many debugging messages you would enter:

```
setenv NIS_OPTIONS "debug_calls=2 debug_bind debug_rpc"
```

- To obtain a simple list of API calls and store them in the file `/tmp/CALLS` you would enter:

```
setenv NIS_OPTIONS "debug_calls debug_file=/tmp/CALLS"
```

- To obtain a simple list of API calls sent to a particular server you would enter:

```
setenv NIS_OPTIONS "debug_calls server=sirius"
```

NIS+ Administration Problems

This section describes problems that may be encountered in the course of routine NIS+ namespace administration work. Common symptoms include:

- `"Illegal object type"` for operation message.
- Other "object problem" error messages
- Initialization failure
- Checkpoint failures
- Difficulty adding a user to a group
- Logs too large/lack of disk space/difficulty truncating logs
- Cannot delete `groups_dir` or `org_dir`

Illegal Object Problems

Symptoms

- `"Illegal object type"` for operation message
- Other `"object problem"` error messages

There are a number of possible causes for this error message:

- You have attempted to create a table without any searchable columns.
- A database operation has returned the status of `DB_BADOBJECT` (see the `nis_db` man page for information on the `db` error codes).
- You are trying to add or modify a database object with a length of zero.
- You attempted to add an object without an owner.
- The operation expected a directory object, and the object you named was not a directory object.
- You attempted to link a directory to a LINK object.
- You attempted to link a table entry.
- An object that was not a group object was passed to the `nisgrpadm` command.
- An operation on a group object was expected, but the type of object specified was not a group object.
- An operation on a table object was expected, but the object specified was not a table object.

`nisinit` Fails

Make sure that:

- You can `ping` the NIS+ server to check that it is up and running as a machine.
- The NIS+ server that you specified with the `-H` option is a valid server and that it is running the NIS+ software.
- `rpc.nisd` is running on the server.
- The nobody class has read permission for this domain.
- The netmask is properly set up on this machine.

Checkpoint Keeps Failing

If checkpoint operations with a `nisping -C` command consistently fail, make sure you have sufficient swap and disk space. Check for error messages in `syslog`. Check for `core` files filling up space.

Cannot Add User to a Group

A user must first be an NIS+ principal client with a LOCAL credential in the domain's `cred` table before the user can be added as a member of a group in that domain. A DES credential alone is not sufficient.

Logs Grow too Large

Failure to regularly checkpoint your system with `nisping -C` causes your log files to grow too large. Logs are not cleared on a master until *all* replicas for that master are updated. If a replica is down or otherwise out of service or unreachable, the master's logs for that replica cannot be cleared. Thus, if a replica is going to be down or out of service for a period of time, you should remove it as a replica from the master as described in "Removing a Directory" on page 338. Keep in mind that you must first remove the directory's `org_dir` and `groups_dir` subdirectories before you remove the directory itself.

Lack of Disk Space

Lack of sufficient disk space will cause a variety of different error messages. (See "Insufficient Disk Space" on page 461 for additional information.)

Cannot Truncate Transaction Log File

First, check to make sure that the file in question exists and is readable and that you have permission to write to it.

- You can use `ls /var/nis/trans.log` to display the transaction log.
- You can use `nisls -l` and `niscat` to check for existence, permissions, and readability.
- You can use `syslog` to check for relevant messages.

The most likely cause of inability to truncate an existing log file for which you have the proper permissions is lack of disk space. (The checkpoint process first creates a duplicate temporary file of the log before truncating the log and then removing the temporary file. If there is not enough disk space for the temporary file, the checkpoint process cannot proceed.) Check your available disk space and free up additional space if necessary.

Domain Name Confusion

Domain names play a key role in many NIS+ commands and operations. To avoid confusion, you must remember that, except for root servers, all NIS+ masters and replicas are clients of the domain *above* the domain that they serve. If you make the mistake of treating a server or replica as if it were a client of the domain that it serves, you may get `Generic system error` or `Possible loop detected in namespace` *directoryname*:*domainname* error messages.

For example, the machine `altair` might be a client of the `subdoc.doc.com.` domain. If the master server of the `subdoc.doc.com.` subdomain is the machine `sirius`, then `sirius` is a client of the `doc.com.` domain. When using, specifying, or changing domains, remember these rules to avoid confusion:

1. Client machines belong to a given domain or subdomain.
2. Servers and replicas that serve a given subdomain are clients of the domain above the domain they are serving.
3. The only exception to Rule 2 is that the root master server and root replica servers are clients of the same domain that they serve. In other words, the root master and root replicas are all clients of the root domain.

Thus, in the example above, the fully qualified name of the `altair` machine is `alladin.subdoc.doc.com.` The fully qualified name of the `sirius` machine is `sirius.doc.com.` The name `sirius.subdoc.doc.com.` is wrong and will cause an error because `sirius` is a client of `doc.com.`, not `subdoc.doc.com.`

Cannot Delete `org_dir` or `groups_dir`

Always delete `org_dir` and `groups_dir` *before* deleting their parent directory. If you use `nisrmdir` to delete the domain before deleting the domain's `groups_dir` and `org_dir`, you will not be able to delete either of those two subdirectories.

Removal or Disassociation of NIS+ Directory from Replica Fails

When removing or disassociating a directory from a replica server you must first remove the directory's `org_dir` and `groups_dir` subdirectories before removing the directory itself. After each subdirectory is removed, you must run `nisping` on the parent directory of the directory you intend to remove. (See "Removing a Directory" on page 338.)

If you fail to perform the `nisping` operation, the directory will not be completely removed or disassociated.

If this occurs, you need to perform the following steps to correct the problem:

1. Remove `/var/nis/rep/org_dir` on the replica.
2. Make sure that `org_dir.`*domain* does not appear in `/var/nis/rep/serving_list` on the replica.
3. Perform a `nisping` on *domain*.
4. From the master server, run `nisrmdir -f` *replica_directory*.

If the replica server you are trying to dissociate is down or out of communication, the `nisrmdir -s` command will return a `Cannot remove replica` *name*`: attempt to remove a non-empty table` error message.

In such cases, you can run `nisrmdir -f -s` *replicaname* on the master to force the dissociation. Note, however, that if you use `nisrmdir -f -s` to dissociate an out-of-communication replica, you *must* run `nisrmdir -f -s` *again* as soon as the replica is back on line in order to clean up the replica's `/var/nis` file system. If you fail to rerun `nisrmdir -f -s` *replicaname* when the replica is back in service, the old out-of-date information left on the replica could cause problems.

NIS+ Database Problems

This section covers problems related to the namespace database and tables. Common symptoms include error messages with operative clauses such as:

- `Abort_transaction: Internal database error`
- `Abort_transaction: Internal Error, log entry corrupt`
- `Callback: select failed`
- `CALLBACK_SVC: bad argument`

as well as when `rpc.nisd` fails.

See also "NIS+ Ownership and Permission Problems" on page 444.

Multiple `rpc.nisd` Parent Processes

Symptoms:

Various Database and transaction log corruption error messages containing the terms:

- `Log corrupted`
- `Log entry corrupt`
- `Corrupt database`
- `Database corrupted`

Possible Causes:

You have multiple *independent* `rpc.nisd` daemons running. In normal operation, `rpc.nisd` can spawn other child `rpc.nisd` daemons. This causes no problem. However, if two parent `rpc.nisd` daemons are running at the same time on the same machine, they will overwrite each other's data and corrupt logs and databases. (Normally, this could only occur if someone started running `rpc.nisd` by hand.)

Diagnosis:

Run `ps -ef | grep rpc.nisd`. Make sure that you have no more than one parent `rpc.nisd` process.

Solution:

If you have more than one "parent" `rpc.nisd` entries, you must kill all but one of them. Use `kill -9` *process-id*, then run the `ps` command again to make sure it has died.

Note – If you started `rpc.nisd` with the `-B` option, you must also kill the `rpc.nisd_resolv` daemon.

If an NIS+ database is corrupt, you will also have to restore it from your most recent backup that contains an uncorrupted version of the database. You can then use the logs to update changes made to your namespace since the backup was recorded. However, if your logs are also corrupted, you will have to recreate by hand any namespace modifications made since the backup was taken.

`rpc.nisd` Fails

If an NIS+ table is too large, `rpc.nisd` may fail.

Diagnosis:

Use `nisls` to check your NIS+ table sizes. Tables larger than 7k may cause rpc.nisd to fail.

Solution:

Reduce the size of large NIS+ tables. Keep in mind that as a naming service NIS+ is designed to store references to objects, not the objects themselves.

NIS+ and NIS Compatibility Problems

This section describes problems having to do with NIS compatibility with NIS+ and earlier systems and the switch configuration file. Common symptoms include:

- The `nsswitch.conf` file fails to perform correctly.
- Error messages with operative clauses.

Error messages with operative clauses include:

- `Unknown user`
- Permission denied
- Invalid principal name

User Cannot Log In After Password Change

Symptoms:

New users, or users who recently changed their password are unable to log in at all, or able to log in on one or more machines but not on others. The user may see error messages with operative clauses such as:

- Unknown user*username*"
- `Permission denied`
- `Invalid principal name`

First Possible Cause:

Password was changed on NIS machine.

If a user or system administrator uses the `passwd` command to change a password on a Solaris operating environment machine running NIS in a domain served by NIS+ namespace servers, the user's password is changed only in that machine's `/etc/passwd` file. If the user then goes to some other machine on the network, the user's new password will not be recognized by that machine. The user will have to use the old password stored in the NIS+ passwd table.

Diagnosis:

Check to see if the user's old password is still valid on another NIS+ machine.

Solution:

Use `passwd` on a machine running NIS+ to change the user's password.

Second Possible Cause:

Password changes take time to propagate through the domain.

Diagnosis:

Namespace changes take a measurable amount of time to propagate through a domain and an entire system. This time might be as short as a few seconds or as long as many minutes, depending on the size of your domain and the number of replica servers.

Solution:

You can simply wait the normal amount of time for a change to propagate through your domain(s). Or you can use the `nisping org_dir` command to resynchronize your system.

`nsswitch.conf` File Fails to Perform Correctly

A modified (or newly installed) `nsswitch.conf` file fails to work properly.

Symptoms:

You install a new `nsswitch.conf` file or make changes to the existing file, but your system does not implement the changes.

Possible Cause:

Each time an `nsswitch.conf` file is installed or changed, you must reboot the machine for your changes to take effect. This is because nscd caches the `nsswitch.conf` file.

Solution:

Check your `nsswitch.conf` file against the information contained in the `nsswitch.conf` man page. Correct the file if necessary, and then reboot the machine.

NIS+ Object Not Found Problems

This section describes problem in which NIS+ was unable to find some object or principal. Common symptoms include:

Error messages with operative clauses such as:

- `Not found`
- `Not exist`
- `Can't find suitable transport for`*`name`*"
- `Cannot find`
- `Unable to find`
- `Unable to stat`

Syntax or Spelling Error

The most likely cause of some NIS+ object not being found is that you mistyped or misspelled its name. Check the syntax and make sure that you are using the correct name.

Incorrect Path

A likely cause of an "*object* not found" problem is specifying an incorrect path. Make sure that the path you specified is correct. Also make sure that the `NIS_PATH` environment variable is set correctly.

Domain Levels Not Correctly Specified

Remember that all servers are clients of the domain above them, not the domain they serve. There are two exceptions to this rule:

- The root masters and root replicas are clients of the root domain.
- *NIS+ domain names end with a period.* When using a fully qualified name you must end the domain name with a period. If you do not end the domain name with a period, NIS+ assumes it is a partially qualified name. However, the domain name of a machine should not end with a dot in the `/etc/defaultdomain` file. If you add a dot to a machine's domain name in the `/etc/defaultdomain` file, you will get `Could not bind to server serving domain` *name* error messages and encounter difficulty in connecting to the net on boot up.

Object Does Not Exist

The NIS+ object may not have been found because it does not exist, either because it has been erased or not yet created. Use `nisls -l`in the appropriate domain to check that the object exists.

Lagging or Out-of-Sync Replica

When you create or modify an NIS+ object, there is a time lag between the completion of your action and the arrival of the new updated information at a given replica. In ordinary operation, namespace information may be queried from a master or any of its replicas. A client automatically distributes queries among the various servers (master and replicas) to balance system load. This means that at any given moment you do not know which machine is supplying you with namespace information. If a command relating to a newly created or modified object is sent to a replica that has not yet received the updated information from the master, you will get an "object not found" type of error or the old out-of-date information. Similarly, a general command such as `nisls` may not list a newly created object if the system sends the `nisls` query to a replica that has not yet been updated.

You can use `nisping` to resync a lagging or out of sync replica server.

Alternatively, you can use the `-M` option with most NIS+ commands to specify that the command must obtain namespace information from the domain's master server. In

this way you can be sure that you are obtaining and using the most up-to-date information. (However, you should use the `-M` option only when necessary because a main point of having and using replicas to serve the namespace is to distribute the load and thus increase network efficiency.)

Files Missing or Corrupt

One or more of the files in `/var/nis/data` directory has become corrupted or erased. Restore these files from your most recent backup.

Old `/var/nis` Filenames

In Solaris Release 2.4 and earlier, the `/var/nis` directory contained two files named *hostname*`.dict` and *hostname*`.log`. It also contained a subdirectory named `/var/nis/`*hostname*. Starting with Solaris Release 2.5, the two files were renamed `trans.log` and `data.dict`, and the subdirectory is named `/var/nis/data`.

Do not rename the `/var/nis` or `/var/nis/data` directories or any of the files in these directories that were created by `nisinit` or any of the other NIS+ setup procedures.

In Solaris Release 2.5, the *content* of the files were also changed and they are not backward compatible with Solaris Release 2.4 or earlier. Thus, if you rename either the directories or the files to match the Solaris Release 2.4 patterns, the files will not work with *either* the Solaris Release 2.4 or the Solaris Release 2.5 or later versions of `rpc.nisd`. Therefore, you should not rename either the directories or the files.

Blanks in Name

Symptoms:

Sometimes an object is there, sometimes it is not. Some NIS+ or UNIX commands report that an NIS+ object does not exist or cannot be found, while other NIS+ or UNIX commands do find that same object.

Diagnoses:

Use `nisls` to display the object's name. Look carefully at the object's name to see if the name actually begins with a blank space. (If you accidentally enter two spaces after the flag when creating NIS+ objects from the command line with NIS+ commands, some NIS+ commands will interpret the second space as the beginning of the object's name.)

Solution:

If an NIS+ object name begins with a blank space, you must either rename it without the space or remove it and then recreate it from scratch.

Cannot Use Automounter

Symptoms:

You cannot change to a directory on another host.

Possible Cause:

Under NIS+, automounter names must be renamed to meet NIS+ requirements. NIS+ cannot access `/etc/auto*` tables that contain a period in the name. For example, NIS+ cannot access a file named `auto.direct`.

Diagnosis:

Use `nisls` and `niscat` to determine if the automounter tables are properly constructed.

Solution:

Change the periods to underscores. For example, change `auto.direct` to `auto_direct`. (Be sure to change other maps that might reference these.)

Links To or From Table Entries Do Not Work

You cannot use the `nisln` command (or any other command) to create links between entries in tables. NIS+ commands do not follow links at the entry level.

NIS+ Ownership and Permission Problems

This section describes problems related to user ownership and permissions. Common symptoms include:

Error messages with operative clauses such as:

- `Unable to stat name`
- `Unable to stat NIS+ directory name`
- `Security exception on LOCAL system`
- `Unable to make request`
- `Insufficient permission to . . .`
- `You` *`name`* `do not have secure RPC credentials`

Another Symptom:

- User or root unable to perform any namespace task.

No Permission

The most common permission problem is the simplest: you have not been granted permission to perform some task that you try to do. Use `niscat -o` on the object in question to determine what permissions you have. If you need additional permission, you, the owner of the object, or the system administrator can either change the permission requirements of the object (as described in Chapter 15,) or add you to a group that does have the required permissions (as described in Chapter 17).

No Credentials

Without proper credentials for you and your machine, many operations will fail. Use `nismatch` on your home domain's cred table to make sure you have the right credentials. See "Corrupted Credentials" on page 452 for more on credentials-related problems.

Server Running at Security Level 0

A server running at security level 0 does not create or maintain credentials for NIS+ principals.

If you try to use `passwd` on a server that is running at security level 0, you will get the error message: `You` *name* `do not have secure RPC credentials in NIS+ domain` *domainname*.

Security level 0 is only to be used by administrators for initial namespace setup and testing purposes. Level 0 should not be used in any environment where ordinary users are active.

User Login Same as Machine Name

A user cannot have the same login ID as a machine name. When a machine is given the same name as a user (or vice versa), the first principal can no longer perform operations requiring secure permissions because the second principal's key has overwritten the first principal's key in the cred table. In addition, the second principal now has whatever permissions were granted to the first principal.

For example, suppose a user with the login name of `saladin` is granted namespace read-only permissions. Then a machine named `saladin` is added to the domain. The user `saladin` will no longer be able to perform any namespace operations requiring

any sort of permission, and the root user of the machine `saladin` will only have read-only permission in the namespace.

Symptoms:

- The user or machine gets "`permission denied`" type error messages.
- Either the user or root for that machine cannot successfully run `keylogin`.
- `Security exception on LOCAL system. UNABLE TO MAKE REQUEST.` error message.
- If the first principal did not have read access, the second principal might not be able to view otherwise visible objects.

Note – When running `nisclient` or `nisaddcred`, if the message `Changing Key` is displayed rather than `Adding Key`, there is a duplicate user or host name already in existence in that domain.

Diagnosis:

Run `nismatch` to find the host and user in the hosts and passwd tables to see if there are identical host names and user names in the respective tables:

```
nismatch username passwd.org_dir
```

Then run `nismatch` on the domain's cred table to see what type of credentials are provided for the duplicate host or user name. If there are both LOCAL and DES credentials, the cred table entry is for the user; if there is only a DES credential, the entry is for the machine.

Solution:

Change the machine name. (It is better to change the machine name than to change the user name.) Then delete the machine's entry from the `cred` table and use `nisclient` to reinitialize the machine as an NIS+ client. (If you wish, you can use `nistbladm` to create an alias for the machine's old name in the hosts tables.) If necessary, replace the user's credentials in the cred table.

Bad Credentials

See "Corrupted Credentials" on page 452.

NIS+ Security Problems

This section describes common password, credential, encryption, and other security-related problems.

Security Problem Symptoms

Error messages with operative clauses such as:

- `Authentication error`
- `Authentication denied`
- `Cannot get public key`
- `Chkey failed`
- `Insufficient permission to`
- `Login incorrect`
- `Keyserv fails to encrypt`
- `No public key`
- `Permission denied`
- `Password [problems]`

User or root unable to perform any namespace operations or tasks. (See also "NIS+ Ownership and Permission Problems" on page 444.)

`Login Incorrect` Message

The most common cause of a "login incorrect" message is the user mistyping the password. Have the user try it again. Make sure the user knows the correct password and understands that passwords are case-sensitive and also that the letter "o" is not interchangeable with the numeral "0," nor is the letter "l" the same as the numeral "1."

Other possible causes of the "login incorrect" message are:

- The password has been locked by an administrator. See "Locking a Password" on page 307 and "Unlocking a Password" on page 308.
- The password has been locked because the user has exceeded an inactivity maximum See "Specifying Maximum Number of Inactive Days" on page 315.
- The password has expired. See "Password Privilege Expiration" on page 313.

See Chapter 16 for general information on passwords.

Password Locked, Expired, or Terminated

A common cause of a `Permission denied, password expired`, type message is that the user's password has passed its age limit or the user's password privileges have expired. See Chapter 16 for general information on passwords.

- See "Setting a Password Age Limit" on page 310.
- See "Password Privilege Expiration" on page 313.

Stale and Outdated Credential Information

Occasionally, you may find that even though you have created the proper credentials and assigned the proper access rights, some client requests still get denied. This may be due to out-of-date information residing somewhere in the namespace.

Storing and Updating Credential Information

Credential-related information, such as public keys, is stored in many locations throughout the namespace. NIS+ updates this information periodically, depending on the time-to-live values of the objects that store it, but sometimes, between updates, it gets out of sync. As a result, you may find that operations that should work, don't work. Table 24–2 lists all the objects, tables, and files that store credential-related information and how to reset it.

TABLE 24–2 Where Credential-Related Information is Stored

Item	Stores	To Reset or Change
cred table	NIS+ principal's secret key and public key. These are the master copies of these keys.	Use `nisaddcred` to create new credentials; it updates existing credentials. An alternative is `chkey`.
Directory object	A copy of the public key of each server that supports it.	Run the `/usr/lib/nis/nisupdkeys` command on the directory object.
Keyserver	The secret key of the NIS+ principal that is currently logged in.	Run `keylogin` for a principal user or `keylogin -r` for a principal machine.
NIS+ daemon	Copies of directory objects, which in turn contain copies of their servers' public keys.	Kill the daemon and the cache manager. Then restart both.
Directory cache	A copy of directory objects, which in turn contain copies of their servers' public keys.	Kill the NIS+ cache manager and restart it with the `nis_cachemgr -i` command. The `-i` option resets the directory cache from the cold-start file and restarts the cache manager.

TABLE 24–2 Where Credential-Related Information is Stored *(Continued)*

Item	Stores	To Reset or Change
Cold-start file	A copy of a directory object, which in turn contains copies of its servers' public keys.	On the root master, kill the NIS+ daemon and restart it. The daemon reloads new information into the existing `NIS_COLD_START` file. For a client, first remove the cold-start and shared directory files from `/var/nis`, and kill the cache manager. Then re-initialize the principal with `nisinit -c`. The principal's trusted server reloads new information into the principal's existing cold-start file.
passwd table	A user's password or a machine's superuser password.	Use the `passwd -r nisplus` command. It changes the password in the NIS+ passwd table and updates it in the cred table.
`passwd` file	A user's password or a machine's superuser password.	Use the `passwd -r nisplus` command, whether logged in as superuser or as yourself, whichever is appropriate.
`passwd` map (NIS)	A user's password or a machine's superuser password.	Use `passwd -r nisplus`.

Updating Stale Cached Keys

The most commonly encountered out-of-date information is the existence of stale objects with old versions of a server's public key. You can usually correct this problem by running `nisupdkeys` on the domain you are trying to access. (See Chapter 12 for information on using the `nisupdkeys` command.)

Because some keys are stored in files or caches, `nisupdkeys` cannot always correct the problem. At times you might need to update the keys manually. To do that, you must understand how a server's public key, once created, is propagated through namespace objects. The process usually has five stages of propagation. Each stage is described below.

Stage 1: Server's Public Key Is Generated

An NIS+ server is first an NIS+ client. So, its public key is generated in the same way as any other NIS+ client's public key: with the `nisaddcred` command. The public key is then stored in the cred table of the server's home domain, not of the domain the server will eventually support.

Stage 2: Public Key Is Propagated to Directory Objects

Once you have set up an NIS+ domain and an NIS+ server, you can associate the server with a domain. This association is performed by the `nismkdir` command. When the `nismkdir` command associates the server with the directory, it also copies

the server's public key from the cred table to the domain's directory object. For example, assume the server is a client of the `doc.com.` root domain, and is made the master server of the `sales.doc.com.` domain.

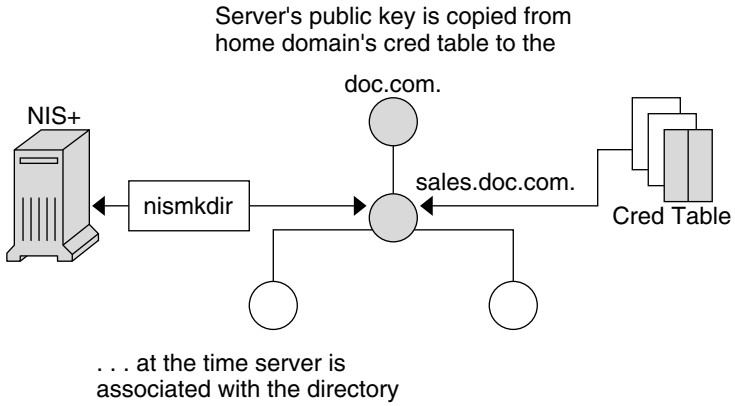


FIGURE 24–1 Public Key is Propagated to Directory Objects

Its public key is copied from the `cred.org_dir.doc.com.` domain and placed in the `sales.doc.com.` directory object. This can be verified with the `niscat -o sales.doc.com.` command.

Stage 3: Directory Objects Are Propagated Into Client Files

All NIS+ clients are initialized with the `nisinit` utility or with the `nisclient` script.

Among other things, `nisinit` (or `nisclient`) creates a cold-start file `/var/nis/NIS_COLDSTART`. The cold-start file is used to initialize the client's directory cache `/var/nis/NIS_SHARED_DIRCACHE`. The cold-start file contains a copy of the directory object of the client's domain. Since the directory object already contains a copy of the server's public key, the key is now propagated into the cold-start file of the client.

In addition when a client makes a request to a server outside its home domain, a copy of the remote domains directory object is stored in the client's `NIS_SHARED_DIRCACHE` file. You can examine the contents of the client's cache by using the `nisshowcache` command, described on page 184.

This is the extent of the propagation until a replica is added to the domain or the server's key changes.

Stage 4: When a Replica is Added to the Domain

When a replica server is added to a domain, the `nisping` command (described in "The `nisping` Command" on page 345) is used to download the NIS+ tables, including the cred table, to the new replica. Therefore, the original server's public key is now also stored in the replica server's cred table.

Stage 5: When the Server's Public Key Is Changed

If you decide to change DES credentials for the server (that is, for the root identity on the server), its public key will change. As a result, the public key stored for that server in the cred table will be different from those stored in:

- The cred table of replica servers (for a few minutes only)
- The main directory object of the domain supported by the server (until its time-to-live expires)
- The `NIS_COLDSTART` and `NIS_SHARED_DIRCACHE` files of every client of the domain supported by server (until their time-to-live expires, usually 12 hours)
- The `NIS_SHARED_DIRCACHE` file of clients who have made requests to the domain supported by the server (until their time-to-live expires)

Most of these locations will be updated automatically within a time ranging from a few minutes to 12 hours. To update the server's keys in these locations immediately, use the commands:

TABLE 24–3 Updating a Server's Keys

Location	Command	See
Cred table of replica servers (instead of using `nisping`, you can wait a few minutes until the table is updated automatically)	`nisping`	"The `nisping` Command" on page 345
Directory object of domain supported by server	`nisupdkeys`	"The `nisupdkeys` Command" on page 255
`NIS_COLDSTART` file of clients	`nisinit -c`	"The `nisinit` Command" on page 342
`NIS_SHARED_DIRCACHE` file of clients	`nis_cachemgr`	"The `nis_cachemgr` Command" on page 343

Note – You must first kill the existing `nis_cachemgr` before restarting `nis_cachemgr`.

Corrupted Credentials

When a principal (user or machine) has a corrupt credential, that principal is unable to perform any namespace operations or tasks, not even `nisls`. This is because a corrupt credential provides no permissions at all, not even the permissions granted to the nobody class.

Symptoms:

User or root cannot perform any namespace tasks or operations. All namespace operations fail with a "permission denied" type of error message. The user or root cannot even perform a `nisls` operation.

Possible Cause:

Corrupted keys or a corrupt, out-of-date, or otherwise incorrect `/etc/.rootkey` file.

Diagnosis:

Use `snoop` to identify the bad credential.

Or, if the principal is listed, log in as the principal and try to run an NIS+ command on an object for which you are sure that the principal has proper authorization. For example, in most cases an object grants read authorization to the nobody class. Thus, the `nisls` *object* command should work for any principal listed in the cred table. If the command fails with a "permission denied" error, then the principal's credential is likely corrupted.

Solution

- *Ordinary user*. Perform a `keylogout` and then a `keylogin` for that principal.
- *Root* or *superuser*. Run `keylogout -f` followed by `keylogin -r`.

`Keyserv` Failure

The `keyserv` is unable to encrypt a session. There are several possible causes for this type of problem:

Possible Causes and Solutions:

- The client has not keylogged in. Make sure that the client is keylogged in. To determine if a client is properly keylogged in, have the client run `nisdefaults -v` (or run it yourself as the client). If `(not authenticated)` is returned on the

`Principal Name` line, the client is not properly keylogged in.

- The client (host) does not have appropriate LOCAL or DES credentials. Run `niscat` on the client's cred table to verify that the client has appropriate credentials. If necessary, add credentials as explained in "Creating Credential Information for NIS+ Principals" on page 242.
- The `keyserv` daemon is not running. Use the `ps` command to see if `keyserv` is running. If it is not running, restart it and then do a `keylogin`.
- While `keyserv` is running, other long running processes that make secure RPC or NIS+ calls are not. For example, `automountd`, `rpc.nisd`, and `sendmail`. Verify that these processes are running correctly. If they are not, restart them.

Machine Previously Was an NIS+ Client

If this machine has been initialized before as an NIS+ client of the same domain, try `keylogin -r` and enter the root login password at the Secure RPC password prompt.

No Entry in the cred Table

To make sure that an NIS+ password for the principal (user or host) exists in the cred table, run the following command in the principal's home domain

`nisgrep -A cname=`*principal* `cred.org_dir.`*domainname*

If you are running `nisgrep` from another domain, the *domainname* must be fully qualified.

Changed Domain Name

Do not change a domain name.

If you change the name of an existing domain you will create authentication problems because the fully qualified original domain name is embedded in objects throughout your network.

If you have *already* changed a domain name and are experiencing authentication problems, or error messages containing terms like "malformed" or "illegal" in relation to a domain name, change the domain name back to its original name. The recommended procedure for renaming your domains is to create a *new* domain with the *new* name, set up your machines as servers and clients of the new domain, make sure they are performing correctly, and then remove the old domain.

When Changing a Machine to a Different Domain

If this machine is an NIS+ client and you are trying to change it to a client of a different domain, remove the `/etc/.rootkey` file, and then rerun the `nisclient` script using the network password supplied by your network administrator or taken from the `nispopulate` script.

NIS+ and Login Passwords in `/etc/passwd` File

Your NIS+ password is stored in the NIS+ passwd table. Your user login password may be stored in NIS+ passwd table or in your `/etc/passwd` file. (Your user password and NIS+ password can be the same or different.) To change a password in an `/etc/passwd` file, you must run the `passwd` command with the `nsswitch.conf` file set to files or with the `-r files` flag.

The `nsswitch.conf` file specifies which password is used for which purpose. If the `nsswitch.conf` file is directing system queries to the wrong location, you will get password and permission errors.

Secure RPC Password and Login Passwords Are Different

When a principal's login password is different from his or her Secure RPC password, `keylogin` cannot decrypt it at login time because `keylogin` defaults to using the principal's login password, and the private key was encrypted using the principal's Secure RPC password.

When this occurs the principal can log in to the system, but for NIS+ purposes is placed in the authorization class of nobody because the keyserver does not have a decrypted private key for that user. Since most NIS+ environments are set up to deny the nobody class create, destroy, and modify rights to most NIS+ objects this results in "permission denied" types errors when the user tries to access NIS+ objects.

Note – In this context network password is sometimes used as a synonym for Secure RPC password. When prompted for your "network password," enter your Secure RPC password.

To be placed in one of the other authorization classes, a user in this situation must explicitly run the `keylogin` program and give the principal's Secure RPC password when `keylogin` prompts for password. (See "Keylogin" on page 249.)

But an explicit `keylogin` provides only a temporary solution that is good only for the current login session. The keyserver now has a decrypted private key for the user, but the private key in the user's cred table is still encrypted using the user's Secure RPC password, which is different than the user's login password. The next time the user

logs in, the same problem reoccurs. To permanently solve the problem the user needs to change the private key in the cred table to one based on the user's login ID rather than the user's Secure RPC password. To do this, the user need to run the `chkey` program as described in "Changing Keys for an NIS+ Principal" on page 250.

Thus, to permanently solve a Secure RPC password different than login password problems, the user (or an administrator acting for the user) must perform the following steps:

1. Log in using the login password.
2. Run the `keylogin` program to temporarily get a decrypted private key stored in the keyserver and thus gain temporary NIS+ access privileges.
3. Run `chkey -p`to permanently change the encrypted private key in the cred table to one based on the user's login password.

Preexisting `/etc/.rootkey` File

Symptoms:

Various `insufficient permission to` and `permission denied` error messages.

Possible Cause:

An `/etc/.rootkey` file already existed when you set up or initialized a server or client. This could occur if NIS+ had been previously installed on the machine and the `.rootkey` file was not erased when NIS+ was removed or the machine returned to using NIS or `/etc` files.

Diagnosis:

Run `ls -l` on the `/etc` directory and `nisls -l org_dir` and compare the date of the `/etc/.rootkey` to the date of the cred table. If the `/etc/.rootkey` date is clearly earlier than that of the cred table, it may be a preexisting file.

Solution:

Run `keylogin -r` as root on the problem machine and then set up the machine as a client again.

Root Password Change Causes Problem

Symptoms:

You change the root password on a machine, and the change either fails to take effect or you are unable to log in as superuser.

Possible Cause:

Note – For security reasons, you should not have User ID 0 listed in the `passwd` table.

You changed the root password, but root's key was not properly updated. Either because you forgot to run `chkey -p` for root or some problem came up.

Solution

Log in as a user with administration privileges (that is, a user who is a member of a group with administration privileges) and use `passwd` to restore the old password. Make sure that old password works. Now use `passwd` to change root's password to the new one, and then run `chkey -p`.

Caution – Once your NIS+ namespace is set up and running, you can change the root password on the root master machine. But do not change the root master keys, as these are embedded in all directory objects on all clients, replicas, and servers of subdomains. To avoid changing the root master keys, always use the `-p` option when running `chkey` as root.

NIS+ Performance and System Hang Problems

This section describes common slow performance and system hang problems.

Performance Problem Symptoms

Error messages with operative clauses such as:

- `Busy try again later`
- `Not responding`

Other common symptoms:

- You issue a command and nothing seems to happen for far too long.
- Your system, or shell, no longer responds to keyboard or mouse commands.
- NIS+ operations seem to run slower than they should or slower than they did before.

Checkpointing

Someone has issued an `nisping` or `nisping -C` command. Or the `rpc.nisd` daemon is performing a checkpoint operation.

Caution – Do not reboot! Do not issue any more `nisping` commands.

When performing a `nisping` or checkpoint, the server will be sluggish or may not immediately respond to other commands. Depending on the size of your namespace, these commands may take a noticeable amount of time to complete. Delays caused by checkpoint or ping commands are multiplied if you, or someone else, enter several such commands at one time. Do not reboot. This kind of problem will solve itself. Just wait until the server finishes performing the `nisping` or checkpoint command.

During a full master-replica resync, the involved replica server will be taken out of service until the resync is complete. Do not reboot—just wait.

Variable `NIS_PATH`

Make sure that your `NIS_PATH` variable is set to something clean and simple. For example, the default: `org_dir.$:$`. A complex `NIS_PATH`, particularly one that itself contains a variable, will slow your system and may cause some operations to fail. (See "`NIS_PATH` Environment Variable" on page 81for more information.)

Do not use `nistbladm` to set nondefault table paths. Nondefault table paths will slow performance.

Table Paths

Do not use table paths because they will slow performance.

Too Many Replicas

Too many replicas for a domain degrade system performance during replication. There should be no more than 10 replicas in a given domain or subdomain. If you have more than five replicas in a domain, try removing some of them to see if that improves performance.

Recursive Groups

A recursive group is a group that contains the name of some other group. While including other groups in a group reduces your work as system administrator, doing so slows down the system. You should not use recursive groups.

Large NIS+ Database Logs at Start-up

When `rpc.nisd` starts up it goes through each log. If the logs are long, this process could take a long time. If your logs are long, you may want to checkpoint them using `nisping -C` before starting `rpc.nisd`.

The Master `rpc.nisd` Daemon Died

Symptoms:

If you used the `-M` option to specify that your request be sent to the master server, and the `rpc.nisd` daemon has died on that machine, you will get a "server not responding" type error message and no updates will be permitted. (If you did not use the `-M` option, your request will be automatically routed to a functioning replica server.)

Possible Cause:

Using uppercase letters in the name of a home directory or host can sometimes cause `rpc.nisd` to die.

Diagnosis:

First make sure that the server itself is up and running. If it is, run `ps -ef | grep rpc.nisd` to see if the daemon is still running.

Solution:

If the daemon has died, restart it. If `rpc.nisd` frequently dies, contact your service provider.

No `nis_cachemgr`

Symptoms:

It takes too long for a machine to locate namespace objects in other domains.

Possible Cause:

You do not have `nis_cachemgr` running.

Diagnosis:

Run `ps -ef | grep nis_cachemgr` to see if it is still running.

Solution

Start `nis_cachemgr` on that machine.

Server Very Slow at Start-up After NIS+ Installation

Symptoms:

A server performs slowly and sluggishly after using the NIS+ scripts to install NIS+ on it.

Possible Cause:

You forgot to run `nisping -C -a` after running the `nispopulate` script.

Solution:

Run `nisping -C -a` to checkpoint the system as soon as you are able to do so.

`niscat` Returns: `Server busy. Try Again`

Symptoms:

You run `niscat` and get an error message indicating that the server is busy.

Possible Cause:

- The server is busy with a heavy load, such as when doing a resync.
- The server is out of swap space.

Diagnosis:

Run `swap -s` to check your server's swap space.

Solution:

You must have adequate swap and disk space to run NIS+. If necessary, increase your space.

NIS+ Queries Hang After Changing Host Name

Symptoms:

Setting the host name for an NIS+ server to be fully qualified is not recommended. If you do so, and NIS+ queries then just hang with no error messages, check the following possibilities:

Possible Cause:

Fully qualified host names must meet the following criteria:

- The domain part of the host name must be the same as the name returned by the `domainname` command.
- After the setting the host name to be fully qualified, you must also update all the necessary `/etc` and `/etc/inet` files with the new host name information.
- The host name must end in a period.

Solution:

Kill the NIS+ processes that are hanging and then kill `rpc.nisd` on that host or server. Rename the host to match the two requirements listed above. Then reinitialize the server with `nisinit`. (If queries still hang after you are sure that the host is correctly named, check other problem possibilities in this section.)

NIS+ System Resource Problems

This section describes problems having to do with lack of system resources such as memory, disk space, and so forth.

Resource Problem Symptoms

Error messages with operative clauses such as:

- `No memory`
- `Out of disk space`
- "Cannot [do something] with log" type messages
- `Unable to fork`

Insufficient Memory

Lack of sufficient memory or swap space on the system you are working with will cause a wide variety of NIS+ problems and error messages. As a short-term, temporary solution, try to free additional memory by killing unneeded windows and

processes. If necessary, exit your windowing system and work from the terminal command line. If you still get messages indicating inadequate memory, you will have to install additional swap space or memory, or switch to a different system that has enough swap space or memory.

Under some circumstances, applications and processes may develop memory leaks and grow too large. you can check the current size of an application or process by running:

```
ps -el
```

The `sz` (size) column shows the current memory size of each process. If necessary, compare the sizes with comparable processes and applications on a machine that is not having memory problems to see if any have grown too large.

Insufficient Disk Space

Lack of disk space will cause a variety of error messages. A common cause of insufficient disk space is failure to regularly remove `tmp` files and truncate `log` files. `log` and `tmp` files grow steadily larger unless truncated. The speed at which these files grow varies from system to system and with the system state. `log` files on a system that is working inefficiently or having namespace problems will grow very fast.

Note – If you are doing a lot of troubleshooting, check your `log` and `tmp` files frequently. Truncate `log` files and remove `tmp` files before lack of disk space creates additional problems. Also check the root directory and home directories for core files and delete them.

The way to truncate `log` files is to regularly checkpoint your system (Keep in mind that a checkpoint process may take some time and will slow down your system while it is being performed, checkpointing also requires enough disk space to create a complete copy of the files before they are truncated.)

To checkpoint a system, run `nisping -C`.

Insufficient Processes

On a heavily loaded machine it is possible that you could reach the maximum number of simultaneous processes that the machine is configured to handle. This causes messages with clauses like “unable to fork”. The recommended method of handling this problem is to kill any unnecessary processes. If the problem persists, you can reconfigure the machine to handle more processes as described in your system administration documentation.

NIS+ User Problems

This section describes NIS+ problems that a typical user might encounter.

User Problem Symptoms

- User cannot log in.
- User cannot `rlogin` to other domain

User Cannot Log In

There are many possible reasons for a user being unable to log in:

- *User forgot password*. To set up a new password for a user who has forgotten the previous one, run `passwd` for that user on another machine (naturally, you have to be the NIS+ administrator to do this).
- *Mistyping password*. Make sure the user knows the correct password and understands that passwords are case-sensitive and that the letter "o" is not interchangeable with the numeral "0," nor is the letter "l" the same as the numeral "1."
- *"Login incorrect" type message*. For causes other than simply mistyping the password, see "`Login Incorrect` Message" on page 447.
- The user's password privileges have expired (see "Password Privilege Expiration" on page 313).
- An inactivity maximum has been set for this user, and the user has passed it (see "Specifying Maximum Number of Inactive Days" on page 315).
- The user's `nsswitch.conf` file is incorrect. The `passwd` entry in that file must be one of the following five permitted configurations:
  - `passwd: files`
  - `passwd: files nis`
  - `passwd: files nisplus`
  - `passwd: compat`
  - `passwd: compat passwd_compat: nisplus`

  Any other configuration will prevent a user from logging in.

(See "`nsswitch.conf` File Requirements" on page 296 for further details.)

User Cannot Log In Using New Password

Symptoms:

Users who recently changed their password are unable to log in at all, or are able to log in on some machines but not on others.

Possible Causes:

- It may take some time for the new password to propagate through the network. Have users try to log in with the old password.
- The password was changed on a machine that was not running NIS+ (see "User Cannot Log In Using New Password" on page 462).

User Cannot Remote Log In to Remote Domain

Symptoms:

User tries to `rlogin` to a machine in some other domain and is refused with a "Permission denied" type error message.

Possible Cause:

To `rlogin` to a machine in another domain, a user must have LOCAL credentials in that domain.

Diagnosis:

Run `nismatch` *username.domainname*. `cred.org_dir` in the other domain to see if the user has a LOCAL credential in that domain.

Solution:

Go to the remote domain and use `nisaddcred` to create a LOCAL credential for the user in the that domain.

User Cannot Change Password

The most common cause of a user being unable to change passwords is that the user is mistyping (or has forgotten) the old password.

Other possible causes:

- The password Min value has been set to be greater than the password Max value. See "Setting Minimum Password Life" on page 310.
- The password is locked or expired. See "`Login Incorrect` Message" on page 447 and "Password Locked, Expired, or Terminated" on page 448.

Other NIS+ Problems

This section describes problems that do not fit any of the previous categories.

How to Tell if NIS+ Is Running

You may need to know whether a given host is running NIS+. A script may also need to determine whether NIS+ is running.

You can assume that NIS+ is running if:

- `nis_cachemgr` is running.
- The host has a `/var/nis/NIS_COLD_START` file.
- `nisls` succeeds.

Replica Update Failure

Symptoms:

Error messages indicating that the update was not successfully complete. (Note that the message: `replica_update:` *number* `updates` *number* `errors` indicates a successful update.)

Possible Causes:

Any of the following error messages indicate that the server was busy and that the update should be rescheduled:

- Master server busy, full dump rescheduled
- `replica_update` error result was Master server busy full dump rescheduled, full dump rescheduled
- `replica_update:` master server busy, rescheduling the resync
- `replica_update:` master server busy, will try later
- `replica_update:` nis dump result Master server busy, full dump rescheduled
- `nis_dump_svc:` one replica is already resyncing

(These messages are generated by, or in conjunction with, the NIS+ error code constant: `NIS_DUMPLATER` one replica is already resyncing.)

These messages indicate that there was some other problem:

- `replica_update:` error result was ...
- `replica_update:` nis dump result `nis_perror` error string
- `rootreplica_update:` update failednis dump result `nis_perror` string-variable: could not fetch object from master

(If `rpc.nisd` is being run with the `-C` (open diagnostic channel) option, additional information may be entered in either the master server or replica server's system log.

These messages indicate possible problems such as:

- The server is out of child processes that can be allocated.
- A read-only child process was requested to dump.
- Another replica is currently resynching.

Diagnosis:

Check both the replica and server's system log for additional information. How much, if any, additional information is recorded in the system logs depends on your system's error reporting level, and whether or not you are running `rpc.nisd` with the `-C` option (diagnostics).

Solution:

In most cases, these messages indicate minor software problems which the system is capable of correcting. If the message was the result of a command, simply wait for a while and then try the command again. If these messages appear often, you can change the threshold level in your `/etc/syslog.conf` file. See the `syslog.conf` man page for details.

PART IV FNS Setup, Configuration and Administration

This part contains information on the setup, configuration and administration of the Federated Naming Service (FNS).

APPENDIX **A**

Federated Naming Service (FNS)

This appenidx describes how to set up and configure the Federated Naming Service (FNS) in an NIS+, NIS, or files-based naming environment. (*Files-based* naming refers to name services that obtain their data from `/etc` files rather than NIS+ or NIS.)Additionally, it described the administration and troubleshooting for the FNS in the Solaris operating environment.

FNS Quickstart

FNS, the Federated Naming Service, supports the use of different autonomous naming systems in a single Solaris operating environment. FNS allows you to use a single, simple naming system interface for all of the different name services on your network. FNS conforms to the X/Open federated naming (XFN) specification.

FNS is not a replacement for NIS+, NIS, DNS, or `/etc` files. Rather, FNS is implemented on top of these services and allows you to use a set of common names with desktop applications.

X/Open Federated Naming (XFN)

The programming interface and policies that FNS supports are specified by XFN (X/Open Federated Naming).

Why FNS?

FNS is useful for the following reasons:

- A single uniform naming and directory interface is provided to clients for accessing naming and directory services. Consequently, the addition of new naming and directory services does not require changes to applications or existing services.
- Names can be composed in a uniform way. FNS defines a way to uniformly compose names from different naming systems so that applications can uniformly address objects in these different naming systems.
- Coherent naming is encouraged through the use of shared contexts and shared names. Different applications can use these shared names and contexts and need not duplicate the work.

Composite Names and Contexts

Fundamental to FNS are the notions of composite names and contexts.

Composite Names

A composite name is a name that spans multiple naming systems.

A composite name consists of an ordered list of components. Each component is a name from the namespace of a single naming system. Individual naming systems are responsible for the syntax of each component. FNS defines the syntax for constructing a composite name using names from component naming systems. Composite names are composed left to right using the slash character (/) as the component separator.

For example, the composite name `.../doc.com/site/bldg-5.alameda` consists of four components: `...`, `doc.com`, `site`, and `bldg-5.alameda`.

Contexts

A context provides operations for:

- Associating (binding) names to objects
- Resolving names to objects
- Removing bindings
- Listing names

- Renaming
- Associating attributes with named objects
- Retrieving and updating attributes associated with named objects
- Searching for objects using attributes

A context contains a set of name-to-reference bindings. Each reference contains a list of communication end-points or addresses. The federated naming system is formed by contexts from one naming system being bound in the contexts of another naming system. Resolution of a composite name proceeds from contexts within one naming system to those in the next until the name is resolved.

Attributes

Attributes may be applied to named objects. Attributes are optional. A named object can have no attributes, one attribute, or multiple attributes.

Each attribute has a unique attribute identifier, an attribute syntax, and a set of zero or more distinct attribute values.

XFN defines the base attribute interface for examining and modifying the values of attributes associated with existing named objects. These objects can be contexts or any other types of objects. Associated with a context are syntax attributes that describe how the context parses compound names.

The extended attribute interface contains operations that search for specific attributes and that create objects and their associated attributes.

FNS and the Name Service Switch

FNS, the Solaris implementation of the XFN API, can also be used to specify which name service a client is to query for naming information. The XFN API is more general in both the X and Y dimensions than the update `getXbyY()` interfaces that use the switch file. For example, it can be used to look up information on both hosts and users, from both NIS+ and NIS. An application can be a client of either `getXbyY()`, or XFN, or both.

Maintaining Consistency Between FNS and the Switch File

In order to ensure that changes made to namespace data through FNS are always available to clients obtaining namespace information through the switch file, always configure both the switch and FNS to use the same name service.

Namespace Updates

The support for data updates provided by the XFN API is superior to that of the `getXbyY()` interfaces. Most namespaces are composed of data from multiple sources. A groups namespace, for example, might contain information from both the `/etc/group` file and the NIS+ `group.org_dir` object. But the switch file does not provide enough information for an application update routine to identify the source of some particular piece of group data or the source to update.

Because each FNS subordinate namespace comes entirely from a single name service, updates are simple and straightforward because there is no confusion over which name service the update applies to.

Enterprise Naming Services

Enterprise-level naming services are used to name objects within an enterprise. FNS currently supports three enterprise-level naming services: NIS+, NIS and Files.

NIS+

NIS+ is the preferred enterprise-wide information service in the Solaris operating environment environment. FNS organization units correspond to NIS+ domains and subdomains. There is one `orgunit` context for each domain and subdomain.

Under NIS+, FNS context and attribute data are stored in NIS+ tables. These tables are stored in NIS+ directory objects named `ctx_dir`. There is a `ctx_dir` directory object for each NIS+ domain and subdomain, residing at the same level as the domain's `groups_dir` and `org_dir` directory objects. Thus, the directory object `ctx_dir.sales.doc.com.` contains FNS tables which store FNS context and attribute data for the `sales.doc.com.` domain.

Under NIS+, you use FNS and NIS+ commands to work with the information in FNS tables. Do not edit these tables directly or manipulate them with UNIX commands.

NIS

NIS is an enterprise-wide information service in the Solaris operating environment. Each enterprise is a single NIS domain. There is one FNS organizational unit which corresponds to the single NIS domain.

Under NIS, FNS context and attribute data are stored in NIS maps. These maps are stored in a `/var/yp/`*domainname* directory on an NIS server. Under NIS, the super user can use FNS commands to work with the information in FNS maps.

NIS Clients Can Update Contexts With FNS if SKI is Running

If certain conditions are met, any NIS client (machine, process, or user) can use FNS commands such as `fncreate_fs` or `fncreate_printer` to update the client's own contexts. This allows NIS clients to use FNS commands to update applications such as Printer Administrator, CDE Calendar Manager, Admin Tool and others.

For non-super-users to update their own contexts with FNS commands, the following conditions must be met:

- Secure Key_management Infrastructure (SKI) must be available on the NIS master server.
- The `fnsypd` daemon must be running on the NIS master server. This daemon must be started by someone with super user privileges.
- A client user or machine is only allowed to update its own context.
- The client must be authorized to perform the requested update.

Note – SKI does not support 64–bit mode. Thus, NIS clients cannot update contexts in 64–bit mode.

Files-Based naming files

Files refers to the naming files normally found in a machine's `/etc` directory. These machine-based files contain UNIX user and password information, host information, mail aliases, and so forth. They also support Solaris-specific data such as the automount maps.

Under a files-based naming system, FNS context and attribute data is stored in files. These FNS files are stored in machine's `/var/fn` directory. (The `/var/fn` directory does not have to be on each machine, it could be exported from an NFS file server.)

Under a files naming system, you use FNS commands to work with the information in FNS files.

Global Naming Services

FNS also supports federating NIS+ and NIS with DNS and X.500. This means that you can connect enterprise level namespaces with global namespaces to make the enterprise objects accessible in the global scope.

FNS currently supports the following global naming services:

- DNS
- X.500 (via DAP or LDAP)

FNS Naming Policies

FNS defines naming policies so that users and applications can depend on and use the shared namespace.

Within an enterprise, there are namespaces for organizational units, sites, hosts, users, files and services, referred to by the names `orgunit`, `site`, `host`, `user`, `fs` (for file system), and `service`. These namespaces can also be named by preceding each name with an underscore (_). For example, `host` and `_host` are considered identical.

Table A–1 summarizes the FNS policies for enterprise-level namespaces.

TABLE A–1 FNS Policy Summary

Context Type	Subordinate Contexts	Parent Contexts
`orgunit _orgunit`	`site user host fs service`	enterprise root
`site _site`	`user host fs service`	enterprise root `orgunit`

TABLE A–1 FNS Policy Summary *(Continued)*

Context Type	Subordinate Contexts	Parent Contexts
`user _user`	`service fs`	enterprise root
		`orgunit`
`host _host`	`service fs`	enterprise root
		`orgunit`
`service _service`	Printer and other applications	enterprise root
		`orgunit site user host`
`fs _fs`(file system)	(none)	enterprise root`orgunit site user host`

Organization Names

The binding of an FNS `orgunit` is determined by the underlying naming service:

- Under NIS+, an organizational unit corresponds to an NIS+ domain or subdomain. For example, assume that the NIS+ root domain is `doc.com.` and `sales` is a subdomain of `doc.com.` Then, the FNS names `org/sales.doc.com.` and `org/sales` both refer to the organizational unit corresponding to the NIS+ domain `sales.doc.com.` (Note the trailing dot in `sales.doc.com.`which is required for fully qualified NIS+ names.)
- Under NIS, an organizational unit is the NIS domain which is always identified by the FNS name `org//` or `org/`*domainname* where *domainname* is a fully qualified domain name such as `doc.com.`. Under NIS, there is no hierarchy in organizational unit names.
- Under a files-based naming system, the organizational unit is the system which is always identified by the FNS name `org//`.

The types of objects that may be named relative to an organizational unit name are: `user`, `host`, `service`, `fs`, and `site`. For example:

- `org/sales/site/conference1.bldg-6` names a conference room `conference1` located in building #6 of the site associated with the organizational unit `sales`. In this example, if `org/sales` corresponds to `sales.doc.com.`, another way to name this object would be: `org/sales.doc.com./site/conference1.bldg-6` (note the trailing dot in `sales.doc.com.`)
- `org/finance/user/mjones` names a user `mjones` in the organizational unit `finance`.
- `org/finance/host/inmail` names a machine `inmail` belonging to the organizational unit `finance`.

- `org/accounts.finance/fs/pub/reports/FY92-124` names a file `pub/reports/FY92-124` belonging to the organizational unit `accounts.finance`.
- `org/accounts.finance/service/calendar` names the calendar service of the organizational unit `accounts.finance`. This might manage the meeting schedules of the organizational unit.

Site Names

Site names are created as needed. The types of objects that may be named relative to a site name are: `user`, `host`, `service` and `fs`. For example:

- `site/alameda/user/mjones` names a user `mjones` at the site `alameda`.
- `site/alameda/host/sirius` names a machine `sirius` at the site `alameda`.
- `site/alameda/service/printer/Sparc-2` names the printer `Sparc-2` at the site `alameda`.
- `site/alameda/fs/usr/dist` names a file directory `usr/dist` available in the site `alameda`.

User Names

User names correspond to names in the corresponding `passwd` table in NIS+, the passwd map in NIS, or the `/etc/passwd` file under files. A user's file context is obtained from his or her `passwd` entry.

The types of objects that may be named relative to a user name are: `service`, and `fs`. For example:

- `user/chou/service/fax` names the fax service of the user `chou`.
- `user/esperanza/fs/projects/conf96.doc` names the file `conf96.doc` in the `projects` subdirectory of the user `esperanza`'s file system.

Host Names

Host names correspond to names in the corresponding `hosts` table in NIS+, the `hosts` map in NIS, or the `/etc/hosts` file under files. The host's file context corresponds to the files systems exported by the host.

The types of objects that may be named relative to a host name are: `service`, and `fs`. For example:

- `host/smtp-1/service/mailbox` names the mailbox service associated with the machine `smtp-1`.
- `host/deneb/fs/etc/.cshrc` names the file `.cshrc` in the `/etc` directory on the host `deneb`.

Service Names

Service names correspond to, and are determined by, service applications. The service context must be named relative to an organization, user, host, or site context. For example:

- `org//service/printer` names the organization's printer service.
- `host/deneb/service/printer` names the printer service associated with the machine `deneb`.
- `host/deneb/service/printer/Sparc-2` names the printer associated with the machine `deneb`.
- `user/charlie/service/calendar` names the user `charlie`'s calendar service.
- `site/conf_pine.bldg-7.alameda/service/calendar` names the calendar service for the conf_pine conference room in Building 7 at the Alameda site.

File Names

File system names correspond to file names. For example:

- `host/altair/fs/etc/.login` names the `.login` file on the machine `altair`.
- `user/prasad/fs/projects/96draft.doc` names the file `96draft.doc` in the user `prasad`'s `projects` directory.

Getting Started

To begin using FNS with your underlying name service, you run the `fncreate` command.

The `fncreate` command recognizes the underlying naming service in which FNS contexts are to be created (such as, NIS+, NIS, or files). To specify a specific naming service, you must run the `fnselect` command as explained in "Designating a Non-Default Naming Service" on page 478..

Designating a Non-Default Naming Service

By default:

- If `fncreate` is executed on a machine that is an NIS+ client or server, the FNS namespace will be set up in NIS+. (See "How to Replicate FNS Under NIS+" on page 507 if you want or need to designate some other machine as an FNS NIS+ master server.)
- If the machine is an NIS client, the namespace will be set up in NIS.
- If the machine is neither, the namespace will be set up in the machine's `/var/fn` directory. When your underlying naming system is files-based, the common practice is to create `/var/fn` by running `fncreate` on each machine. It is possible however to create `/var/fn` on one machine and export it by NFS to be mounted by other clients.

You can also explicitly specify a non-default target naming service by using the `fnselect` command. For example the following command selects the target naming service to be NIS.

```
# fnselect nis
```

Creating the FNS Namespace

Once the naming service has been selected either using the default policy or explicitly via `fnselect`, you can execute the following command to create the FNS namespace:

```
# fncreate -t org org//
```

This creates all the necessary contexts for users and hosts in the corresponding naming service.

NIS+ Considerations

When your primary enterprise-level naming service is NIS+, take into account the following points.

NIS+ Domains and Subdomains

The command syntax shown above creates the FNS namespace for the root NIS+ domain. To specify a domain other than the root, add the domain name between the double slashes, as in:

```
# fncreate -t org org/sales.doc.com./
```

Note the trailing dot after the fully qualified `sales.doc.com.` domain name.

Space and Performance Considerations

The `fncreate` commands creates NIS+ tables and directories in the `ctx_dir` directory. The `ctx_dir` directory object resides at the same level as the NIS+ `groups_dir` and `org_dir` directory objects of the domain.

- With a large domain, the additional space required on the NIS+ server could be substantial and in a large installation performance might be improved by using separate servers for FNS and the standard NIS+ tables. See for information on how to use separate servers for FNS and NIS+.
- In a large, or mission-critical domain, FNS service should be replicated. See "Replicating FNS Service" on page 507for information on how to replicate FNS service.

NIS+ Security Requirements

The user who runs `fncreate` and other FNS commands is expected to have the necessary NIS+ credentials.

The environment variable `NIS_GROUP` specifies the group owner for the NIS+ objects created by `fncreate`. In order to facilitate administration of the NIS+ objects, `NIS_GROUP` should be set to the name of the NIS+ group responsible for FNS administration for that domain prior to executing `fncreate` and other FNS commands.

Changes to NIS+ related properties, including default access control rights, could be effected using NIS+ administration tools and interfaces after the context has been created. The NIS+ object name that corresponds to an FNS composite name can be obtained using `fnlookup` and `fnlist`, described later in this document.

NIS Considerations

The `fncreate` command must be executed by superuser on the NIS system that will serve as the NIS master server for the FNS maps.

The NIS maps used by FNS are stored in `/var/yp/`*domainname*.

Any changes to the FNS information can only be done by the superuser on the FNS NIS master server using FNS commands.

Files Considerations

When using `fncreate` with the `-t org` option to create your FNS namespace, the command must be executed by superuser on the machine that owns the file system on which `/var` is located. The files used by FNS are stored in the `/var/fn` directory.

Once users' contexts are created, users are allowed to modify their own contexts based on their UNIX credentials.

If exported, the file system `/var/fn` can be mounted by other systems to access the FNS namespace.

Browsing the FNS Namespace

Once the namespace has been set up, you can browse using the following commands:

- `fnlist` to list context contents (see "Listing Context Contents" on page 480)
- `fnlookup` to display the bindings of a composite name (see "Displaying the Bindings of a Composite Name" on page 481).
- `fnattr` to show the attributes of a composite name (see "Showing the Attributes of a Composite Name" on page 481).

Listing Context Contents

The `fnlist` command displays the names and references bound in the context of *name*.

```
fnlist [-lvA] [name]
```

TABLE A–2 `fnlist` Command Options

Option	Description
name	A composite name. Displays the names bound in the context of *name*
`-v`	Verbose. Displays the binding in more detail
`-l`	Also displays the bindings of the names bound in the named context
`-A`	Forces `fnlist` to obtain its information from the authoritative server. Under NIS and NIS+, that is the domain master server. The `-A` option has no effect when the primary naming service is files.

For example:

To list names in the initial context:

```
% fnlist
```

To list in detail all the users in the current organizational unit:

```
% fnlist -v user
```

To list the contents of the `service` context for the user `pug`:

```
% fnlist user/pug/service
```

To list names and bindings from the authoritative server:

```
% fnlist -l -A
```

Displaying the Bindings of a Composite Name

The `fnlookup` command shows the binding of the given composite name.

`fnlookup [-vAL] [`*name*`]`

TABLE A–3 `fnlookup` Command Options

Option	Description
name	The name of a context. Displays the binding and XFN link of *name*
`-v`	Verbose. Displays the binding in more detail
`-L`	Also displays the XFN link that the name is bound to
`-A`	Forces `fnlist` to obtain its information from the authoritative server. Under NIS and NIS+, that is the domain master server. The `-A` option has no effect when the primary naming service is files-based.

For example: to display the binding of `user/ana/service/printer`:

```
# fnlookup user/ana/service/printer
```

Showing the Attributes of a Composite Name

The `fnattr` command displays (and updates) the attributes of the given composite name.

For example, to search for the attributes associated with a user named `ada`:

```
# fnattr user/ada
```

To search for the attributes associated with a printer named `laser-9`:

```
# fnattr thisorgunit/service/printer/laser-9
```

See "Working With Attributes" on page 489 for more details.

Searching for FNS Information

The `fnsearch` command displays the names and, optionally, the attributes and references of objects bound at or below a composite name whose attributes satisfy the given search criteria.

For example:

To list the users and their attributes who have an attribute called `realname`:

```
% fnsearch user realname
```

To list the users with the attribute `realname` whose value is `Ravi Chattha`:

```
% fnsearch user "realname == 'Ravi Chattha'"
```

The `fnsearch` command uses the common Boolean operators. Note the use of double and single quotes and double equals sign in the above example.

Updating the Namespace

Once the namespace has been set up, you can add, delete, and modify elements using the following commands:

- `fnbind` to bind new references to a composite name (see "Binding a Reference to a Composite Name" on page 483).
- `fnunbind` to remove bindings (see "Removing Bindings" on page 485).
- `fncreate` to create new organization, user, host, site, and service contexts (see "Creating New Contexts" on page 485).
- `fncreate_fs` to create new file system contexts (see "Creating File Contexts" on page 486).
- `fncreate_printer` to create new printer contexts (see "Creating Printer Contexts" on page 487).
- `fndestroy` to destroy contexts (see "Destroying Contexts" on page 488).

- `fnattr` to display, create, modify, and remove attributes (see "Working With Attributes" on page 489).
- `fncopy` to copy FNS contexts and attributes from one naming service to another (see "Copying and Converting FNS Contexts" on page 490).

FNS Administration Privileges

FNS System administration varies according to the underlying naming service:

- *NIS+*. Under NIS+, FNS system administration tasks can only be performed by those with authorization to do so. The usual method of granting system administration privileges is to create an NIS+ group and assign that group the necessary privileges for that domain. Any member of the group can then perform system administration functions.
- *NIS*. Under NIS, FNS administration tasks must be performed by `root` on the NIS master server.
- *Files*. Under a files-based naming system, FNS administration tasks must be performed by someone with `root` access to the `/var/fn` directory.

The ability of users to make changes to their own user sub-contexts varies according to the underlying naming service:

- *NIS+*. Under NIS+, a user's context (and associated sub-contexts) are owned by them. When logged in as an NIS+ principle, users who have the appropriate credentials and privileges can make changes to their own context using the `fncreate`, `fnbind`, `fnunbind`, and similar commands.
- *NIS*. Under NIS, users cannot make any changes to any FNS data. Only those with `root` access on the NIS master server can change FNS data.
- *Files*. Under a files-based naming system, users own their own contexts. Standard UNIX access controls apply to FNS files.

Binding a Reference to a Composite Name

The `fnbind` command is used to bind an existing reference (name) to a new composite name.

`fnbind -r [-s][-v][-L]` *name* `[-O|-U]` *newname reftype addrtype* `[-c|-x]` *address*

TABLE A–4 `fnbind` Command Options

Option	Description
name	The existing composite name

TABLE A–4 `fnbind` Command Options *(Continued)*

Option	Description
newname	The composite name of the new binding
addrtype	Address type to use. Applications-specific such as `onc_cal_str`.
address	Address contents to use. For example, `tsvi@altair`.
reftype	Reference type to use. Applications-specific such as `one_calendar`.
`-s`	Bind to *newname* even if it is already bound. This replaces the previous binding of *newname*. Without `-s`, fnbind fails if *newname* is already bound.
`-v`	Display the reference that will be bound to *newname*.
`-L`	Create an XFN link using *oldname* and bind it to *newname*.
`-r`	Bind *newname* to the reference constructed by the command line arguments.
`-c`	Store *address* contents in the form as entered, do not use XDR-encoding.
`-x`	Convert *address* to a hexadecimal string without converting it to XDR-encoding.
`-O`	The identifier format is FN_ID_ISO_OID_STRING, an ASN.1 dot-separated integer list string.
`-U`	The identifier format is FN_ID_DCE_UUID, a DCE UUID in string form.

For example:

To add a calendar binding for the user `jamal`:

```
# fnbind -r user/jamal/service/calendar onc_calendar onc_cal_str
 jamal@cygnus
```

To replace the existing binding of `org//service/Sparc-4` with that of `org//service/printer`:

```
# fnbind -s org//service/printer org//service/Sparc-4
```

To copy the reference `site/bldg-5/service/printer` to `user/ando/service/printer`:

```
# fnbind site/bldg-5/service/printer user/ando/service/printer
```

To bind the reference `site/bldg-5/service/printer` to `user/ando/service/printer` using a symbolic link:

```
# fnbind -L site/bldg-5/service/printer user/ando/service/printer
```

To bind the name `thisens/service/calendar` to the address `staff@altair`, when `staff@altair` is a reference of the type `onc_cal` and an address of the type `onc_cal_str`:

```
# fnbind -r thisens/service/calendar onc_calendar onc_cal_str staff@altair
```

To bind *newname* to the reference constructed by its command line *address*

```
# fnbind -r [-sv] newname [-O|-U] reftype {[-O|-U] addrtype [-c|-x] address}
```

Removing Bindings

The `fnunbind` *name* command is used to remove bindings.

For example: to remove the binding for `user/jsmith/service/calendar`:

```
# fnunbind user/jsmith/service/calendar
```

Creating New Contexts

The `fncreate` command is used to create contexts.

```
fncreate -t context [-f file] [-o] [-r reference] [-s] [-v] [-D] name
```

TABLE A–5 `fncreate` Command Options

Option	Description
`-t` *context*	Create context of type *context*. *Context* types can be: `org`, `hostname`, `host`, `username`, `user`, `service`, `fs`, `site`, `nsid`, and `generic`.
`-f` *file*	Use an input file to list users and hosts for whom to create contexts.
`-r` *reference*	Type of reference. The `-r` *reference* option can only be used with `-t generic`.
name	A composite name
`-o`	Create only the context identified by *name*.
`-s`	Overwrite (supersede) any existing binding. If `-s` is not used, `fncreate` will fail if name is already bound.
`-D`	Display information about each context and corresponding tables, directories, and files as it is created.
`-v`	Verbose. Display information about each context as it is displayed.

For example:

To create a context and subcontexts for the root organization:

```
# fncreate -t org org//
```

To create a context, and subcontexts, for the host `deneb`:

```
# fncreate -t host host/deneb
```

To create a context, service and file subcontexts, and then add a calendar binding for the user `sisulu`:

```
# fncreate -t user user/sisulu
# fnbind -r user/sisulu onc_calendar onc_cal_str sisulu@deneb
```

To create a site context for the `sales` organization:

```
# fncreate -t site org/sales/site/
```

The site context supports a hierarchal namespace, with dot-separated right-to-left names, which allows sites to be partitioned by their geographical coverage relationships. For example, to create a site context `alameda` and a site subcontext `bldg-6.alameda` for it:

```
# fncreate -t site org/sales/site/alameda
# fncreate -t site org/sales/site/bldg-6.alameda
```

Creating File Contexts

- The `fncreate_fs` command creates file contexts for organizations and sites with the description of the binding entered from the command line.

  `fncreate_fs [-r] [-v]` *name* `[`*options*`] [`*mount*`]`

- The `fncreate_fs` command creates file contexts for organizations and sites with the description of the bindings supplied by an input file.

  `fncreate_fs [-r] [-v] -f` *file name*

TABLE A–6 `fncreate_fs` Command Options

Option	Description
name	The name of the file context
options	Mount options
mount	Mount location
`-f` *file*	Input file

TABLE A–6 `fncreate_fs` Command Options *(Continued)*

Option	Description
`-v`	Verbose. Displays information about the contexts being created
`-r`	Replace the bindings in the context *name* with those specified in the input.

For example:

To create a file system context named `data` for the `sales` organization bound to the `/export/data` path of an NFS server named `server4`.

```
# fncreate_fs org/sales/fs/data server4:/export/data
```

To create a hierarchy of file system contexts for the `sales` organization named `buyers` and `buyers/orders` mounted on two different servers:

```
# fncreate_fs org/sales/fs/buyers server2:/export/buyers
# fncreate_fs org/sales/fs/buyers/orders server3:/export/orders
```

To create a file system context named `leads` for the `sales` organization bound to a server and path specified by an input file named `input_a`:

```
# fncreate_fs -f input_a org/sales/fs/leads
```

(See the `fncreate_fs` man page for information on input file format.)

Creating Printer Contexts

The `fncreate_printer` command creates printer contexts for organizations, users, hosts and site contexts. The printer context is created under the service context of the respective composite name.

`fncreate_printer [-vs]` *name printer* `[`*prntaddr*`]`

`fncreate_printer [-vs] [-f [`*file*`]]` *name*

TABLE A–7 `fncreate_printer` Command Options

Option	Description
name	The name of the org, host, user, or site of the printer
printer	The name of the printer
prntaddr	The printer address in the form `<addresstype>=<address>`

TABLE A–7 `fncreate_printer` Command Options *(Continued)*

Option	Description
`-f` *file*	Use the named *file* as input for a list of printers to be created. The input file is in the format of the `/etc/printers.conf` file. If neither a printer *name* nor a `-f` *file* is specified, `fncreate_printer` uses the `/etc/printer.conf` file on the machine where `fncreate_printer` is run as a default input file.
`-s`	Replace an existing address with the same address-type.
`-v`	Verbose. Displays the binding in more detail

For example:

To create printers for the `sales` organization based on the printers listed in the `/etc/printers.conf` file of the machine on which `fncreate_printer` is run:

```
# fncreate_printer -s org/sales/
```

Assume that the machine `altair` is the server for a printer named `Sparc-5`. To create a printer named `invoices` for the user `nguyen` that is actually the `Sparc-5` printer:

```
# fncreate_printer user/nguyen invoices bsdaddr=altair,Sparc-5
```

It is also possible to organize printers hierarchically. For example, the `fncreate_printer` command can create printer contexts for the printers, `color`, `color/inkjet` and `color/Sparc` with the resulting contexts:

```
org/doc.com/service/printer/color
org/doc.com/service/printer/color/inkjet
org/doc.com/service/printer/color/Sparc
```

To create the above contexts, you would run:

```
# fncreate_printer org/doc.com color bsdaddr=colorful,color
# fncreate_printer org/doc.com color/inkjet bsdaddr=colorjet,inkjet
# fncreate_printer org/doc.com color/Sparc bsdaddr=colorprt,Sparc
```

Destroying Contexts

The `fndestroy` command is used to destroy empty contexts.

For example, to destroy the `service` context of the user `patel`:

```
# fndestroy user/patel/service
```

Working With Attributes

The `fnattr` command can be used to add, delete or modify attributes associated with a name. You can make modifications one at a time, or batch several within the same command.

- `fnattr` [`-l`] *name* to list attributes for *name*.
- `fnattr` *name* `-a -s -U -O` *attrib values* to add an attribute
- `fnattr` *name* `-m -O -U` *attrib oldvalue newvalue* to modify an attribute
- `fnattr` *name* `-d -O | -U` [*values attrib*] to destroy an attribute

TABLE A–8 `fnattr` Command Options

Option	Description
name	The composite name
attrib	The identifier of an attribute
values	One or more attribute values
oldvalue	An attribute value to be replaced by a new value
newvalue	The attribute value that replaces an old value
`-a`	Add an attribute
`-d`	Destroy an attribute
`-l`	List attributes
`-m`	Modify an attribute
`-s`	Replace all old attribute values with the new values for the attribute specified.
`-O`	The identifier format is FN_ID_ISO_OID_STRING, an ASN.1 dot-separated integer list string.
`-U`	The identifier format is FN_ID_DCE_UUID, a DCE UUID in string form.

For example:

To show all of the attributes associated with the user name `rosa`:

```
# fnattr user/rosa
```

To display the `size` attribute associated with the user `uri`:

```
# fnattr user/uri/ size
```

For a user named `devlin`, to add an attribute named `shoesize` with a value of `small`, delete the `hatsize` attribute, and change the `dresssize` attribute value from `12` to `8`:

```
# fnattr user/devlin -a shoesize small -d hatsize -m dresssize 12 8
```

Federating a Global Namespace

You can federate NIS+ or NIS to a global naming service like DNS and X.500.

To federate an NIS+ or NIS namespace under DNS or X.500, you first need to obtain the root reference for the NIS+ hierarchy or NIS domain.

From the point of view of the global name service, the root reference is known as the *next naming system reference* because it refers to the next naming system beneath the DNS domain or X.500 entry. To federate NIS+ or NIS with a global name service, you add the root reference information to that global service.

Once you have added the root reference information to the global service, clients outside of your NIS+ hierarchy or NIS domain can access and perform operations on the contexts in the NIS+ hierarchy or NIS domain. Foreign NIS+ clients access the hierarchy as unauthenticated NIS+ clients.

For example:

If NIS+ is federated underneath the DNS domain doc.com., you can now list the root of the NIS+ enterprise using the command

```
# fnlist .../doc.com/
```

If NIS+ is federated underneath the X.500 entry `/c=us/o=doc`, you can list the root of the NIS+ enterprise using the command:

```
# fnlist .../c=us/o=doc/
```

Note the mandatory trailing slash in both examples.

Copying and Converting FNS Contexts

The `fncopy` command can be used to copy or convert an FNS context and attributes to a new FNS context.

By using the `-i` and `-o` options, you can copy FNS contexts based on one underlying enterprise-level name service to a context based on a different underlying name

service. For example, if you have an FNS installation running on top of NIS, and you upgrade your NIS service to NIS+, you can use `fncopy` to create a new context using NIS+.

Note that:

- If the new FNS context that you are copying an old context to already exists for the target name service, only new contexts and bindings are copied. The contexts are not over-written or changed
- `fncopy` does not follow links, but copies the FNS link bound to a name to the new context namespace.

TABLE A–9 `fncopy` Command Options

Option	Description
`-i` *oldservice*	The old (input) underlying enterprise-level name service. For example, `-i nis` specifies that the old service is NIS. Allowed values are `files`, `nis`, `nisplus`.
`-o` *newservice*	The new (output) underlying enterprise-level name. For example, `o nisplus` specifies that the new service is NIS+. Allowed values are `files`, `nis`, `nisplus`.
`-f` *filename*	A text file listing FNS contexts to be copied. In the absence of the `-i` and `-o` options, contexts must be identifies using global names.
oldcontext	The name of the context being copied
newcontext	The name of the context being created or copied to.

For example, to copy the `doc.com` printer contexts (and sub-contexts) and bindings to `orgunit/east/doc.com`:

```
# fncopy .../doc.com/service/printer .../doc.com/orgunit/east/service/printer
```

To copy the NIS FNS users' contexts specified in the file `user_list` to an NIS+ FNS users' context of the `orgunit west/doc.com`:

```
# fncopy -i nis -o nisplus -f /etc/user_list thisorgunit/user org/doc.com/user
```

Namespace Browser Programming Examples

The programming examples in this section shows the usage of XFN APIs to perform the following operations:

Listing Names Bound in a Context

The example below shows XFN operations to list a context.

```
#include <stdio.h>
#include <xfn/xfn.h>
#include <string.h>
#include <stdlib.h>
/*
 This routine returns the list of names
 bound under the given context (ctx_name).
 Examples of ctx_name are "user", "thisorgunit/service",
    host/alto/service, user/jsmit/service/calendar, etc.,
*/
typedef struct fns_listing {
    char *name;
    struct fns_listing *next;
} fns_listing;
fns_listing *
fns_list_names(const char *ctx_name)
{
    FN_status_t *status;
    FN_ctx_t *initial_context;
    FN_composite_name_t *context_name;
    FN_namelist_t *name_list;
    FN_string_t *name;
    unsigned int stat;
    fns_listing *head = 0, *current, *prev;
    int no_names = 0;
    status = fn_status_create();
    /* Obtain the initial context */
    initial_context = fn_ctx_handle_from_initial(0, status);
    if (!fn_status_is_success(status)) {
        fprintf(stderr, "Unable to obtain intial context\n");
```

```
        return (0);
    }
    context_name = fn_composite_name_from_str((unsigned char *)
                   ctx_name);
    /* FNS call to list names */
    name_list = fn_ctx_list_names(initial_context, context_name,
                status);
    if (!fn_status_is_success(status)) {
        fprintf(stderr, "Unable to list names\n");
        return (0);
    }
    /* Obtain the names individually */
    while (name = fn_namelist_next(name_list, status)) {
        no_names++;
        current = (fns_listing *) malloc(sizeof(fns_listing));
        current->name = (char *)
         malloc(strlen((char *) fn_string_str(name, &stat)) + 1);
        strcpy(current->name, (char *) fn_string_str(name, &stat));
        current->next = 0;
        if (head) {
            prev->next = current;
            prev = current;
        } else {
            head = current;
            prev = current;
        }
        fn_string_destroy(name);
    }
    fn_namelist_destroy(name_list);
    fn_status_destroy(status);
    fn_ctx_destroy(initial_context);
    return (head);
```

Creating a Binding

Example A–1 shows how to create a binding.

EXAMPLE A–1 Creating a Binding

```
#include <stdio.h>
#include <xfn/xfn.h>
#include <string.h>
/*
 This routine creates a binding with a name provided by "name"
 and having a reference type "reference_type" and address type
 "address_type".
 An example of using the function could be:
     fns_create_bindings(
     "user/jsmith/service/calendar",
     "onc_calendar",
     "onc_cal_str",
```

EXAMPLE A–1 Creating a Binding *(Continued)*

```
     "jsmith&calserver");
*/
int fns_create_bindings(
 char *name,
 char *reference_type,
 char *address_type,
 char *data)
{
    int return_status;
    FN_composite_name_t *binding_name;
    FN_identifier_t ref_id, addr_id;
    FN_status_t *status;
    FN_ref_t *reference;
    FN_ref_addr_t *address;
    FN_ctx_t *initial_context;
    /* Obtain the initial context */
    status = fn_status_create();
    initial_context = fn_ctx_handle_from_initial(0, status);
    /* Check status for any error messages */
    if ((return_status = fn_status_code(status)) != FN_SUCCESS) {
        fprintf(stderr, "Unable to obtain the initial context\n");
        return (return_status);
    }
    /* Get the composite name for the printer name */
    binding_name = fn_composite_name_from_str((unsigned char *) name);
    /* Construct the Address */
    addr_id.format = FN_ID_STRING;
    addr_id.length = strlen(address_type);
    addr_id.contents = (void *) address_type;
    address = fn_ref_addr_create(&addr_id,
        strlen(data), (const void *) data);
    /* Construct the Reference */
    ref_id.format = FN_ID_STRING;
    ref_id.length = strlen(reference_type);
    ref_id.contents = (void *) reference_type;
    reference = fn_ref_create(&ref_id);
    /* Add Address to the Reference */
    fn_ref_append_addr(reference, address);

    /* Create a binding */
    fn_ctx_bind(initial_context, binding_name, reference, 0, status);
    /* Check the error status and return */
    return_status = fn_status_code(status);
    fn_composite_name_destroy(binding_name);
    fn_ref_addr_destroy(address);
    fn_ref_destroy(reference);
    fn_ctx_destroy(initial_context);
    return (return_status);
}
```

Listing and Working Wtih Object Attributes

The examples below show techniques to list and work with attributes of an object.

Listing an Object's Attributes

The example below shows how to list the attributes of an object.

```
#include <stdio.h>
#include <xfn/xfn.h>
/*
 This routine prints all the attributes associated
 with the named object to the standard output.
 Examples of using the function:
     fns_attr_list("user/jsmith");
    fns_attr_list("thisorgunit/service/printer/color");
*/
void fns_attr_list(const char *name)
{
    FN_composite_name_t *name_comp;
    const FN_identifier_t *identifier;
    FN_attribute_t *attribute;
    const FN_attrvalue_t *values;
    char *id, *val;
    FN_multigetlist_t *attrset;
    void *ip;
    FN_status_t *status;
    FN_ctx_t *initial_context;
    name_comp = fn_composite_name_from_str((unsigned char *) name);
    status = fn_status_create();
    /* Obtain the initial context */
    initial_context = fn_ctx_handle_from_initial(0, status);
    if (!fn_status_is_success(status)) {
        fprintf(stderr, "Unable to obtain intial context\n");
        return;
    }
    /* Obtain all the attributes */
    attrset = fn_attr_multi_get(initial_context, name_comp, 0, 0,
            status);
    if (!fn_status_is_success(status)) {
        fprintf(stderr, "Unable to obtain attributes\n");
        return;
    }
    /* List all attributes */
    while (attribute = fn_multigetlist_next(attrset, status)) {
        identifier = fn_attribute_identifier(attribute);
        switch(identifier->format) {
        case FN_ID_STRING:
            id = (char *) malloc(identifier->length + 1);
            memcpy(id, identifier->contents, identifier->length);
            id[identifier->length] = '\0';
            printf("Attribute Identifier: %s", id);
```

```
            free(id);
            break;
        default:
            printf("Attribute of non-string format\n\n");
            continue;
        }
        for (values = fn_attribute_first(attribute, &ip);
         values != NULL;
         values = fn_attribute_next(attribute, &ip)) {
            val = (char *) malloc(values->length + 1);
            memcpy(val, values->contents, values->length);
            val[values->length] = '\0';
            printf("Value: %s", val);
            free(val);
        }
        fn_attribute_destroy(attribute);
        printf("\n");
    }
    fn_multigetlist_destroy(attrset);
    fn_ctx_destroy(initial_context);
    fn_status_destroy(status);
    fn_composite_name_destroy(name_comp);
}
```

Adding, Deleting, and Modifying an Object's Attributes

The example below shows how to add, delete, or modify an object's attributes.

```
#include <stdio.h>
#include <xfn/xfn.h>
/*
 This routine modifies an attribute associated
 with the named object. The modify operation supported are:
     FN_ATTR_OP_ADD
 FN_ATTR_OP_ADD_EXCLUSIVE
 FN_ATTR_OP_REMOVE
 FN_ATTR_OP_ADD_VALUES
 FN_ATTR_OP_REMOVE_VALUES
 The function assumes the attribute values to be strings.
 Examples of using the function:
 The following function add an attribute of identifier "realname"
 with value "James Smith" to the user object "user/jsmith".
     fns_attr_modify(
        "user/jsmith",
        "realname",
        "James Smith",
        FN_ATTR_OP_ADD);
 The following function removes an attribute of identifier
 "location" from the printer object
 "thisorgunit/service/printer/color".
     fns_attr_modify(
        "thisorgunit/service/printer/color",
```

```
        "location",
        NULL,
        FN_ATTR_OP_REMOVE);
*/
static const char *attr_id_syntax = "fn_attr_syntax_ascii";
void fns_attr_modify(const char *name,
    const char *attr_id,
    const char *attr_value,
    unsigned int operation)
{
    FN_composite_name_t *name_comp;
    FN_identifier_t identifier, syntax;
    FN_attrvalue_t *values;
    FN_attribute_t *attribute;
    FN_status_t *status;
    FN_ctx_t *initial_context;
    name_comp = fn_composite_name_from_str((unsigned char *) name);
    status = fn_status_create();
    /* Obtain the initial context */
    initial_context = fn_ctx_handle_from_initial(0, status);
    if (!fn_status_is_success(status)) {
        fprintf(stderr, "Unable to obtain intial context\n");
        return;
    }
    /* Create the attribute to be added */
    /* First, the identifier */
    identifier.format = FN_ID_STRING;
    identifier.length = strlen(attr_id);
    identifier.contents = (void *) strdup(attr_id);
    /* Second, the syntax */
    syntax.format = FN_ID_STRING;
    syntax.length = strlen(attr_id_syntax);
    syntax.contents = (void *) strdup(attr_id_syntax);
    /* Third, the attribute value */
    if (attr_value) {
        values = (FN_attrvalue_t *) malloc(sizeof(FN_attrvalue_t));
        values->length = strlen(attr_value);
        values->contents = (void *) strdup(attr_value);
    } else
        values = NULL;
    /* Fourth, create the attribute */
    attribute = fn_attribute_create(&identifier, &syntax);
    /*Fifth, add the attribute value */
    if (values)
        fn_attribute_add(attribute, values, 0);

    /* Perform the XFN operation */
    fn_attr_modify(initial_context, name_comp, operation, attribute, 0,
status);
    if (!fn_status_is_success(status))
        fprintf(stderr, "Unable to perform attribute operation\n");
    fn_ctx_destroy(initial_context);
    fn_status_destroy(status);
    fn_composite_name_destroy(name_comp);
```

```
    fn_attibute_destroy(attribute);
    free(identifier.contents);
    free(syntax.contents);
    if (values) {
        free(values->contents);
        free(values);
 ]
]
```

Searching for Objects in a Context

The example below shows how to search for objects in a context with a specific attribute identifier and value.

```
#include <stdio.h>
#include <xfn/xfn.h>
#include <string.h>
#include <stdlib.h>
/*
 This routine searchs for objects in a context
 which has the specified attribute identifier and value.
*/
typedef struct fns_search_results {
    char *name;
    struct fns_search_results *next;
} fns_search_results;
static const char *attr_id_syntax = "fn_attr_syntax_ascii";
fns_search_results *
fns_attr_search(const char *name,
    const char *attr_id,
    const char *attr_value)
{
    FN_status_t *status;
    FN_ctx_t *initial_context;
    FN_composite_name_t *context_name;
    FN_searchlist_t *search_list;
    FN_string_t *search_name;
    FN_attribute_t *attribute;
    FN_attrset_t *attrset;
    FN_identifier_t identifier, syntax;
    FN_attrvalue_t *values;
    unsigned stat;
    fns_search_results *head = 0, *current, *prev;
    int no_names = 0;
    context_name = fn_composite_name_from_str((unsigned char *) name);
    status = fn_status_create();
    initial_context = fn_ctx_handle_from_initial(0, status);
    if (!fn_status_is_success(status)) {
        fprintf(stderr, "Unable to obtain intial context\n");
        return (0);
    }
```

```
/* Construnct the attrset with attributes to be searched */
/* First, the identifier */
identifier.format = FN_ID_STRING;
identifier.length = strlen(attr_id);
identifier.contents = (void *) strdup(attr_id);
/* Second, the syntax */
syntax.format = FN_ID_STRING;
syntax.length = strlen(attr_id_syntax);
syntax.contents = (void *) strdup(attr_id_syntax);
/* Third, the attribute value */
values = (FN_attrvalue_t *) malloc(sizeof(FN_attrvalue_t));
values->length = strlen(attr_value);
values->contents = (void *) strdup(attr_value);
/* Fourth, create the attribute */
attribute = fn_attribute_create(&identifier, &syntax);
/* Fifth, add the attribute value */
fn_attribute_add(attribute, values, 0);
/* Sixth, create attrset, and add the attribute */
attrset = fn_attrset_create();
fn_attrset_add(attrset, attribute, 0);
search_list = prelim_fn_attr_search(initial_context,
 context_name, attrset, 0, 0, status);
if (!fn_status_is_success(status)) {
    fprintf(stderr, "Unable to list names\n");
    return (0);
}
while (search_name = prelim_fn_searchlist_next(search_list,
 0, 0, status)) {
    no_names++;
    current = (fns_search_results *)
malloc(sizeof(fns_search_results));
    current->name = (char *)
     malloc(strlen((char *) fn_string_str(search_name, &stat)) + 1);
    strcpy(current->name, (char *) fn_string_str(search_name, &stat));
    current->next = 0;
    if (head) {
        prev->next = current;
        prev = current;
    } else {
        head = current;
        prev = current;
    }
    fn_string_destroy(search_name);
}
fn_searchlist_destroy(search_list);
fn_status_destroy(status);
fn_ctx_destroy(initial_context);
fn_attrset_destroy(attrset);
fn_attribute_destroy(attribute);
free(identifier.contents);
free(syntax.contents);
free(values->contents);
free(values);
return (head);
```

}

Setting Up FNS: An Overview

After your Solaris operating environment software is installed, you must perform the following tasks to set up FNS:

1. Make sure that your servers can handle FNS. See "Determining Resource Requirements" on page 500.
2. Prepare your namespace for FNS. See "Preparing the Namespace for FNS" on page 501.
3. Set up the FNS namespace contexts. There are two ways to do this:
   a. Globally create all contexts in one process. See "Creating Global FNS Namespace Contexts" on page 504.
   b. Individually create your FNS contexts.
4. Set up FNS replica servers. See "Replicating FNS Service" on page 507.

Depending on the size of the organization, you should allow several hours for the FNS setup to be completed, plus additional time for namespace preparation.

Determining Resource Requirements

Before proceeding with any installation procedure, you must first ensure that the servers supporting FNS have sufficient memory and disk storage. Space for FNS is in addition to the space needed for your enterprise-level name service (NIS+, NIS, or files).

As a general rule-of-thumb, you will need approximately 17 Kbytes of disk storage for each user and host, plus adequate swap space. Where this disk storage space is located and how it is calculated varies according to your underlying enterprise-level naming service:

- *NIS+*. The disk storage must be mounted on the machine that will function as the FNS server for the domain or subdomain. In an NIS+ environment, a server hosting the FNS `ctx_dir` directory does not have to be the same server hosting the standard NIS+ directories, such as `org_dir`. In order to more evenly distribute server load, many large installations choose to use separate machines for NIS+ and FNS servers. The amount of space needed on an FNS server in an NIS+

environment is determined by the number of users and hosts in the domain, or subdomain, for which the server provides naming.

- *NIS*. The disk storage must be mounted on the machine that will function as the FNS server for the domain. In an NIS environment, a server hosting FNS does not have to be the same server hosting NIS. In order to more evenly distribute server load, many large installations choose to use separate machines for NIS and FNS servers. The amount of space needed on an FNS server in an NIS environment is determined by the number of users and hosts in the domain.
- *Files-based*. When your enterprise-level name service is files-based, the amount of disk storage needed by FNS is determined by the number of users and hosts in `/etc/users` and `/etc/hosts` files of the machine mounting `/var/fn`. If every machine has its own `/var/fn` directory, then the amount of space needed is determined by each machine's user and host files. If `/var/fn` is mounted on one machine and exported to the rest of the machines on the network by NFS, the space needed by the machine hosting `/var/fn` is determined by the number of users and hosts in that machine's `/etc/users` and `/etc/hosts` files.

For example, to support an FNS environment in an NIS+ domain with 1200 users and hosts, you will need:

- A minimum of 20 Mbytes of disk space beyond the space needed by your underlying enterprise namespace (NIS+, NIS, or files-based).
- An additional 40 Mbytes of swap space

Preparing the Namespace for FNS

This section describes the preparations you need to make before running `fncreate` to set up your FNS contexts. The preparations vary according to your enterprise-level naming service.

Preparing the Namespace for FNS — Task Map

TABLE A–10 Preparing the Namespace for FNS

Task	Description	For Instructions, Go To
Preparing the Namespace for FNS	Convert files to NIS maps	"Working With NIS Maps" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

TABLE A–10 Preparing the Namespace for FNS *(Continued)*

Task	Description	For Instructions, Go To
Preparing the Namespace for FNS	Prepare NIS service	"How to Prepare NIS Service for FNS" on page 503
Preparing the Namespace for FNS	Prepare files-based naming	"Preparing Files-Based Naming for FNS" on page 503

▼ How to Prepare NIS+ Service for FNS

Before setting up the FNS namespace, do the following:

1. **Make sure that the NIS+ domain is properly set up.**

   The NIS+ domain and associated subdomains must already be set up before configuring FNS. In other words, NIS+ standard tables, such as `hosts` and `passwd`, must already exist and be populated.

2. **Make sure that the domain's `hosts.org_dir` and `passwd.org_dir` tables are fully populated with the names of every host and user.**

   You can use the `niscat` or `nismatch` commands to check the contents of these tables.

3. **Set the `NIS_GROUP` environment variable to the name of the group that will be administering the FNS objects.**

   The `fncreate` command will not let you complete the FNS setup without setting this variable first. When `fncreate` creates user and host contexts, they are owned by those hosts and users, and not by the administrator who executed the command. Setting `NIS_GROUP` allows the administrators who are members of the group to subsequently modify these contexts, even though they do not own the objects.

   Assuming a C-Shell, the example below sets `NIS_GROUP` to `fns_admins.doc.com`.

   ```
   rootmaster# setenv NIS_GROUP fns_admins.doc.com
   ```

4. **[Optional] Specify that FNS run on a machine other than the NIS+ master server.**

   All NIS+ objects used by FNS are kept under the `ctx_dir` directory of an NIS+ domain, at the same level as the domain's `org_dir` directory. For large domains, such as those with more than 5000 users and hosts, it is recommended (though not required) that the `ctx_dir` used by FNS be supported by a server different from the one supporting the standard NIS+ directories, such as `groups_dir`. Using separate servers avoids placing too much load on one server. It also allows you to keep separate the administration of FNS's use of NIS+ and the administration of NIS+ itself.

   To specify that FNS be hosted by a machine that is not the NIS+ master server for the domain, you must manually create a `ctx_dir` directory object on the machine that will serve as the FNS host for the domain. (If you omit this step, FNS will be installed on the domain's NIS+ root master server.)

To specify the machine that will become the FNS master server:

a. **Create the `ctx_dir` directory for the NIS+ domain.**

   For example, to create a `ctx_dir` directory on a machine named `fns_server` in the `doc.com` domain, run the following command on the domain's master server (note the trailing dot at the end of the domain name, as shown):

   ```
   nismaster# nismkdir -m fns_server ctx_dir.doc.com.
   ```

   (See "The `nismkdir` Command" on page 334 for more information on creating NIS+ directory objects with the `nismkdir` command.)

Note – If you are creating an FNS `ctx_dir` directory for a *subdomain*, the machine you specify as the FNS server hosting `ctx_dir` must reside *in* the subdomain, it cannot be a machine in the parent domain. (By contrast, a subdomain's NIS+ master server always resides in the domain *above* the one it serves.) In other words, when configuring FNS for an NIS+ subdomain, if you use the *same* server for both NIS+ and FNS, that server resides in the domain above the subdomain; but if you use *different* servers for NIS+ and FNS, the NIS+ master server resides in the domain above and the FNS server resides in the subdomain that it serves.

---

b. **Use the `nisls` command to verify that the `ctx_dir` directory has been created.**

   ```
   rootmaster # nisls doc.com.ctx_dir
   ```

c. **Run `nisping` to checkpoint the directory**

   ```
   # /usr/lib/nis/nisping -C ctx_dir.doc.com.
   ```

▼ How to Prepare NIS Service for FNS

Before setting up the FNS namespace, do the following:

- **Make sure that the `hosts.byname`, `user.byname`, and `printer.conf.byname` maps are complete, correct, and up to date.**

Note – You can assign a different master server for FNS maps, using the same procedure that you would to assign a different master for any other NIS map.

Preparing Files-Based Naming for FNS

Files-based naming refers to name services that obtain their data from `/etc` files rather than NIS+ or NIS.

If you are going to install a `/var/fn` directory on each machine, as is normally the case, the steps below must be performed on each machine. If you decide to mount and export the `/var/fn` directory from one machine, the steps below need to be performed on the machine that exports `/var/fn`.

- **Make sure that the `/etc/hosts` and `/etc/passwd` files are complete and contain the names of all users and hosts.**

Creating Global FNS Namespace Contexts

This section describes how to create your namespace globally for a given enterprise or NIS+ domain.

The FNS namespace is created by the `fncreate` command.

```
# fncreate -t org org//
```

Or, alternatively:

```
# fncreate -t org org/domain/
```

Where *domain* is the name of an NIS+ domain or subdomain.

The `fncreate` command creates the default contexts for the specified organization and all its subcontexts, including contexts and subcontexts for users and hosts in the organization.

Creating Global FNS Namespace Contexts — Task Map

TABLE A–11 Globally Creating FNS Namespace Contexts

Task	Description	For Instructions, Go To
Globally Creating FNS Namespace Contexts	Create FNS namespace under NIS+	"How to Create Namespace Contexts Under NIS+" on page 505
Globally Creating FNS Namespace Contexts	Create FNS namespace under NIS	"How to Create Namespace Contexts Under NIS" on page 506

TABLE A–11 Globally Creating FNS Namespace Contexts *(Continued)*

Task	Description	For Instructions, Go To
Globally Creating FNS Namespace Contexts	Create FNS namespace under files	"How to Create Namespace Contexts Under Local Files" on page 506

▼ How to Create Namespace Contexts Under NIS+

When your primary enterprise-level name service is NIS+, namespace contexts must be created separately for each NIS+ domain or subdomain in your enterprise.

- The NIS+ domain or subdomain must already exist.
- If you intend to use the same server for both NIS+ and FNS, you must run the `fncreate` command on the domain's (or subdomain's) master server. If you intend to use different servers for NIS+ and FNS, you must run the `fncreate` command on the machine that will function as the FNS server. (If you are going to use different machines, you must first prepare the FNS server, as explained in step 4.)
- You must have full NIS+ administration authorization.

For example, to create the contexts for the `manf.doc.com` subdomain on the `submaster` machine that is the NIS+ master server for that domain:

- **On the subdomain master, run `fncreate` as shown below:**

```
submaster# fncreate -t org org/manf.doc.com./
```

This creates the organization context for the NIS+ `manf.doc.com.` subdomain, and contexts and associated subcontexts for all users found in that subdomain's `passwd.org_dir` table and all hosts found in the subdomain's `hosts.org_dir` table.

(If you want to use different machines for NIS+ and FNS servers, run the above command on the machine you want to use as the FNS server. See step 4 for information on how to prepare a non-NIS+ server to be an FNS server.)

- **Use `nisping` to checkpoint the `ctx_dir` directory:**

```
# /usr/lib/nis/nisping -C ctx_dir.manf.doc.com.
```

Note – For a large organization with several thousand users and hosts, the initial `fncreate` operation can take several hours; the subsequent checkpoint can also take several hours.

▼ How to Create Namespace Contexts Under NIS

When your primary enterprise-level name service is NIS, there is only one domain for the enterprise. Namespace contexts are created for that enterprise-wide domain.

- The NIS domain must already exist.
- The `fncreate` command must be run by `root` on the FNS master server. (Normally, this would be the NIS master server, but you could choose to use a different server.)

For example, create the contexts for the `doc.com` domain, on the machine named `fns_master`, which is also the NIS master server:

- **On the domain master, run `fncreate` as shown below:**

```
fns_master# fncreate -t org org//
```

This creates the organization context for the NIS domain `doc.com`, and contexts and associated subcontexts for all users found in NIS servers's `passwd` map and all hosts found in the server's `hosts` map.

Note – After you have created your context maps, you can assign the same machine to be the master server, using the same procedure that you would to assign a different master for any other NIS map. The FNS maps all have names starting with `fns_` and ending with either `.ctx` or `.attr`.

▼ How to Create Namespace Contexts Under Local Files

When your primary enterprise-level name service is files-based, namespace contexts are created for the system.

- The `/etc/passwd` and `/etc/hosts` files on the machine where the `/var/fn` directory resides must be clean and fully populated.
- The `fncreate` command must be run by `root` on the machine where the `/var/fn` directory resides.

For example, to create the contexts for the system:

- **On the machine hosting the** `/var/fn` **directory, run** `fncreate`**, as shown below:**

  ```
  server1# fncreate -t org org//
  ```

  This creates the organization context for the system and contexts and associated subcontexts for all users found in machine's `/etc/passwd` file, and all hosts found in the machine's `/etc/hosts` file.

Replicating FNS Service

On large or mission-critical networks where performance and reliability of FNS naming is of vital importance, FNS service should be replicated.

Replicating FNS Service — Task Map

TABLE A–12 Replicating FNS Service

Task	Description	For Instructions, Go To
Replicating FNS Service	Replicate FNS service under NIS+	"How to Replicate FNS Under NIS+" on page 507
Replicating FNS Service	Replicate FNS service under NIS	"How to Replicate FNS Under NIS" on page 508
Replicating FNS Service	Replicate FNS service under files	"How to Replicate FNS Under Files-Based Naming" on page 509

▼ How to Replicate FNS Under NIS+

After the FNS namespace has been set up on the master server, additional replicas can be added in each domain to serve the domain's `ctx_dir` directory. Replicas enhance availability and performance of the servers.

1. **Run the** `nismkdir` **command on the FNS master server to add a replica for the** `ctx_dir` **directory.**

   For example, establish the machine `fnsrserver` as an FNS replica for the `doc.com.` domain:

   ```
   # nismkdir -s fnsrserver ctx_dir.doc.com.
   ```

2. **Checkpoint the `ctx_dir` directory with the `nisping` command.**

   ```
   # /usr/lib/nis/nisping -C ctx_dir.doc.com.
   ```

   FNS replicas should be checkpointed at regular intervals. The recommended period is every few days. The period you choose depends on how frequently changes are made to the FNS namespace.

▼ How to Replicate FNS Under NIS

After the FNS namespace has been set up on the domain master server, additional slave servers can be added to enhance availability and performance of the servers.

1. **As root, edit the `/etc/hosts` file on the slave server to add the name and IP addresses of all the other NIS servers.**

2. **Change directory to `/var/yp` on the slave server.**

3. **To initialize the slave server as a client, type the following:**

   ```
   # /usr/sbin/ypinit -c
   ```

   The `ypinit` command prompts you for a list of NIS servers. Enter the name of the local slave you are working on first, then the master server, followed by the other NIS slave servers in your domain in order, from the physically closest to the furthest (in network terms).

Note – You must first configure the new slave server as an NIS client so that it can get the NIS maps from the master for the first time. (See "Setting Up and Configuring NIS Service" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for details.)

---

4. **To determine if `ypbind` is running, type:**

   ```
   # ps -ef | grep ypbind
   ```

   If a listing is displayed, `ypbind` is running.

5. **If `ypbind` is running, stop it by typing:**

   ```
   # /usr/lib/netsvc/yp/ypstop
   ```

6. **Type the following to restart `ypbind`:**

   ```
   # /usr/lib/netsvc/yp/ypstart
   ```

7. **To initialize this machine as a slave, type the following:**

   ```
   # /usr/sbin/ypinit -s master
   ```

   Where *master* is the machine name of the existing NIS master server.

8. **Stop** `yp` **processes on the Slave Server:**

   ```
   # /usr/lib/netsvc/yp/ypstop
   ```

9. **Restart** `yp` **service:**

   ```
   # /usr/lib/netsvc/yp/ypstart
   ```

   Alternatively, you can reboot the slave server and allow daemons to start automatically.

▼ How to Replicate FNS Under Files-Based Naming

There is no server replication when your primary naming service is files-based.

FNS Administration, Problem Solving, and Error Messages

FNS Error Messages

FNS messages are encapsulated in the `FN_status_t` object as status codes. See the `FN_status_t` man page for the corresponding status codes

When an error occurs, FNS commands print out the remaining part of the name on which the operation failed. The part of the name that has not been printed has been processed successfully.

For example, a user attempted to create a context for `org//service/trading/bb`. The name `org//service/` was resolved successfully, but `trading` was not found in the context named by `org//service/`. Thus, `trading/bb` is displayed as the part of the name that remains when the operation failed:

```
Error in creating 'org//service/trading/bb': Name Not Found: 'trading/bb'
```

In another example, a user attempted to destroy the context `org//service/dictionary/english`, but could not carry out the operation

because the context named was not empty. The pair of single quotes (`''`) indicates that FNS was able to resolve the complete name given, but could not complete the operation as requested:

```
Error in destroying 'org//service/dictionary/english': Context Not Empty: ''
```

DNS Text Record Format for XFN References

The Solaris environment conforms to the XFN specification for federating global naming systems within DNS. In order to federate a naming system under DNS, you need to enter information into DNS TXT resource records. This information is then used to construct an XFN reference for that subordinate naming system. This appendix describes the format of these DNS TXT records.

- See Chapter 26, FNS and Global Naming Systems, for the procedures needed to federate DNS.
- For details on how to manipulate records in DNS in general, see *DNS and BIND in a Nutshell*, by Paul Albitz and Crickett Liu (O'Reilly and Associates, 1992).

The reference type of an XFN reference is constructed from a TXT record that begins with the `XFNREF` tag. It has the following format:

```
TXT "XFNREF rformat reftype"
```

If spaces occur within the string appearing after `TXT`, such spaces must be escaped, or the entire string must be enclosed within double quotation marks. The three fields, `XFNREF`, *rformat* and *reftype*, are separated using space (spaces and tabs). *rformat* specifies format of the reference type identifier. It can be one of the following:

- `STRING` – Maps to `FN_ID_STRING` format
- `OID` – Maps to `FN_ID_ISO_OID_STRING` format
- `UUID` – Maps `FN_ID_DCE_UUID` format

reftype specifies the contents of the reference type identifier.

If no `XFNREF` TXT record exists, the reference type defaults to an identifier `XFN_SERVICE`, with an `FN_ID_STRING` format. If more than one `XFNREF` TXT record exists, the handling of the record is undefined. The following TXT record is equivalent to the default `XFNREF`:

```
TXT "XFNREF STRING XFN_SERVICE"
```

The address information for an XFN reference is constructed using TXT records with tags prefixed with the `XFN` string. Multiple addresses may be specified for a single

reference. Records with the same tag are grouped and passed to the handler for each group. Each handler generates zero or more addresses from its group of TXT records and appends the addresses to the reference. The `XFNREF` tag is special in that it is used only to construct the reference type and thus, it is excluded from the address-construction process.

The syntax of address TXT records is as follows:

XFNaddress_type_tag address_specific_data

The two fields, *XFN_address_type_tag* and *address_specific_data*, are separated using space (spaces and tabs). The *address_type_tag* specifies the handler to be used for *address_specific_data*.

TXT records have a limitation of 2K bytes of characters per record. If the address-specific data is too long to be stored in a single TXT record, multiple TXT records may be used, as shown:

```
TXT "XFNaddress_type_tag  address_specific_data1"
TXT "XFNaddress_type_tag  address_specific_data2"
```

When the tag-specific handler is called, both records are passed to it. The handler is responsible for determining the order in which these two lines need to be interpreted.

The order in which TXT records appear is not significant. If lines with different tags are present, lines with the same tag are grouped together before the tag-specific handler is called. In the following example, the handler for *tag1* will be called with two text lines, and the handler for *tag2* will be called with three text lines.

```
TXT "XFNtag1  address_specific_data1"
TXT "XFNtag2  address_specific_data2"
TXT "XFNtag1  address_specific_data3"
TXT "XFNtag2  address_specific_data4"
TXT "XFNtag2  address_specific_data5"
```

Here are some examples of TXT records that can be used for XFN references.

Example 1

```
TXT        "XFNREF STRING XFN_SERVICE"
TXT        "XFNNISPLUS doc.com. nismaster 129.144.40.23"
```

Example 2

```
TXT        "XFNREF OID 1.3.22.1.6.1.3"
TXT        "XFNDCE (1 fd33328c4-2a4b-11ca-af85-09002b1c89bb...)"
```

The following is an example of a DNS table with a subordinate naming system bound in it.

```
$ORIGIN test.doc.com
@      IN SOA foo root.eng.doc.com          (
             100    ;; Serial
```

```
            3600   ;; Refresh
            3600   ;; Retry
            3600   ;; Expire
            3600   ;; Minimum
         )
      NS    nshost
      TXT   "XFNREF STRING XFN_SERVICE"
      TXT   "XFNNISPLUS doc.com. nismaster 129.144.40.23"
nshost IN  A 129.144.40.21
```

X.500 Attribute Syntax for XFN References

This section contains supplemental information about the use of X.500 attributes for XFN references. In order to permit an XFN reference to be stored as an attribute in X.500, the directory schema must be modified to support the object classes and attributes defined in this appendix.

- See Chapter 26, FNS and Global Naming Systems, for the procedures needed to federate X.500.
- See *Managing the X.500 Client Toolkit* for information about modifying the X.500 directory schema.

Object Classes

Two new object classes, XFN and XFN-supplement, are introduced to support XFN references. The XFN object class is not relevant in FNS since the Sun Microsystems X.500 directory product cannot support the introduction of new compound ASN.1 syntaxes. Instead, FNS uses the XFN-supplement object class.

The two new object classes are defined in ASN.1 as follows:

```
xFN OBJECT-CLASS ::= {
          SUBCLASS OF          { top }
          KIND                 auxiliary
          MAY CONTAIN          { objectReferenceId |
                                 objectReference |
                                 nNSReferenceId |
                                 nNSReference }
          ID                   id-oc-xFN
       }
       id-oc-xFN OBJECT IDENTIFIER ::= {
           iso(1) member-body(2) ansi(840) sun(113536)
```

```
        ds-oc-xFN(24)
    }
xFNSupplement OBJECT-CLASS ::= {
        SUBCLASS OF         { top }
        KIND                auxiliary
        MAY CONTAIN         { objectReferenceString |
                              nNSReferenceString }
        ID                  id-oc-xFNSupplement
    }
    id-oc-xFNSupplement OBJECT IDENTIFIER ::= {
        iso(1) member-body(2) ansi(840) sun(113536)
        ds-oc-xFNSupplement(25)
    }
```

The XFN-supplement object class is defined as an auxiliary object class so that it may be inherited by all X.500 object classes. It is defined with two optional attributes:

- `objectReferenceString` is used to hold an XFN reference to the object itself.
- `nNSReferenceString` is used to hold an XFN reference to a next naming system.

Both attributes are defined in ASN.1 as follows:

```
    objectReferenceString ATTRIBUTE ::= {
        WITH SYNTAX             OCTET STRING
        EQUALITY MATCHING RULE  octetStringMatch
        SINGLE VALUE            TRUE
        ID                      { id-at-objectReferenceString }
    }
    id-at-objectReferenceString OBJECT IDENTIFIER ::= {
        iso(1) member-body(2) ansi(840) sun(113536)
        ds-at-objectReferenceString(30)
    }
    nNSReferenceString ATTRIBUTE ::= {
        WITH SYNTAX             OCTET STRING
        EQUALITY MATCHING RULE  octetStringMatch
        SINGLE VALUE            TRUE
        ID                      { id-at-nNSReferenceString }
    }
    id-at-nNSReferenceString OBJECT IDENTIFIER ::= {
        iso(1) member-body(2) ansi(840) sun(113536)
        ds-at-nNSReferenceString(31)
    }
```

Both `objectReferenceString` and `nNSReferenceString` store XFN references in a string form. Their octet string syntax is further constrained to conform to the following BNF definition:

```
<ref>          ::= <id> '$' <ref-addr-set>
<ref-addr-set> ::= <ref-addr> | <ref-addr> '$' <ref-addr-set>
<ref-addr>     ::= <id> '$' <addr-set>
<addr>         ::= <hex-string>
<id>           ::= 'id'   '$' <string> |
                   'uuid' '$' <uuid-string> |
                   'oid'  '$' <oid-string>
```

```
<string>       ::= <char> | <char> <string>
<char>         ::= <PCS> | '\' <PCS>
<PCS>          ::= // Portable Character Set:
                   // !"#$%&'()*+,-./0123456789:;<=>?
                   // @ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_
                   // `abcdefghijklmnopqrstuvwxyz{|}~
<uuid-string>  ::= <uuid-char>  | <uuid-char> <uuid-string>
<uuid-char>    ::= <hex-digit> | '-'
<oid-string>   ::= <oid-char>  | <oid-char> <oid-string>
<oid-char>     ::= <digit> | '.'
<hex-string>   ::= <hex-octet> | <hex-octet> <hex-string>
<hex-octet>    ::= <hex-digit> <hex-digit>
<hex-digit>    ::= <digit> |
                   'a' | 'b' | 'c' | 'd' | 'e' | 'f' |
                   'A' | 'B' | 'C' | 'D' | 'E' | 'F'
<digit>        ::= '0' | '1' | '2' | '3' | '4' | '5' |
                   '6' | '7' | '8' | '9'
```

The following example is a string form XFN reference:

```
id$onc_fn_enterprise$id$onc_fn_nisplus_root$0000000f77697a2e636fd2e2062696762696700
```

The example uses an XFN reference of type `onc_fn_enterprise`. It contains the address type `onc_fn_nisplus_root` and a single address value. The address value is an XDR-encoded string, comprising the domain name, `doc.com`, followed by the host name, `cygnus`.

An XFN reference may be added to an X.500 entry by using the FNS command `fnattr`, as in this example:

```
# fnattr -a .../c=us/o=doc object-class top organization xfn-supplement
```

creates a new entry called `c=us/o=doc` and adds an object class attribute with the values `top`, `organization` , and `XFN-supplement`.

The FNS command `fnbind` binds the NIS+ reference to the named entry and links X.500 to the root of the NIS+ namespace. (Note the use of a trailing slash in the name argument to `fnbind`.)

```
# fnbind -r .../c=us/o=doc/ onc_fn_enterprise onc_fn_nisplus_root
 "doc.com. cygnus"
```

Creating Enterprise Level Contexts

FNS contexts are created using the `fncreate` command. This section describes how to create FNS contexts individually rather than for the entire organization.. The

`fncreate` command creates a context of the specified type and binds it to the given composite name. It also creates subcontexts for the context.

The `fncreate` command has the following syntax,

```
fncreate -t context_type [-f input_file] [-o][-r reference_type][-s][-v] [-D] composite_name
```

TABLE A–13 `fncreate` Command Options

Option	Description
`- -t` *context*	Specifies the type of context to create. The *context* operator can be one of `org`, `hostname`, `username`, `host`, `user`, `service`, `site`, `nsid`, `generic`, or `fs`
`-f`	Creates a context for every host or user listed in *input_file*. This option can only be used with the `-t username` or `-t hostname` option and is useful for creating contexts for a subset of users and hosts found in the corresponding NIS+ passwd and hosts tables, respectively.
`-o`	Creates only the context specified. Without the `-o` option, subcontexts are created according to the FNS policies.
`-r`	Specifies the *reference_type* of the generic context being created. It can only be used with the `-t generic` option.
`-s`	Creates new contexts for composite names already in use. Otherwise, no new contexts are created for names already bound.
`-D`	Displays information about the NIS+ object associated with a context each time a context is created. This option is useful for debugging.
`-v`	Displays information about the creation as each context is created.

Note – If you specify the `-o` option when creating an organization context, the associated `host`, `user`, and `service` contexts are still created but they are not populated.

When creating contexts bound to namespace identifiers, the name without the underscore (for example, `user`) is used to create the context and the name with the underscore (for example, `_user`) is then bound to the reference of the newly created context. This is done regardless of whether the name with or without the underscore is specified in the command line.

For example, the command

```
fncreate -t username org/sales/_user
```

creates a context for `org/sales/user` and adds a binding for `org/sales/_user` to the context of `org/sales/user`.

Creating an Organization Context

Use the `org` type to create an organization context. The composite name must be one of the following, depending on the primary naming service:

- *NIS+*. The name of an existing NIS+ domain (or subdomain). An NIS+ domain is an NIS+ directory object with an `org_dir` subdirectory. Populated host and passwd tables for the domain must exist in the domain's `org_dir` subdirectory.
- *NIS*. The name of the NIS domain. Associated host and passwd maps must also exist.
- `/etc` *files*. Only the `org//` organization context is available when using `/etc` files.

Organization Context NIS+ Example

Assume the root NIS+ domain is `doc.com` and the subdomain is `sales.doc.com`. To create a `sales` organization context to correspond to the `sales` subdomain, you would enter the following command:

```
fncreate -t org org/sales/
```

When the new context is created, a `ctx_dir` directory, if it does not already exist, is created under the directory of the domain, `sales.doc.com`.

Because this example used only the `-t` option without the `-o` option, it created an organization context for the composite name `org/sales/` and, in addition, created `hostname`, `username`, and `service` subcontexts for it, which in turn, created `host` and `user` contexts, and `service` subcontexts for hosts and users. In effect, that is the same as running the following commands:

```
fncreate -t hostname org/sales/host/
fncreate -t username org/sales/user/
fncreate -t service org/sales/service/
```

If, instead, you ran `fncreate -o -t org`, the `org` context is created and the `hostname`, `username`, and `service` contexts are also created, but not populated with `host` and `user` contexts.

The `org` context is owned by the administrator who executed the `fncreate` command, as are the `hostname`, `username`, and `service` subcontexts. The `host` and `user` contexts, however, and their subcontexts are owned by the hosts or users for which the contexts were created. In order for the administrator to subsequently manipulate host and user contexts, the `NIS_GROUP` environment variable must have been set accordingly at the time `fncreate` is executed. For example, assuming a C-Shell, to set `NIS_GROUP` to `fns_admins.doc.com`:

```
rootmaster# setenv NIS_GROUP fns_admins.doc.com
```

All Hosts Context

The `hostname` type creates a hostname context in which host contexts can be created and bound. Host contexts and their subcontexts are created for each machine name found in the NIS+ `hosts.org_dir` table unless the `-o` option is used. When the `-o` option is used, only the `hostname` context is created.

For example, running the command

```
fncreate -t hostname org/sales/host/
```

creates the `hostname` context and effectively runs the command:

```
fncreate -t host org/sales/host/hname
```

Where *hname* is the name of each machine found in the `hosts.org_dir` table. It also adds a binding for `org/sales/_host/` that is bound to the reference of `org/sales/host/`.

The `hostname` context is owned by the administrator who executed the `fncreate` command. A host context and its subcontexts are owned by the machine for which the contexts were created. That is, each host owns its own host context and subcontexts.

The `-f` option can be used to create contexts for a subset of the hosts found in the NIS+ table `hosts.org_dir`. It creates contexts for those hosts listed in the given input file.

Single Host Context

The `host` type creates the context and subcontexts for a single host. The command automatically creates a `service` context for the host and a binding for `fs` unless the `-o` option is used. When the `-o` option is used, only the `host` context is created.

For example, the command

```
# fncreate -t host org/sales/host/antares/
```

creates a context for the host named `antares` and effectively runs the commands

```
fncreate -t service org/sales/host/antares/service/
fncreate -t fs org/sales/host/antares/fs/
```

The `host` context and its subcontexts are owned by the machine. In the above example, the machine `antares`, with NIS+ principal name `antares.sales.doc.com`, owns the contexts:

- `org/sales/host/antares/`
- `org/sales/host/capsule/service/`
- `org/sales/host/capsule/fs`.

The `hostname` context (`org/sales/host` in the above example) to which the machine belongs must already exist. The machine name supplied should already exist in the NIS+ `hosts.org_dir` table.

Host Aliases

Alias host names may exist in an NIS+ hosts.org_dir table. These appear in the table as a set of hosts with the same canonical name but different alias names.

In FNS, a single host with multiple alias names has a single host context. Alias names for that host in the `hostname` context are bound to the reference of that host context.

All–Users Context

The `username` type creates a username context in which individual user contexts can be created and bound. User contexts and their subcontexts are created for each user name found in the NIS+ passwd.org_dir table unless the `-o` option is used. When the `-o` option is used, only the `username` context is created.

For example, running the command

```
# fncreate -t username org/sales/user/
```

creates the `username` context and effectively runs the command:

```
fncreate -t user org/sales/user/uname
```

Where *uname* represents the various user names that appear in the passwd.org_dir table. It also adds a binding for `org/sales/_user/` that is bound to the reference of `org/sales/user/`.

The `username` context is owned by the administrator who executed the `fncreate` command. Individual user contexts and their subcontexts are owned by the users for which the contexts were created. Each user owns his or her own `user` context and subcontexts.

The `-f` option can be used to create contexts for a subset of the users found in the NIS+ table passwd.org_dir. It creates contexts for those users listed in the given input file.

Single User Context

The `user` type creates the `user` context and subcontexts for a user. A service subcontext and a binding for `fs` are created under the `user` context unless the `-o` option is used. When the `-o` option is used, only the `user` context is created.

For example, the command

```
# fncreate -t user org/sales/user/jjones/
```

creates the `user` context for the user named `jjones` and effectively runs the commands

```
fncreate -t service org/sales/user/jjones/service/
fncreate -t fs org/sales/user/jjones/fs/
```

The `user` context and its subcontexts are owned by the user for whom the contexts were created. In the above example, the contexts created are owned by the user `jjones` with NIS+ principal name `jjones.sales.doc.com`.

The `username` context (`org/sales/user` in the above example) to which the user belongs must already exist. The user name supplied should already exist in the NIS+ `passwd.org_dir` table.

Service Context

The `service` type creates the `service` context in which service names can be bound. There is no restriction on what type of references may be bound in a service context. The policies depend on the applications that use the `service` context. For example, a group of desktop applications may bind references for a calendar, a telephone directory, a fax service, and a printer in a service context.

For example, the command

```
# fncreate -t service org/sales/service/
```

creates a service context for the organization `sales`. Because the terminal atomic name is a namespace identifier, `fncreate` also adds a binding for `org/sales/_service/` that is bound to the reference of `org/sales/service/`. After executing this command, names such as `org/sales/service/calendar` and `org/sales/service/fax` can then be bound in this service context.

The `service` context supports a hierarchical namespace, with slash-separated left-to-right names. The service namespace can be partitioned for different services. Continuing with the desktop applications example, a group of plotters may be named under the `service` context after the creation of the `plotter` context.

```
# fncreate -t service org/sales/service/plotter
```

Names such as `org/sales/service/plotter/speedy` and `org/sales/service/plotter/color` could then be bound under the `service` context.

Note – Because the terminal atomic name is not a namespace identifier, no additional binding is added (as was the case with `service` and `_service`).

The `service` context created is owned by the administrator who ran the `fncreate` command.

Printer Context

The `printer` context is created under the `service` context of the respective composite name.

Generic Context

The `generic` type creates a context for binding names used by applications.

A generic context is similar to a service context except it can have a different reference type. The `-r` option is used to specify the reference type for the generic context being created. If it is omitted, the reference type is inherited from its parent generic context or, if the parent context is not a generic context, the reference type used is a default generic reference type.

Like a service context, there is no restriction on what type of references may be bound in a generic context. The policies depend on the applications that use the generic context.

For example, the command

```
# fncreate -t generic -r WIDC_comm org/sales/service/extcomm
```

creates a generic context with the `WIDC_comm` reference type under the `service` context of the organization `sales`. Names such as `org/sales/service/extcomm/modem` can then be bound in this generic context.

The `generic` context supports a hierarchical namespace, with slash-separated left-to-right names, which allows an application to partition its namespace for different services. Continuing with the example above, a `generic` subcontext for `modem` can be created running the command

```
# fncreate -t generic org/sales/service/extcomm/modem
```

Names such as `org/sales/service/extcomm/modem/secure` and `org/sales/service/extcomm/modem/public` could then be bound under the `modem` context.

The generic context created is owned by the administrator who ran the `fncreate` command.

Site Context

The `site` type creates contexts in which site names can be bound.

For example, the command

```
# fncreate -t site org/sales/site/
```

creates a site context. Because the terminal atomic name is a namespace identifier, `fncreate` also adds a binding for `org/sales/_site/` that is bound to the reference of `org/sales/site/`.

The `site` context supports a hierarchial namespace, with dot-separated right-to-left names, which allows sites to be partitioned by their geographical coverage relationships.

For example, the commands

```
# fncreate -t site org/sales/alameda
# fncreate -t site org/sales/site/alameda.bldg-5
```

create a site context `alameda` and a site subcontext `alameda.bldg-5` for it.

Note – Because these terminal atomic names are not namespace identifiers, no additional bindings are added (as was the case with `site` and `_site`).

The `site` context created is owned by the administrator who ran the `fncreate` command.

File Context

The `fs` type creates a file system context (or file context) for a user or a host. For example, the command

```
# fncreate -t fs org/sales/user/petrova/fs/
```

creates the `fs` context for user `petrova`. Because the terminal atomic name is a namespace identifier, `fncreate` also adds a binding for

`org/sales/user/petrova/_fs/` that is bound to the reference of `org/sales/user/petrova/fs/`.

The `fs` context of a user is the user's home directory as it is stored in the NIS+ passwd.org_dir table. The `fs` context of a host is the set of NFS file systems that the host exports.

Use the `fncreate_fs` command to create file contexts for organizations and sites or to create file contexts other than the defaults for users and hosts. See "File Contexts Administration" on page 544 for details.

The `fs` context created is owned by the administrator who ran the `fncreate` command.

Namespace Identifier Context

The `nsid` (namespace identifier) type creates a context in which namespace identifiers can be bound.

For example, the command

```
# fncreate -t nsid org/sales/site/alameda.bldg-5/
```

creates the `nsid` context for the site `alameda.bldg-5` and permits the creation of subcontexts such as `service/`. Continuing with this example, you could then execute the command

```
# fncreate -t service org/sales/site/alameda.bldg-5/service/
```

to create the `service` context for `alameda.bldg-5`.

The `nsid` context created is owned by the administrator who ran the `fncreate` command.

Administering Enterprise Level Contexts

A number of tools are provided for examining and managing FNS contexts. The commands and their syntax are shown in the sections that follow.

Displaying the Binding

`fnlookup` displays the binding of the given composite name.

`fnlookup [-v][-L]` *composite_name*

TABLE A–14 `fnlookup` Command Options

Option	Description
`-v`	Displays the binding in more detail
`-L`	Displays the reference to which the XFN link is bound

For example, to show the binding for the user darwin in detail, you would enter:

```
# fnlookup -v user/darwin/
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 length: 52
 context type: user
 representation: normal
 version: 0
 internal name: fns_user_darwin.ctx_dir.sales.doc.com.
```

Suppose `user/Charles.Darwin` is linked to `user/darwin`. The first command in the following example shows what `user/Charles.Darwin` is bound to (an XFN link). The second command follows the XFN link, `user/darwin`, and shows what `user/darwin` is bound to (the `user` context).

```
# fnlookup user/Charles.Darwin
Reference type: fn_link_ref
Address type: fn_link_addr
 Link name: user/darwin
# fnlookup -L user/Charles.Darwin
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 context type: user
```

Listing the Context

`fnlist` lists the contents of the context identified by the given name.

`fnlist [-lv] [`*name*`]`

TABLE A–15 `fnlist` Command Options

Option	Description
`-v`	Displays the binding in more detail
`-l`	Displays the bindings of the names bound in the named context

For example, to display the bindings under the `user` context:

```
# fnlist user/
Listing 'user/':
jjones
julio
chaim
James.Jones
```

If no *name* is given, the command lists the contents of the initial context.

```
# fnlist
Listing '':
_myorgunit
...
_myself
thishost
myself
_orgunit
_x500
_host
_thisens
myens
thisens
org
orgunit
_dns
thisuser
_thishost
myorgunit
_user
thisorgunit
host
_thisorgunit
_myens
user
```

When the `-l` option is given, the bindings of the names bound in the named context are displayed.

```
# fnlist -l user/
Listing bindings 'user/':
name: julio
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 context type: user
```

```
name: chaim
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 context type: user
name: James.Jones
Reference type: fn_link_ref
Address type: fn_link_addr
 Link name: user/jjones
name: jjones
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 context type: user
```

When the `-v` option is given in conjunction with the `-l` option, the bindings are displayed in detail.

```
# fnlist -lv user/
Listing bindings 'user/':
name: julio
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 length: 52
 context type: user
 representation: normal
 version: 0
 internal name: fns_user_julio.ctx_dir.sales.doc.com.
name: chaim
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 length: 52
 context type: user
 representation: normal
 version: 0
 internal name: fns_user_chaim.ctx_dir.sales.doc.com.
name: James.Jones
Reference type: fn_link_ref
Address type: fn_link_addr
 length: 11
 data: 0x75 0x73 0x65 0x72 0x2f 0x6a 0x6a 0x6f 0x6e 0x65
user/jjones
name: jjones
Reference type: onc_fn_user
Address type: onc_fn_nisplus
 length: 52
 context type: user
 representation: normal
 version: 0
 internal name: fns_user_jjones.ctx_dir.sales.doc.com.
```

Binding a Composite Name to a Reference

`fnbind` allows you to bind a composite name to a reference.

There are two uses of this command.

- The first usage allows the user to bind the reference of an existing name to a new name. (See below.)
- The second usage allows the user to bind a reference constructed using arguments in the command line to a name. (See "Constructing a Reference on the Command Line" on page 527.)

Binding an Existing Name to a New Name

The syntax of `fnbind` for binding existing names to new names is:

`fnbind [-s][-v][-L]` *oldname newname*

TABLE A–16 `fnbind` Command Options (Binding Names)

Option	Description
oldname	The existing composite name
newname	The new name to which you are binding the old name
`-s`	Supersedes any existing binding of the original composite name
`-v`	Prints out the reference used for the binding
`-L`	Creates an XFN link using *name* and binding it to *new_name*

For example, to bind the name `user/julio/service/printer` to the reference of `myorgunit/service/printer` you would enter:

```
# fnbind myorgunit/service/printer user/julio/service/printer
```

If the given *newname* is already bound, `fnbind -s` must be used or the operation will fail. In the above example, if `user/julio/service/printer` is already bound, the `-s` option must be used to overwrite the existing binding with that of `myorgunit/service/printer` as shown below:

```
# fnbind -s myorgunit/service/printer user/julio/service/printer
```

The `-v` option prints out the reference used for the binding.

```
# fnbind -v myorgunit/service/printer user/julio/service/printer
Reference type: onc_printers
Address type: onc_fn_printer_nisplus
```

The following command constructs an XFN link out of `user/jjones` and binds it to the name `user/James.Jones`:

```
# fnbind -L user/jjones user/James.Jones
```

Similarly, to create a link from `user/julio/service/printer` to `myorgunit/service/printer` you would enter:

```
# fnbind -sL myorgunit/service/printer user/julio/service/printer
```

Constructing a Reference on the Command Line

The syntax of `fnbind` for building a reference on the command line is:

```
fnbind -r [-s] [-v] newname [-O | -U] reftype {[-O | -U] | addresstype
[-c|-x] addresscontents}+
```

TABLE A–17 `fnbind` Command Options (Reference Construction)

Option	Description
newname	The new name for which you are constructing a reference
reftype	The type of reference you are creating. Unless the `-O` or `-U` options are used, `FN_ID_STRING` is used as the indentifier for *reftype*.
addresstype	The type of address you are creating. Unless the `-O` or `-U` options are used, `FN_ID_STRING` is used as the indentifier for *addresstype*.
addresscontents	The address of the reference you are creating. Unless the `-c` or `-x` options are used, the address is stored as an XDR-encoded string.
`-s`	Supersedes any existing binding of the original composite name
`-v`	Prints out the reference used for the binding
`-c`	Stores address contents without XDR encoding
`-x`	Interprets address contents as a hexadecimal input string and store it as is
`-r`	Creates a reference with a specified type and binds the reference to a name specified on the command line
`-O`	Interprets and stores type string as ASN.1 dot-separated integer list
`-U`	Interprets and stores type string as a DCE UUID

For example, to bind the name `thisorgunit/service/calendar` to the address contents of `staff@cygnus` with a reference type of `onc_calendar` and and an address type `onc_cal_str` you would enter:

```
# fnbind -r thisorgunit/service/calendar onc_calendar
onc_cal_str staff@cygnus
```

By default, the address contents supplied in the command line is XDR-encoded before being stored in the reference. If the `-c` option is given, the address contents are stored in normal, readable characters, not as an XDR-encoded string. If the `-x` option is given, the address contents supplied in the command line are interpreted as a hexadecimal string and stored (and not XDR-encoded).

By default, the reference and address types of the reference to be constructed uses the `FN_ID_STRING` identifier format. If the `-O` option is given, the identifier format is `FN_ID_ISO_OID_STRING`, an ASN.1 dot-separated integer list string. If the `-U` option is given, the identifier format is `FN_ID_DCE_UUID`, a DCE UUID in string form.

Note – For more information on ASN.1, see *ISO 8824: 1990, Information Technology — Open Systems Interconnection — Specification of Abstract Syntax Notation One (ASN.1)*. For more information on DCE UUID see *X/Open Preliminary Specification, October 1993, X/Open DCE: Remote Procedure Call (ISBN: 1-872630-95-2).*

For example, to bind to the name `thisorgunit/service/nx` a reference with a hexadecimal string as the address contents and OIDs as reference and address types, you would enter:

```
# fnbind -r thisorgunit/service/nx -O 1.2.99.6.2.1
-O 1.2.99.6.2.3 -x ef12eab67290
```

Removing a Composite Name

`fnunbind` removes the given composite name from the namespace. Note that this does not remove the object associated with the name; it only unbinds the name from the object.

For example, to remove the binding associated with the name `user/jjones/service/printer/color`, you would enter:

```
# fnunbind user/jjones/service/printer/color
```

Renaming an Existing Binding

The `fnrename` command renames an existing binding.

For example, to rename the binding of `clndr` to `calendar`, in the context named by `user/jjones/service/` you would enter:

```
# fnunbind user/jjones/service/printer/color
```

Destroying a Context

`fndestroy` removes the given composite name from the namespace and destroys the context named by the composite name.

For example, to unbind the name `user/jones/` from the namespace and destroys the context named by `user/jjones/` you would enter:

```
# fndestroy user/jjones/
```

If the composite name identifies a context to be removed, the command fails if the context contains subcontexts.

Administering FNS: Attributes Overview

Attributes can be applied to named objects. Attributes are optional. A named object can have no attributes, one attribute, or multiple attributes.

Each attribute has a unique attribute identifier, an attribute syntax, and a set of zero or more distinct attribute values.

XFN defines the base attribute interface for examining and modifying the values of attributes associated with existing named objects. These objects can be contexts or any other type of object. Associated with a context are syntax attributes that describe how the context parses compound names.

The extended attribute interface contains operations that search for specific attributes and that create objects and their associated attributes.

Examining Attributes

Search for attributes with the `fnsearch` command.

The syntax of the `fnsearch` command is

```
fnsearch [-ALlv] [-n max] [-s scope] name [-a ident]... [-O|-U] filter_expr [filter_arg]
```

TABLE A–18 `fnsearch` Command Options

Option	Description
`-n` *max*	Display only max number of objects.
`-s` *scope*	Set the scope of the search
`-a` *ident*	Display only those attributes that match ident.
name	Composite name
filter_expr	Boolean, logical, grouping, relational, and comparison operators (see Table A–19)
filter_arg	Arguments for filter expressions (see Table A–19]
`-A`	Consult only the authoritative source.
`-L`	Follow XFN links.
`-l`	Display the object references for the matching objects.
`-v`	Verbose. Display detailed object references for the matching objects.
`-O`	Use an OSI OID as the identifier
`-U`	Use a DCE UUID as the identifier

Searching for Objects Associated With an Attribute

With the `fnsearch` command, you can search for objects that are associated with the attributes you choose.

For example, to find all the objects that are associated with the attribute `for_sale` in `orgunit/sales/site/`, you would enter the following command:

```
% fnsearch orgunit/sales/site/ for_sale
```

Customizing Attribute Searches

You can also use all the following in filter expressions in your search patterns.

TABLE A–19 fnsearch Filter Expression Operators

Filter Expression Operator	Symbols and Forms
Logical operators	`or`, `and`, `not`
Parentheses for grouping	`( )`
Relational operators: Compare an attribute to a supplied value	`==` True if at least one attribute value is equal to the supplied value. `!=` True if none of the attribute values are equal to the supplied value. `<` True if at least one attribute value is less than the supplied value. `<=` True if at least one attribute value is less than or equal to the supplied value. `>` True if at least one attribute value is greater than the supplied value. `>=` True if at least one attribute value is greater than or equal to the supplied value. `~=` True if at least one attribute value matches the supplied value according to some context-specific approximate matching criterion. This criterion must subsume strict equality.
Example:	`% fnsearch` *name* `"not (make == 'olds' and year == 1983)"`
Substitution tokens:	`%a` for attribute
Helpful when writing shell scripts; allow the use of OSI OIDs and DCE UUIDs when used with the `-O` and `-U` options	`%s` for string `%i` for identifier `%v` for attribute value (only `fn_attr_syntax_ascii` is currently supported)
Example:	The following three examples are equivalent. % fnsearch *name* "color == 'red'" % fnsearch *name* "%a == 'red'" color % fnsearch *name* "%a == %s" color red
Wild card strings	`*`, `*`*string*, *string*`*`, *str*`*`*ing*, `%s*`
Extended operators	`'name'`(*wildcarded_string*), `'reftype'`(*identifier*), `'addrtype'` (*identifier*)
Example:	Search for objects with names starting with "Bill" and IQ attributes over 80. `% fnsearch name "'name'('bill'*) and IQ > 80"`

See the `fnsearch` man page for detailed information about creating search patterns.

Updating Attributes

The `fnattr` command lets you update and examine attributes associated with FNS named objects. You can perform four attribute operations with the `fnattr` command:

- Add an attribute:

`fnattr -a [-s] name [-O|-U] identifier values`

- Delete an attribute:

`fnattr -d name [[-O|-U] identifier [values]]`

- Modify an attribute:

`fnattr -m name [-O|-U identifier oldvalue newvalue`

- List an attribute:

`fnattr -l name [[-O|-U] identifier`

TABLE A–20 `fnattr` Command Options

Option	Description
name	Composite name.
identifier	Attribute name.
values	One or more attributes values
oldvalue	The attribute value that you want to change.
newvalue	The new attribute value.
`-aa`	Add (create) a new attribute
`-d`	Delete an attribute
`-m`	Change (modify) an attribute
`-l`	List attribute values
`-s`	Add in "supersede" mode. Removes any existing values for the *identifier* attribute and creates new attribute values.
`-l`	List attributes and values.
`-O`	Use an OSI OID as the identifier
`-U`	Use a DCE UUID as the identifier

In each of these cases, the identifier format is `FN_ID_STRING`, unless the option `-O` or `-U` is used.

Adding an Attribute

The `-a` option is for adding an attribute or adding a value to an attribute. Specify the composite name the attribute is associated with, the attribute identifier, and the values to add.

`fnattr -a [-s]` *name* `[-O | -U]` *identifier value1* `[`*value2*`+]`

The following example adds the attribute identifier `model` and the value `hplaser` to `thisorgunit/service/printer`.

```
# fnattr -a thisorgunit/service/printer model hplaser
```

The `-s` option means "add in supersede" mode. If an attribute with the specified identifier already exists, `-s` removes all of its values and replaces them with the values added. If this option is omitted, the resulting values for the specified attribute includes the existing values and the new values added.

```
# fnattr -as thisorgunit/service/printer model hplaser
```

The example above will first remove any existing values associated with `model` and add `hplaser` as the value.

Deleting an Attribute

To delete an attribute associated with an FNS named object, use the `-d` option.

`fnattr -d` *name* `[[-O | -U]` *identifier value1* `[`*value2*`+]]]`

You can control what to delete:

- *Name* only. If only the composite name is specified and no attribute identifier is specified, all the attributes associated with the named object are removed.
- *Name* and *identifier* only. If only the composite name and an attribute identifier is specified, but no attribute values are specified, the entire attribute identified by *identifier* is removed.
- *Name*, *identifier*, and *values*. If the composite name, an attribute identifier, and one or more attribute values are specified, then only those values are removed from the attribute. (Removal of the last remaining value of an attribute is the same as removing the attribute itself.)

For example, to delete all the attributes associated with `thisorgunit/service/printer`.

```
# fnattr -d thisorgunit/service/printer
```

Listing an Attribute

The `-l` option is for listing attributes and their values.

`fnattr -l` *name* `[[-O | -U]` *identifier*`]`

For example to list the values of the `model` attribute of `thisorgunit/service/printer`.

```
# fnattr -l thisorgunit/service/printer model
laser
postscript
```

If an identifier is not specified, all the attributes associated with the named object are displayed.

Modifying an Attribute

The `-m` option lets you modify an attribute value.

`fnattr -m` *name* `[-O | -U]` *identifier old_value new_value*

For example, to replace the value `postscript` with `laser` you would enter:

```
# fnattr -m thisorgunit/service/printer model postscript laser
```

Only the specified values are affected. Other attributes and values associated with the name are not affected.

Other Options

The `-O` option assumes the format of the attribute identifier is an ASN.1 dot-separated integer string list (`FN_ID_ISO_OID_STRING`).

The `-U` option assumes the format of the attribute identifier is a DCE UUID string form (`FN_ID_DCE_UUID`).

FNS and Enterprise-Level Naming Services

Enterprise-level naming services are used to name objects within an enterprise. FNS currently supports three enterprise-level naming services: NIS, NIS+, and local files.

Choosing an Enterprise-Level Name Service

When you initially set up and configure your FNS namespace with the `fncreate` command., See “Preparing the Namespace for FNS” on page 501 for information on how to set up the namespace. the correct default name service is automatically selected for each machine.

If you later change a machine’s primary enterprise-level name service, you should run the `fnselect` command on that machine. See “Selecting a Naming Service” on page 537 for details.

FNS and Naming Service Consistency

As a system administrator one of your tasks is to maintain consistency between FNS and the underlying naming service by ensuring that the contents of FNS contexts and the files, maps, or tables of the underlying naming service correspond.

When you initially set up and configure your FNS namespace with the `fncreate` command as described in “Preparing the Namespace for FNS” on page 501, `fncreate` ensures that FNS contexts are correctly created and are consistent with the underlying naming service data. After the FNS contexts have been set up, this correspondence needs to be maintained as users, hosts, printers, and so forth are added to and removed from the system. The following sections describe how to maintain FNS and name service consistency.

FNS and Solstice AdminSuite

If you have the Solstice AdminSuite product, you can use it to add, change, or delete user and host information in the underlying name service. This is a recommended method because the AdminSuite tools update the corresponding FNS namespace automatically.

Checking Naming Inconsistencies

When updates to FNS or the primary name service are made independent of the Solstice AdminSuite product, the resulting inconsistencies are resolved by the use of the FNS tool, `fncheck`. The `fncheck` command checks for inconsistencies between the FNS `hostname` and `user` contexts, and:

- *NIS+*. The NIS+ `hosts.org_dir` and `passwd.org_dir` system tables.
- *NIS*. The NIS `hosts.byname` and `passwd.byname` maps.
- *Files*. The `etc/hosts` and `etc/passwd` files.

The `fncheck` command lists those host and user names that are in the FNS namespace but not in the name service data, and those host and user names that are in the name service data but not in the FNS namespace.

The command syntax is:

`fncheck [-r] [-s] [-u] [-t` *hostname*|*username*`] [`*domain_name*`]`

TABLE A–21 `fncheck` Command Options

Option	Description
domain	Apply the command to an NIS+ domain other than the one in which you are running the command.
`-t`	Specifies the type of context to check. Allowed types are `hostname` or `username`.
`-s`	Lists host or user names from the namespace dataset that are not in the FNS namespace
`-r`	Lists host or user names from the FNS namespace that do not have entries in the corresponding namespace dataset
`-u`	Updates the FNS namespace based on information in the relevant namespace dataset

The `-t` option is used to specify the contexts to check (host or user). If you omit the `-t` option, both the `hostname` and `username` contexts are checked.

When the `-r` option is used with the `-u` option, items that appear only in the FNS context are removed from the FNS context. When the `-s` option is used with the `-u` option, items that appear only in the namespace dataset are added to the FNS context. If neither `-r` or `-s` are specified, items are added and removed from the FNS context to make it consistent with the corresponding namespace data.

Selecting a Naming Service

When FNS constructs the bindings in the initial context for a machine, it does so on the basis of a particular naming service.

You can choose which name service FNS is to use with the `fnselect` command. The name service setting you specify with `fnselect` affects the entire machine, all applications running on that machine, and all users logged in to that machine.

Only root can run `fnselect`. The command syntax is:

```
fnselect [-D] [namesvc]
```

TABLE A–22 `fnselect` Command Options

Option	Description
namesvc	The naming service you want to select. Must be one of: `default`, `nisplus`, `nis`, or `files`.
`-D`	Display the naming service used to generate the FNS initial context.

For example, to select NIS+ as a machine's name service:

```
#fnselect nisplus
```

For example, to select the default as a machine's name service and print the name of the service used to generate the FNS initial context:

```
#fnselect -D default
```

Default Naming Service

If you do not designate a naming service with `fnselect`, FNS uses the default naming service. The default naming service is determined by FNS based on the name service that the machine is using. If the machine is an NIS+ client, FNS uses NIS+ as

the name service. If the machine is an NIS client, FNS uses NIS. If the machine is neither an NIS+ nor an NIS client, FNS uses `/etc` files as the machine's default name service.

When NIS+ and NIS Coexist

In rare cases you may need to access both NIS+ and NIS-based contexts. For example, you might have an NIS server running that is itself an NIS+ client. In this situation, you use the `fnselect` command to select the enterprise-level naming service that you want to work with.

Advanced FNS and NIS+ Issues

This section provides detailed information on the relationship between NIS+ objects and FNS objects. This information is useful when you must change the access control of FNS objects.

Note – See:

- "Migrating From NIS to NIS+" on page 542.
- "Migrating From Files-Based Naming to NIS or NIS+" on page 543.

Mapping FNS Contexts to NIS+ Objects

FNS contexts are stored as NIS+ objects. All contexts associated with an organization are stored under the FNS `ctx_dir` directory of the associated NIS+ domain. The `ctx_dir` directory resides at the same level as the `org_dir` directory of the same domain. In other words, when running in conjunction with FNS, for every NIS+ domain or subdomain, there are corresponding `org_dir`, `groups_dir` and `ctx_dir` directory objects.

Use the `-v` option for the `fnlookup` or `fnlist` command to see the detailed description of references. The internal name field displays the name of the corresponding NIS+ object.

Browsing FNS Structures Using NIS+ Commands

The NIS+ command, `nisls`, can be used to list the NIS+ objects used by FNS. For example, the following commands list the contents of the NIS+ domain directory and its `ctx_dir` subdirectory.

```
# nisls doc.com.
doc.com.:
manf
sales
groups_dir
org_dir
ctx_dir
```

```
# nisls ctx_dir.doc.com.
ctx_dir.DOC.COM.:
fns
fns_user
fns_host
fns_host_alto
fns_host_mladd
fns_host_elvira
fns_user_jjones
fns_user_jsmith
fns_user_aw
```

Use the `niscat` command to list the contents of the `fns_hosts` table.

```
# niscat fns_host.ctx_dir
altair *BINARY* *BINARY*
cygnus *BINARY* *BINARY*
centauri *BINARY* *BINARY*
```

Checking Access Control

Use `niscat -o` to see the access control of a context. To see the access control of a particular binding, use the name of the binding entry in the parent context's binding table (that is, the name displayed in the internal name field in the output of `fnlookup -v` and `fnlist -v`):

```
# niscat -o fns_host.ctx_dir
Object Name          :    fns_host
Owner                :    alto.doc.com.
Group                   :       admin.doc.com.
Domain                     :    ctx_dir.doc.com.
Access Rights        :    r-c-rmcdrmcdr-c-
Time to Live         :    53:0:56
Object Type          :    TABLE
Table Type           :    H
Number of Columns    :    3
Character Separator
```

```
Search Path         :
Columns             :
[0]    Name        :    atomicname
    Attributes    :    (SEARCHABLE, TEXTUAL DATA,    CASE INSENSITIVE)
    Access Rights    :    r-c-rmcdrmcdr-c-
[1]    Name        :    reference
    Attributes    :    (BINARY DATA)
    Access Rights    :    r-c-rmcdrmcdr-c-
[2]    Name        :    flags
    Attributes    :    (BINARY DATA)
    Access Rights    :    r-c-rmcdrmcdr-c-
```

```
# niscat -o "[atomicname=altair],fns_host.ctx_dir"
Object Name    :    fns_host
Owner       :    altair.doc.com.
Group       :       admin.doc.com.
Domain      :    ctx_dir.doc.com.
Access Rights    :    r-c-rmcdrmcdr-c-
Time to Live    :    12:0:0
Object Type    :    ENTRY
 Entry data of type H
 [1] - [5 bytes] 'alto'
 [2] - [104 bytes] '0x00 ...'
 [3] - [1 bytes] 0x01
```

(See "The `niscat` Command" on page 368 for additional information on the `niscat` command.)

To change the access control or ownership of a particular context, use the commands:

- `nischown`
- `nischmod`
- `nischgrp`

Give either the binding entry or the bindings table as an argument, depending on the object the operation is to affect.

Advanced FNS and NIS Issues

This section provides specific information on the relationship between NIS and FNS.

NIS and FNS Maps and Makefiles

FNS uses six new maps which are stored in `/var/yp/`*domainname* directories on the NIS master and slave servers:

- `fns_host.ctx` which stores host attributes and subcontext data. When this is first created, it derives its information from the `hosts.byname` map.
- `fns_host.ctx` which stores user attributes and subcontext data. When this is first created, it derives its information from the `passwd.byname` map.
- `fns_org.ctx` which stores organization attributes and subcontext data.
- `fns_host.attr` which stores host attributes for attribute based searches.
- `fns_user.attr` which stores user attributes for attribute based searches.
- `fns_org.attr` which stores organization attributes for attribute based searches.

Service and file context information for hosts, users, and the organization are stored in the respective `fns_host.ctx`, `fns_user.ctx`, and `fns_org.ctx` maps. Printer context information is stored in the same maps as other service context information. However, the older `printers.conf.byname` map is still supported.

Sites are subcontexts of the organization and site context information is stored in the `fns_org.ctx` map.

Note – These FNS maps should not be edited directly. You modify or work with these maps by running the appropriate FNS commands such as `fncreate`, `fndestroy`, `fnbind`, `fnunbind`, `fnrename`, `fnattr`, `fnlookup`, and `fnlist`. These commands must be run on the NIS master server. You cannot run them on slave servers or client machines.

The FNS map files are placed in the `/var/yp/`*domainname* directory. The NIS Makefile in `/var/yp` is modified to be aware of the FNS Makefile in `/etc/fn/`*domainname*.

Large FNS Contexts

NIS has a 64K limit on the number of entries an NIS map can contain. If only service and printer contexts are created for each object (host or user), that limit will be reached when the number of users or hosts exceeds 7K. If additional contexts are created for hosts or users, as is usually the case, the upper 64K limit will be reached with far fewer hosts or users.

FNS solves this problem by automatically creating new maps after an old map has reached its maximum size. Each new map is identified by adding a numeric suffix to the map's name. For example, when a second `fns_user.ctx` map is created it is given the name `fns_user_0.ctx`. If a third map became necessary it would be given the name `fns_user_1.ctx`. As additional maps are created, the number is incremented each time.

Printer Backward Compatibility

In Solaris release 2.5, FNS support for printer naming under NIS was provided for the organization context with a map named `printers.conf.byname`. In the current Solaris release, organization context printer support is maintained in the `fns_org.ctx` map. That is, the `fncreate_printer` command now modifies the `fns_org.ctx` map and not the `printers.conf.byname` map.

Migrating From NIS to NIS+

The `fncopy` command handles the FNS-related aspects of changing your underlying enterprise-level naming service from NIS to NIS+. This command copies and converts NIS-based FNS contexts to NIS+ based contexts.

The command syntax is:

`fncopy [-i` *oldsvc* `-o` *newsvc*`] [-f` *filename*`]` *oldctx newctx*

TABLE A–23 `fncopy` Command Options

Option	Description
`-i` *oldsvc*	Source naming service. Only `nis` or `files` may be specified.
`-o` *newsvc*	Target naming service. Only `nisplus` or `nis` may be specified.
`-f` *filename*	Name of file listing the FNS contexts to be copied
oldctx	Old FNS context to be copied
newctx	Target new FNS context

For example, to copy the contexts listed in the file `/etc/sales_users` from the `doc.com` domain of an NIS-based naming service to the `sales.doc.com` domain of an NIS+ naming service, you would enter:

```
fncopy -i nis -o nisplus -f /etc/sales_users org/sales.doc.com/user
```

Advanced FNS and File-Based Naming Issues

This section provides specific information on the relationship between files-based naming and FNS.

FNS Files

FNS uses new files which are stored in `/var/fn` directories on each machine. (While a `/var/fn` directory is normally stored on each machine, you can mount and export a central `/var/fn` directory via NFS.)

The new FNS files are:

- `fns_host.ctx` which stores host attributes and subcontext data. When this is first created, it derives its information from the `/etc/hosts` file.
- `fns_user.ctx` which stores user attributes and subcontext data. When this is first created, it derives its information from the `/etc/passwd` file.
- `fns_org.ctx` which stores organization attributes and subcontext data.
- `fns_host.attr` which stores host attributes for attribute based searches.
- `fns_user.attr` which stores user attributes for attribute based searches.
- `fns_org.attr` which stores organization attributes for attribute based searches.
- Users' sub-context and attribute information is stored in separate `/var/fn` files that are owned by each user. This allows users to modify their own data with FNS commands. These user-specific files are named `fns_user_`*username*`.ctx` where *username* is the login ID of the individual user.

Service and file context information for hosts, users, and the organization are stored in the respective `fns_host.ctx`, `fns_user.ctx`, and `fns_org.ctx` files. Printer context information is stored in the same files as other service context information.

Sites are subcontexts of the organization and site context information is stored in the `fns_org.ctx` file.

Note – These FNS files should not be edited directly. You modify or work with these files by running the appropriate FNS commands such as `fncreate`, `fndestroy`, `fnbind`, `fnunbind`, `fnrename`, `fnattr`, `fnlookup`, and `fnlist`. When you run these commands as root, they affect the context that they are applied to such as hosts, site, and organization unit. When you run these commands as a user, they affect only your own user sub-contexts.

Migrating From Files-Based Naming to NIS or NIS+

The `fncopy` command handles the FNS-related aspects of changing your underlying enterprise-level naming service from files to NIS or NIS+. This command copies and converts files-based FNS contexts to NIS or NIS+ based contexts.

The command syntax is:

```
fncopy [-i oldsvc -o newsvc] [-f filename] oldctx newctx
```

For example, to copy the contexts listed in the file `/etc/host_list` to the `doc.com` domain of an NIS+ naming service, you would enter:

```
fncopy -i files -o nisplus -f /etc/host_list //doc.com/host
```

Printer Backward Compatibility

In Solaris release 2.5, FNS support for printer naming for files was provided for the organization context with a file named `printers.conf.byname`. In the current Solaris release, organization context printer support is maintained in the `fns_org.ctx` map. That is, the `fncreate_printer` command now modifies the `fns_org.ctx` map and not the `printers.conf.byname` map.

File Contexts Administration

File contexts may be:

- *Created* using the `fncreate_fs` command (see "Creating a File Context With `fncreate_fs`" on page 544).
- *Inspected* using the `fnlist` command (see "Listing the Context" on page 523) or the `fnlookup` command (see "Displaying the Binding" on page 523).
- Pruned or destroyed using `fnunbind` command (see "Removing a Composite Name" on page 528) or the `fndestroy` command (see "Destroying a Context" on page 529).

Creating a File Context With `fncreate_fs`

The `fncreate_fs` command creates file contexts for organizations and sites. It may also be used to override the default file contexts for users and hosts that are created by the fncreate command.

There are two methods of using the `fncreate_fs` command.

- *Input file*. File context bindings may be provided by an input file (See "Creating File Contexts With an Input File" on page 545)
- *Command line*. File context bindings may be created from the command line (See "Creating File Contexts With Command-line Input" on page 547).

The two methods of `fncreate_fs` have the following syntax:

```
fncreate_fs [-v] [-r] -f file composite_name
fncreate_fs [-v] [-r] composite_name [options] [location...]
```

TABLE A–24 `fncreate_fs` Command Options

Option	Description
composite_name	The composite name of the file context.
`-f` *file*	Use an input file named *file*.
options	Mount options
location	Mount location.
`-v`	Sets verbose output, displaying information about the contexts being created and modified.
`-r`	Replaces the bindings in the context named by *composite_name* —and all of its subcontexts—with *only* those specified in the input. This is equivalent to destroying the context (and, recursively, its subcontexts), and then running `fncreate_fs` without this option. The `-r` option should be used with care.

The `fncreate_fs` command manipulates FNS contexts and bindings of the `onc_fn_fs` reference type. It uses an address of type `onc_fn_fs_mount` to represent each remote mount point. The data associated with an address of this type are the corresponding mount options and locations in a single, XDR-encoded string.

Creating File Contexts With an Input File

The input file supplies the names and values to be bound in the context of `composite_name`. Its format is based upon and similar, but not identical, to the format of indirect automount maps. The input file contains one or more entries with the form:

name [*options*] [*location...*]

Where:

- *name* is the reference name. The *name* field may be a simple atomic name or a slash-separated hierarchical name. It may also be "`.`" (dot), in which case the

reference is bound directly to *composite_name*.

- *options* are mount options, if any. The *options* field begins with a hyphen ("–"). This is followed by a comma-separated list (with no spaces) of the mount options to use when mounting the directory. These options also apply to any subcontexts of *composite_name/name* that do not specify mount options of their own.
- *location* is the mount location. The *location* field specifies the host or hosts that serve the files for *composite_name/name*. In a simple NFS mount, *location* takes the form:

  host:*path*

- Where *host* is the name of the server from which to mount the file system and *path* is the path name of the directory to mount.

For each entry a reference to the mount locations and the corresponding mount options is bound to the name *composite_name/name*.

If *options* and *location* are both omitted, then no reference is bound to *composite_name/name*. Any existing reference is unbound.

For example, suppose you want `kuanda`'s file system to be an NFS mount of the directory `/export/home/kuanda` from host `altair` as shown in Figure A–3. The command would be run as follows:

```
% fncreate_fs -f infile user/kuanda/fs
```

With `infile` containing:

```
. altair:/export/home/kuanda
```

To set up a more complex file system distributed over more than one server as shown in Figure A–4, run the command

```
% fncreate_fs -f infile org/sales/fs
```

with `infile` containing

```
tools/db         altair:/export/db
project             altair:/export/proj
project/lib             altair:/export/lib
project/src         deneb:/export/src
```

To change the NFS mounts for `project` and its subcontexts `src` and `lib` to be read-only, you can change `infile` as follows:

```
tools/db                  svr1:/export/db
project          -ro            svr1:/export/projproject/lib
altair:/export/lib
project/src                 svr2:/export/src
```

The `-ro` is unnecessary in the third and fourth lines because `src` and `lib` are subcontexts of `project`, they will inherit the `-ro` mount option from above.

The following input file would make all of the mounts read-only except for `org/sales/fs/project/src`.

```
.             -ro
tools/db                  svr1:/export/db
project                     svr1:/export/proj
project/lib altair:/export/lib
project/src         -rw             svr2:/export/src
```

Creating File Contexts With Command-line Input

The fncreate_fs command also allows the binding description to be provided on the command line:

`fncreate_fs` *composite_name* [*mmount_options*] [*mount_location ...*]

This is equivalent to using the input file form of the command but entering the individual bindings from your keyboard. The previous example in which `kuanda`'s file system was set could be set from the command line as follows:

```
% fncreate_fs user/kuanda/fs altair:/export/home/kuanda
```

Similarly, the hierarchy illustrated in Figure A–4 could have been set up by running the sequence of commands:

```
% fncreate_fs org/sales/fs/tools/db altair:/export/db
% fncreate_fs org/sales/fs/project altair:/export/proj
% fncreate_fs org/sales/fs/project/lib altair:/export/lib
% fncreate_fs org/sales/fs/project/src deneb:/export/src
```

To make all three of the mounts read-only, you would run this command:

```
% fncreate_fs org/sales/fs -ro
```

Advanced Input Formats

The following two sections apply to both input file and command-line input formats.

Multiple Mount Locations

Multiple *location* fields may be specified for NFS file systems that are exported from multiple, functionally equivalent locations:

```
% fncreate_fs org/sales/fs altair:/sales cygnus:/sales
```

The automounter will attempt to choose the best server from among the alternatives provided. If several locations in the list share the same path name, they may be combined using a comma-separated list of host names:

```
% fncreate_fs org/sales/fs altair,cygnus:/sales
```

The hosts may be weighted, with the weighting factor appended to the host name as an integer in parentheses: the lower the number, the more desirable the server. The default weighting factor is zero (most desirable). Negative numbers are not allowed.

The following example illustrates one way to indicate that `cygnus` is the preferred server:

```
% fncreate_fs org/sales/fs altair(2),cygnus(1):/sales
```

Variable Substitution

Variable names, prefixed by `$`, may be used in the *options* or *location* fields of `fncreate_fs`. For example, a mount location may be given as:

```
altair:/export/$CPU
```

The automounter will substitute client-specific values for these variables when mounting the corresponding file systems. In the above example, `$CPU` is replaced by the output of `uname -p`; for example, `sparc`.

Backward Compatibility Input Format

For additional compatibility with automount maps, the following input file format is also accepted by `fncreate_fs`:

name [*mount_options*] [*mount_location ...*] \
/offset1 [*mount_options1*] *mount_location1 ...* \
/offset2 [*mount_options2*] *mount_location2 ...* \
. . .

Where each *offset* field is a slash-separated hierarchy. The backslash (\) indicates the continuation of a single long line. This is interpreted as being equivalent to:

name [*mount_options*] [*mount_location ...*] \
name/offset1 [*mount_options1*] *mount_location1 ...* \
name/offset2 [*mount_options2*] *mount_location2 ...* . . .

The first line is omitted if both *mount_options* and *mount_location* are omitted. This format is for compatibility only. It provides no additional functionality, and its use is discouraged.

Introduction to FNS and XFN Policies

XFN defines policies for naming objects in the federated namespace. The goals of these policies are

- To allow easy and uniform composition of names
- To promote coherence in naming across applications and services
- To provide a simple, yet sufficiently rich, set of policies so that applications need not invent and implement ad hoc policies for specific environments
- To enhance an application's portability
- To promote cross-platform interoperability in heterogeneous computing environments

What FNS Policies Specify

FNS policies contain all the XFN policies plus extensions for the Solaris environment.

Computing environments now offer worldwide scope and a large range of services. Users expect to have access to services at every level of the computing environment. FNS policies provide a common framework for the three levels of services: global, enterprise, and application.

FNS provides to applications a set of policies on how name services are arranged and used:

- Policies that specify how to federate the enterprise namespace so that it is accessible in the global namespace.
- Policies that specify the names and bindings present in the initial context of every process.
- Name service policies for enterprise objects: organizations, hosts, users, sites, files, and services.
- Policies that define the relationships among the organization, host, user, site, files, and service enterprise objects.
- Policies that specify the syntax of names used to refer to those enterprise objects.

What FNS Policies Do Not Specify

The FNS policies do not specify:

- The actual names used within name services.
- Naming within applications. Application-level naming is left to individual applications or groups of related applications.
- The attributes to use once the object has been named.

Policies for the Enterprise Namespace

FNS policies specify the types and arrangement of namespaces within an enterprise and how such namespaces can be used by applications. For example, which namespaces can be associated with which other namespaces. The FNS policies described here include some extensions to XFN policy. These are explicitly defined with notes.

Default FNS Enterprise Namespaces

The FNS enterprise policies deal with the arrangement of enterprise objects within the namespace. Each enterprise objects has its own namespace.

By default, there are seven FNS enterprise objects and namespaces:

- *Organization* (`orgunit`). Entities such as departments, centers, and divisions. Sites, hosts, users, and services can be named relative to an organization. The XFN term for organization is *organizational unit*. When used in an initial context the identifier `org` can be used as an alias for `orgunit`.
- *Site* (`site`). Physical locations, such as buildings, machines in buildings, and conference rooms within buildings. Sites can have files and services associated with them.
- *Host* (`host`). Machines. Hosts can have files and services associated with them.
- *User* (`user`). Human users. Users can have files and services associated with them.
- *File* (`fs`). Files within a file system.
- *Service* (`service`). Services such as printers, faxes, mail, and electronic calendars.
- *Printer* (`service/printer`). The printer namespace is subordinate to the service namespace.

The policies that apply to these namespaces are summarized in Table A–26.

Enterprise Namespace Identifiers

Enterprise namespaces are referred to by their atomic names in the federated enterprise namespace.

XFN uses leading underscore ("_") characters to indicate an enterprise namespace identifier. For example, `_site`. FNS also supports the use of these identifiers without the leading underscore ("_") character. These names without the underscore are extensions to the XFN policies. The `site` and `printer` contexts are also extensions to the XFN policies. These atomic names are listed in Table A–25.

TABLE A–25 Enterprise Namespace Identifiers in the Enterprise

Namespace	XFN Identifiers	FNS Identifiers	Resolves to
Organization	_orgunit	orgunit or org	Context for naming organizational units
Site	_site	site	Context for naming sites
Host	_host	host	Context for naming hosts
User	_user	user	Context for naming users
File system	_fs	fs	Context for naming files
Service	_service	service	Context for naming services
Printer		printer	Context for naming printers, (subordinate to service namespace)

Note – In XFN terminology, the names with the leading underscore are the *canonical* namespace identifiers. The names without the underscore are namespace identifies that have been *customized* for the Solaris operating environment. These customized namespace identifiers, with the addition of `printer`, might not be recognized in non-Solaris environments. The canonical namespace identifiers are always recognized and so are portable to other environments.

Component Separators

The XFN component separator (`/`) delimits namespace identifiers. For example, composing the namespace identifier `orgunit` with the organizational unit name `west.sales` gives the composite name, `orgunit/west.sales`.

Default FNS Namespaces

There are seven namespaces supplied with FNS:

- *Organization*.
- *Site*
- *Host*.
- *User*.
- *File*.
- *Service*.
- *Printer*.

Organizational Unit Namespace

The organizational unit namespace provides a hierarchical namespace for naming subunits of an enterprise. Each organizational unit name is bound to an *organizational unit context* that represents the organizational unit. Organization unit names are identified by the prefixes `org/`, `orgunit/`, or `_orgunit/`. (The shorthand alias `org/` is only used in the initial context, never in the middle of a compound name. See "Initial Context Bindings for Naming Within the Enterprise" on page 565 and "Composite Name Examples" on page 556.)

NIS+ Environment

In an NIS+ environment, organizational units correspond to NIS+ domains and subdomains.

Under NIS+, organization units must map to domains and subdomains. You must have an organizational unit for each NIS+ domain and subdomain. You cannot have "logical" organization units within a domain or subdomain. In other words, you cannot divide an NIS+ domain or subdomain into smaller organization units. Thus, if you have an NIS+ domain `doc.com.` and two subdomains `sales.doc.com.` and `manf.doc.com.`, you must have three FNS organizational units corresponding to those three domains.

Organizational units are named using dot-separated right-to-left compound names, where each atomic element names an organizational unit within a larger unit. For example, the name `org/sales.doc.com.` names an organizational unit `sales` within a larger unit named `doc.com.` In this example, `sales` is an NIS+ subdomain of `doc.com.`

Organizational unit names can be either fully qualified NIS+ domain names or relatively named NIS+ names. Fully qualified names have a terminal dot; relative names do not. Thus, if a terminal dot is present in the organization name, the name is treated as a fully qualified NIS+ domain name. If there is no terminal dot, the organization name is resolved relative to the top of the organizational hierarchy. For

example, `orgunit/west.sales.doc.com.` is a fully qualified name identifying the `west` organization unit, and `_orgunit/west.sales` is a relatively qualified name identifying the same subdomain.

NIS Environment

In an NIS environment there is only one organization unit per enterprise which corresponds to the NIS domain. This `orgunit` is named `orgunit/`*domainname* where *domainname* is the name of the NIS domain. For example, if the NIS domain name is `doc.com`, the organizational unit is `org/doc.com`.

In an NIS environment, you can use an empty string as a shorthand for the organizational unit. Thus, `org//` is equivalent to `org/`*domainname*.

Files-Based Environment

There is only one FNS organization unit and no subunits when your primary enterprise-level name service is files-based. The only permitted organization unit under files-based naming is `org//`.

Site Namespace

The site namespace provides a geographic namespace for naming objects that are naturally identified with their physical locations. These objects can be, for example, buildings on a campus, machines and printers on a floor, conference rooms in a building and their schedules, and users in contiguous offices. Site names are identified by the prefixes `site/`or `_site/`.

In the Solaris operating environment, sites are named using compound names, where each atomic part names a site within a larger site. The syntax of site names is dot-separated right-to-left, with components arranged from the most general to the most specific location description. For example, `_site/pine.bldg5` names the Pine conference room in building 5, while `site/bldg7.alameda` identifies building 7 of the Alameda location of some enterprise.

Host Namespace

The host namespace provides a namespace for naming computers. Host names are identified by the prefixes `host/`or `_host/`. For example, `host/deneb` identifies a machine named `deneb`.

Hosts are named in *hostname* contexts. The host context has a flat namespace and contains bindings of host names to *host contexts*. A host context allows you to name objects relative to a machine, such as files and printers found at that host.

In the Solaris operating environment, host names correspond to Solaris host names. Alias names for a single machine share the same context. For example, if the name `mail_server` is an alias for the machines `deneb` and `altair`, both `deneb` and `altair` will share the contexts created for `mail_server`.

Network resources should only be named relative to hosts as appropriate. In most cases, it is more intuitive to name resources relative to entities such as organizations, users, or sites. Dependence on host names forces the user to remember information that is often obscure and sometimes not very stable. For example, a user's files might move from one host to another because of hardware changes, file space usage, network reconfigurations, and so on. And users often share the same file server, which might lead to confusion if files were named relative to hosts. Yet if the files were named relative to the user, such changes do not affect how the files are named.

There might be a few cases in which the use of host names is appropriate. For example, if a resource is available only on a particular machine and is tied to the existence of that machine, and there is no other logical way to name the resource relative to other entities, then it might make sense to name the resource relative to the host. Or, in the case of a file system, if the files are being shared by many users it might make sense to name them relative to the machine they are stored on.

User Namespace

The user namespace provides a namespace for naming human users in a computing environment. User names are identified by the prefixes `user/`or `_user/`.

Users are named in *user contexts*. The user context has a single-level namespace and contains bindings of user names to *user contexts*. A user context allows you to name objects relative to a user, such as files, services, or resources associated with the user.

In the Solaris operating environment, user names correspond to Solaris login IDs. For example, `_user/inga` identifies a user whose login ID is `inga`.

File Namespace

A file namespace (or file system) provides a namespace for naming files. File names are identified by the prefixes `fs/`or `_fs/`. For example the name `fs/etc/motd` identifies the file `motd` which is stored in the `/etc` directory.

The file namespace is described in more detail in ."Files-Based naming files" on page 473 and file contexts are discussed in "File Contexts Administration" on page 544.

Service Namespace

The service namespace provides a namespace for services used by or associated with objects within an enterprise. Examples of such services are electronic calendars, faxes, mail, and printing. Service names are identified by the prefixes `service/` or `_service/`.

In the Solaris operating environment, the service namespace is hierarchical. Service names are slash-separated (/) left-to-right compound names. An application that uses the service namespace can make use of this hierarchical property to reserve a subtree for that application. For example, the printer service reserves the subtree `printer` in the service namespace.

FNS does not specify how service names or reference types are chosen. These are determined by service providers that share the service namespace. For example, the calendar service uses the name `_service/calendar` in the service context to name the calendar service and what is bound to the name `calendar` is determined by the calendar service.

Service Name and Reference Registration

Sun Microsystems, Inc., maintains a registry of the names bound in the first level of the `service` namespace. To register a name, send an email request to fns-register@sun.com, or write to:

FNS Registration Sun Microsystems, Inc., 901 San Antonio Road, Palo Alto, CA 94303

Please include a brief description of the intended use of the name and a description of the format of the reference that can be bound to that name.

Printer Namespace

The printer namespace provides a namespace for naming printers. The printer namespace is associated with (subordinate to) the service namespace. In other words, printer service and the printer namespace is one of the services in the service namespace. Printer names are identified by the prefixes `service/printer` or `_service/printer`. For example, `service/printer/laser1` identifies the printer named `laser1`.

Significance of Trailing Slash

The trailing / names objects in the next naming system. You need it whenever you are going from one naming system to another.

For example, in the name, `org/east.sales/service/printer` the slash between `org` and `east.sales` is a component delimiter as described above and the slash that trails after the last element in the organization name (`sales/`) separates the `service` namespace from the organizational unit namespace. Thus, `org/west.sales/service/printer` names the `printer` service of the `west.sales` organization unit.

FNS Reserved Names

FNS reserves for its own use all the atomic names listed in Table A–25 as namespace identifiers. For example: `_orgunit`, `org`, `_site`, `site`, and so forth. This limitation applies to contexts in which the namespace identifiers can appear, as defined by the arrangement of namespaces in "Structure of the Enterprise Namespace" on page 558. FNS does not otherwise restrict the use of these atomic names in other contexts.

For example, the atomic name `service` is used as a namespace identifier relative to a user name, as in `user/fatima/service/calendar`, to mean the root of user `fatima`'s service namespace. This does not preclude a system from using the name `service` as a user name, as in `user/service`, because FNS specifies that the context to which the name `user/` is bound is for user names and not for namespace identifiers. In this case, `service` is unambiguously interpreted as a user name. On the other hand, you should not create a directory named `user` because `/user/mikhail` would cause confusion between the user `mikhail` and the file (or subdirectory) `/user/mikhail`.

Composite Name Examples

This section shows examples of names that follow FNS policies. (See Table A–26 for a summary of these policies.)

The specific choices of organization names, site names, user names, host names, file names, and service names (such as `calendar` and `printer`) are illustrative only; these names are not specified by FNS policy.

Composing Names Relative to Organizations

The namespaces that can be associated with the organization namespace (`_orgunit`, `orgunit`, or `org`) are: `user`, `host`, `service`, `fs`, and `site`.

For example:

- `orgunit/doc.com/site/videoconf.bldg-5` names a conference room `videoconf` located in Building 5 of the site associated with the organization

doc.com. (You can also use the alias org for orgunit to form, org/doc.com/site/videoconf.bldg-5.)

- orgunit/doc.com/user/mjones names a user mjones in the organization doc.com.
- orgunit/doc.com/host/smptserver1 names a machine smptserver1 belonging to the organization doc.com.
- orgunit/doc.com/fs/staff/agenda9604/ names a file staff/agenda9604 belonging to the organization doc.com.
- orgunit/doc.com/service/calendar names the calendar service for the organization doc.com. This might manage the meeting schedules for the organization.

Composing Names Relative to Users

The namespaces that can be associated with the user namespace are service and fs.

- user/helga/service/calendar names the calendar service of a user named helga.
- user/helga/fs/tasklist names the file tasklist under the home directory of the user helga.

Composing Names Relative to Hosts

The namespaces that can be associated with the hosts namespace are service and fs.

- host/mailhop/service/mailbox names the mailbox service associated with the machine mailhop.
- host/mailhop/fs/pub/saf/archives.96 names the directory pub/saf/archives.96 found under the root directory of the file system exported by the machine mailhop.

Composing Names Relative to Sites

The namespaces that can be associated with the sites namespace are service and fs.

- site/bldg-7.alameda/service/printer/speedy names a printer speedy in the bldg-7.alameda site.
- site/alameda/fs/usr/dist names a file directory usr/dist available in the alameda site.

Composing Names Relative to Services and Files

No other namespaces can be associated with either the files (`fs`) or services (`service`) namespaces. For example, you cannot compose a name such as `/services/calendar/orgunit/doc.com`. In other words, you cannot compose a compound name relative to either the files or the service namespace. You can, of course, compose a file or service name relative to some other namespace such as `/user/esperanza/service/calendar`.

Structure of the Enterprise Namespace

FNS policies define the structure of the enterprise namespace. The purpose of this structure is to allow easy and uniform composition of names. This enterprise namespace structure has two main rules:

- Objects with narrower scopes are named relative to objects with wider scopes.
- Namespace identifiers are used to denote the transition from one namespace to the next.

Table A–26 isf FNS policies for arranging the enterprise namespace. The following table shows an example of a namespace layout that follows these FNS policies.

TABLE A–26 Policies for the Federated Enterprise Namespace

Namespace Identifiers	Subordinate Namespaces	Parent Context	Namespace Organization	Syntax
orgunit _orgunit org	Site, user, host, file system, service	Enterprise root	Hierarchical	Dot-separated right-to-left
site _site	Service, file system	Enterprise root, organizational unit	Hierarchical	Dot-separated right-to-left
user _user	Service, file system	Enterprise root, organizational unit	Flat	Solaris login name
host _host	Service, file system	Enterprise root, organizational unit	Flat	Solaris host name
service _service	Application specific	Enterprise root, organizational unit, site, user, host	Hierarchical	/ separated left-to-right

TABLE A–26 Policies for the Federated Enterprise Namespace *(Continued)*

Namespace Identifiers	Subordinate Namespaces	Parent Context	Namespace Organization	Syntax
fs _fs	None	Enterprise root, organizational unit, site, user, host	Hierarchical	/ separated, left-to-right
printer	None	Service	Hierarchical	/ separated left-to-right

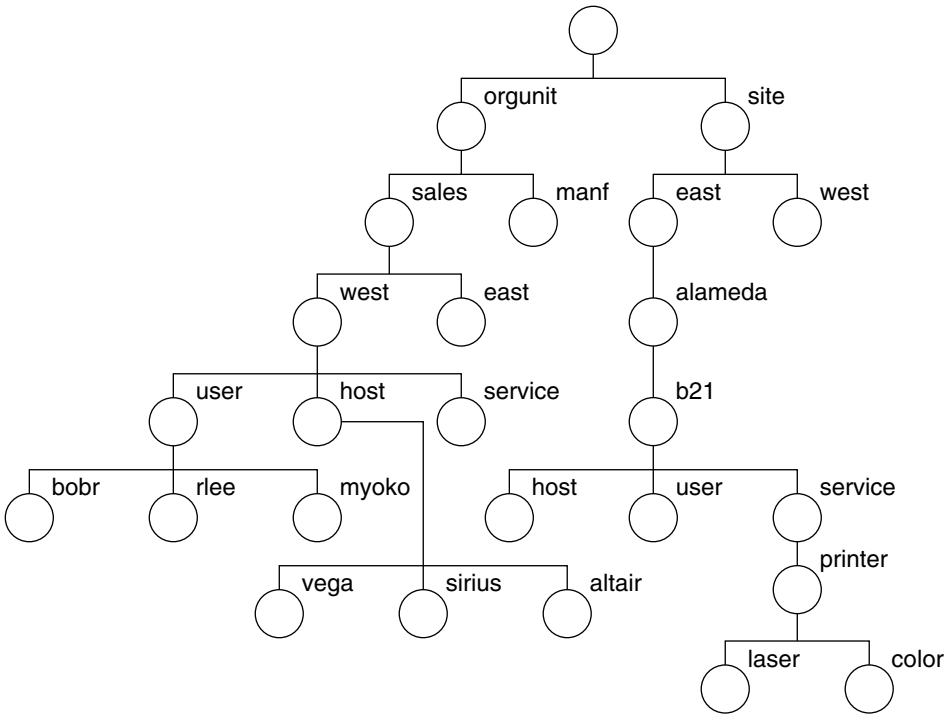


FIGURE A–1 Example of an Enterprise Namespace

The namespace of an enterprise is structured around a hierarchy of organizational units. Names of sites, hosts, users, files, and services can be named relative to names of organizational units by composing the organizational unit name with the appropriate namespace identifier and object name.

InFigure A–2 , a user `myoko` in the west division of the sales organization of an enterprise is named using the name `orgunit/west.sales/user/myoko`.

Note the use of the namespace identifier `user` to denote the transition from the `orgunit` namespace to the `user` namespace. In a similar fashion (with the use of appropriate namespace identifiers), names of files and services can also be named relative to names of sites, users, or hosts. Names of sites can be named relative to organizational unit names.

The goal of easy and uniform composability of names is met using this structure. For example, once you know the name for an organizational unit within an enterprise (for example, `orgunit/west`), you can name a user relative to it by composing it with the `user` namespace identifier and the user's login name to yield a name such as `orgunit/west/user/josepha`.

To name a file in this user's file system, you can use a name like `orgunit/west/user/josepha/fs/notes`.

Enterprise Root

The root context of an enterprise, is a context for naming objects found at the root level of the enterprise namespace. Enterprise roots are bound in the global namespace.

There are two ways of naming the enterprise root:

- `. . ./`*rootdomain*.
- `org//`.

Using Three Dots to Identify the Enterprise Root

You can use `. . .`/*rootdomain*`/` to identify an enterprise root where:

- The initial three dots (`. . .`) are an atomic name indicating the global context (see "Policies for the Global Namespace" on page 580 for a description of the global context).
- *rootdomain*`/` is the enterprise root domain. For example, `doc.com/`.

  Thus, `. . ./doc.com/` identifies the enterprise root of a company whose root domain is `doc.com`. In this example, the context for naming sites associated with the enterprise root is `. . ./doc.com/site/` such as `. . ./doc.com/site/alameda` or `. . ./doc.com/site/alameda.bldg5`.

Note – You can only use the `. . . /`*rootdomain* format if you have set up the global binding in DNS.

Using `org//` to Identify the Enterprise Root

You can use `org//` to identify an enterprise root. In essence, `org//` is an alias or functional equivalent for `. . . /`*domainname*`/`. When using `org//`, the double slashes identifies the root enterprise context and namespaces associated with it.

For example, `org//site/alameda` names the Alameda site associated with the enterprise root.

In contrast, `org/` or `orgunit/` (with a single slash) points to an organizational context which is not necessarily named relative to the enterprise root. For example, `org/sales/site/alameda`.

Enterprise Root Subordinate Contexts

The following objects can be named relative to the enterprise root:

- Organizational units in that enterprise
- Sites in the top organizational unit of the enterprise (an extension to XFN policies)
- Users in the top organizational unit of the enterprise
- Hosts in the top organizational unit of the enterprise
- Services for the top organizational unit of the enterprise
- File service for the top organizational unit of the enterprise

  These objects are named by composing the namespace identifier of the target object's namespace with the name of the target object.

Enterprise Root and Organizational Subunits

Organizational subunits can be named relative to the enterprise root.

Given an organization root name, you can compose names for its subordinate organizational unit contexts by using one of the namespace identifiers, `orgunit` or `_orgunit`.

For example, if `. . . /doc.com` is the name of an enterprise, the root of the context for naming organizational units is `. . . /doc.com/orgunit/`, and organizational unit

names look like `.../doc.com/orgunit/sales` and `.../doc.com/orgunit/west.sales`. Or, you could achieve the same result with `org//orgunit/sales`.

The following objects can be named relative to an organizational unit name:

- Sites for that organizational unit (an extension to the XFN policies)
- Hosts in that organizational unit
- Users in that organizational unit
- Services for that organization unit
- File service for that organizational unit

  For example, the name `...doc.com/orgunit/sales/service/calendar`, identifies the calendar service of the `sales` organizational unit. (See "Organizational Unit Namespace" on page 552 and "Composing Names Relative to Organizations" on page 556 for a more detailed description of naming objects relative to organization units.)

Enterprise Root and Sites

Sites are an extension to the XFN policies.

Sites can be named relative to

- The enterprise root
- An organizational unit

  Sites named relative to the enterprise root are the same as sites named relative to the top organizational unit. Given an organization name, you can compose a name for its site context by using one of the namespace identifiers, `site` or `_site`. For example, if the enterprise root is `../doc.com` the context for naming sites relative to the enterprise root is `../doc.com/site`. Sites would have names like `../doc.com/site/alameda`.

  The following objects can be named relative to a site name:

- Services at the site, such as the site schedule or calendar, printers, and faxes
- The file service available at the site

  These objects are named by composing the site name with the namespace identifier of the target object's namespace and the name of the target object. For example, the name `site/Clark.bldg-5/service/calendar` names the calendar service of the conference room `Clark.bldg-5` and is obtained by composing the site name `site/Clark.bldg-5` with the service name `service/calendar`. (See "Composing Names Relative to Sites" on page 557 for a more detailed description of naming objects relative to sites.)

Enterprise Root and Users

Users can be named relative to

- An organizational unit
- The enterprise root

  Users named relative to the enterprise root are the same as users named relative to the top organizational unit. Given an organization name, you can compose a name for its `username` context by using one of the namespace identifiers, `user` or `_user`. Thus, if `orgunit/east.sales` names an organization, then `orgunit/east.sales/user/hirokani` names a user `hirokani` in the `east.sales` organizational unit.

  The following objects can be named relative to a user name:
- Services associated with the user
- The user's files

  These objects are named by composing the user's name with the namespace identifier of the target object's namespace and the name of the target object. For example, the name `user/sophia/service/calendar` names the calendar for the user `sophia`. (See "User Namespace" on page 554 and "Enterprise Root and Users" on page 563 for more information on the user namespace and naming objects relative to users.)

Enterprise Root and Hosts

Hosts can be named relative to

- An organizational unit
- The enterprise root

  Hosts named relative to the enterprise root are the same as hosts named relative to the top organizational unit. Given an organization name, you can compose a name for its `hostname` context by appending one of the namespace identifiers, `host` or `_host`. Thus if `orgunit/west.sales` names an organization, the name `org/west.sales/host/altair` names a machine `altair` in the `west.sales` organizational unit.

  The following objects can be named relative to a host name:
- Services associated with the host
- Files exported by the host

  These objects are named by composing the host name with the namespace identifier of the target object's namespace and the name of the target object. For example, the name `host/sirius/fs/release` names the file directory `release` being exported by the machine `sirius`. (See "Host Namespace" on page 553 and "Composing Names Relative to Hosts" on page 557 for more information on the host namespace and naming objects relative to hosts.)

Enterprise Root and Services

A service can be named relative to

- An organizational unit
- The enterprise root
- A user
- A host
- A site

  Services named relative to the enterprise root are the same as services named relative to the top organizational unit.

  A service context is named by using the namespace identifiers `service` or `_service`, relative to the organization, site, user, or host with which it is associated. For example, if `orgunit/corp.finance` names an organizational unit, then `orgunit/corp.finance/service/calendar` names the `calendar` service of the organizational unit `corp.finance`. (See "Service Namespace" on page 555 and "Composing Names Relative to Services and Files" on page 558 for more information on the user namespace and naming objects relative to users.)

  FNS does not restrict the types of bindings in the service namespace. Applications can create contexts of a type other than service contexts and bind them in the service namespace.

  FNS supports the creation of *generic* contexts in the service context. A generic context is similar to a service context except that a generic context has an application-determined reference type. All other properties of a generic context are the same as a service context.

  For example, a company named World Intrinsic Designs Corp (WIDC), reserves the name `extcomm` in the service namespace to refer to a generic context for adding bindings related to its external communications line of products. The context bound to `extcomm` is a generic context, with reference type `WIDC_comm`. The only difference between this context and a service context is that this context has a different reference type.

  Service names should be registered with Sun Microsystems, Inc., as directed in "Service Name and Reference Registration" on page 555.

Enterprise Root and Files

A file namespace can be named relative to

- The enterprise root
- An organizational unit
- A user
- A host

- A site

  Files named relative to the enterprise root are the same as files named relative to the top organizational unit. A file context is named by using the namespace identifiers `fs` or `_fs`, relative to the organization, site, user, or host with which it is associated. For example, if `orgunit/accountspayable.finance` names an organizational unit, then the name `user/jsmith/fs/report96.doc` names her file `report96.doc`. The file service of the user defaults to her home directory, as specified in the NIS+ `passwd` table. (See "File Namespace" on page 554for more information on the user namespace.)

  There can be no other type of context subordinate to a file system.

Enterprise Root and Printers

The printer context is an extension of XFN policies.

A printer namespace can be named in the service context. A printer context is named by using the namespace identifier, `printer`, in the service context relative to

- An organizational unit
- A user
- A host
- A site

  For example, if `org/east.sales` names an organizational unit, then `org/eastsales/service/printer` names the printer service of the organizational unit `east.sales`. Thus, an individual printer named `lp1` would be identified as: `org/east.sales/service/printer/lp1`.

  There can be no other type of context subordinate to a printer.

Initial Context Bindings for Naming Within the Enterprise

An initial context is the starting place from which client users, hosts, and applications can (eventually) name any object in the enterprise namespace.

The figure below shows the same naming system as the one shown in Figure A–2, except that the initial context bindings are shaded and shown in italics. These initial contexts are shown from the point of view of the user, host, or application asking for a name to be resolved.

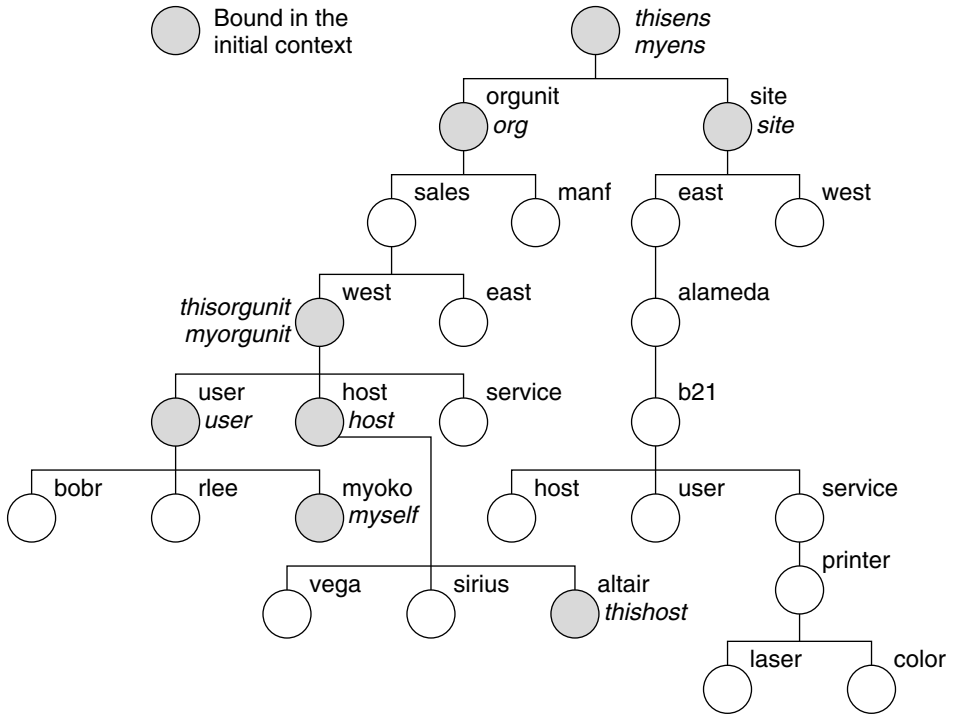


FIGURE A–2 Example of Enterprise Bindings in the Initial Context

XFN provides an *initial context function*, `fn_ctx_handle_from_initial()`, that allows a client to obtain an initial context object as a starting point for name resolution. The initial context has a flat namespace for namespace identifiers. The bindings of these initial context identifiers are summarized in Table A–27 and are described in more detail in subsequent sections. Not all of these names need to appear in all initial contexts. For example, when a program is invoked by the superuser, only the host and client-related bindings appears in the initial context, none of the user-related bindings appear.

TABLE A–27 Initial Context Bindings for Naming Within the Enterprise

Namespace Identifier	Binding
`myself`, `_myself`, `thisuser`	The context of the user who is trying to resolve a name.
`myens, _myens`	The enterprise root of the user who is trying to resolve a name.

TABLE A–27 Initial Context Bindings for Naming Within the Enterprise *(Continued)*

Namespace Identifier	Binding
`myorgunit, _myorgunit`	The user's primary organizational unit context. For example, in an NIS+ environment, the primary organizational unit is the user's NIS+ home domain.
`thishost, _thishost`	The context of the host that is trying to resolve a name.
`thisens, _thisens`	The enterprise root of the host that is trying to resolve a name.
`thisorgunit, _thisorgunit`	The host's primary organizational unit context. For example, in an NIS+ environment, the primary organizational unit is the host's NIS+ home domain
`user, _user`	The context in which users in the same organizational unit as the host are named
`host, _host`	The context in which hosts in the same organizational unit as the host are named
`org, orgunit, _orgunit`	The root context of the organizational unit namespace in the host's enterprise. For example, in an NIS+ environment, this corresponds to the NIS+ root domain
`site, _site`	The root context of the site namespace at the top organizational unit if the site namespace has been configured

In XFN terminology, names with a leading underscore prefix are called the *canonical* namespace identifiers. The names without the leading underscore, with the additions of `org` and `thisuser`, are Solaris customizations. Solaris customized namespace identifiers are not guaranteed to be recognized in other, non-Solaris operating environment. The canonical namespace identifiers are always recognized and therefore portable to other environments.

Note – The current implementations of FNS does not support the addition or modification of names and bindings in the initial context.

Initial context bindings fall into three basic categories:

- User-related bindings (see "User-related Bindings" on page 568)
- Host-related bindings (see "Host-related Bindings" on page 569)
- "Shorthand" bindings (see ""Shorthand" Bindings" on page 570)

User-related Bindings

FNS assumes that there is a user associated with a process when the XFN initial context function is invoked. This association is based on the effective user ID (*euid*) of the process. Although the association of user to process can change during the life of the process, the original context handle does not change.

FNS defines the following bindings in the initial context that are related to the user requesting name resolution.

myself

The namespace identifier `myself` (or either synonym `_myself` or `thisuser`) in the initial context resolves to the user context of whomever is making the request. For example, if a process owned by the user `jsmith` requests name resolution, the name:

- `myself` resolves in the initial context to `jsmith`'s user context
- `myself/fs/.cshrc` names the file `.cshrc` of `jsmith`

myorgunit

FNS assumes that each user is affiliated with an organizational unit of an enterprise. A user can be affiliated with multiple organizational units, but there must be one organizational unit that is primary, perhaps by its position in the organizational namespace or by the user's role in the organization.

- *NIS+*. In an NIS+ namespace, this organizational unit corresponds to the user's home domain (which could be a subdomain).
- *NIS*. In an NIS namespace, there is only one enterprise-level organizational unit which corresponds to the user's domain.
- *Files*. In a files-based namespace, there is only one organizational unit, org// which maps to `myorgunit`.

  The namespace identifier `myorgunit` (or `_myorgunit`) resolves in the initial context to the context of the primary organizational unit of the user making the request. For example, if the user making the request is `jsmith`, and `jsmith`'s home domain is `east.sales`, then `myorgunit` resolves in the initial context to the organizational unit context for `east.sales`, and the name `myorgunit/service/calendar` resolves to the calendar service of `east.sales`.

myens

FNS assumes that there is an association of a user to an enterprise. This corresponds to the namespace that holds `myorgunit`.

The namespace identifier myens (and _myens) resolves in the initial context to the enterprise root of the enterprise to which the user making the request belongs. For example, if jsmith is making the request, and jsmith's NIS+ home domain is east.sales, which in turn is in the NIS+ hierarchy with the root domain name of doc.com. The name myens/orgunit/ resolves to the top organizational unit of doc.com.

Note – Be careful about set-user-ID programs when using user-related composite names, such as myorgunit or myself/service, because these bindings depend on the effective user ID of a process. For programs that set-user-ID to root to access system resources on behalf of the caller, it is usually a good idea to call seteuid(getuid()) before calling fn_ctx_handle_from_initial().

Host-related Bindings

A process is running on a particular host when the XFN initial context function is invoked. FNS defines the following bindings in the initial context that are related to the host the process is running on.

thishost

The namespace identifier thishost (or _thishost) is bound to the host context of the host running the process. For example, if the process is running on the machine cygnus, thishost is bound to the host context of cygnus, and the name thishost/service/calendar refers to the calendar service of the machine cygnus.

thisorgunit

FNS assumes that a host is associated with an organizational unit. A host can be associated with multiple organizational units, but there must be one that is primary. In an NIS+ namespace, this organizational unit corresponds to the host's home domain.

The namespace identifier thisorgunit (or _thisorgunit) resolves to the primary organizational unit of the host running the process. For example, if that host is the machine cygnus, and cygnus's NIS+ home domain is west.sales, then thisorgunit resolves to the organizational unit context for west.sales and the name thisorgunit/service/fax refers to the fax service of the organizational unit west.sales.

thisens

FNS assumes that there is an association of a host to an enterprise. This corresponds to the namespace that holds `thisorgunit`.

The namespace identifier `thisens` (or `_thisens`) resolves to the enterprise root of the host running the process. For example, under NIS+, if the host's home domain is `sales.doc.com`, then the name `thisens/site/` resolves to the root of the site namespace of `doc.com`.

"Shorthand" Bindings

FNS defines the following "shorthand" bindings in the initial context to enable the use of shorter names to refer to objects in certain commonly referenced namespaces.

user

The namespace identifier `user` (or `_user`) is bound in the initial context to the username context in organizational unit of the host running the process. This allows other users in the same organizational unit to be named from this context.

From the initial context, the names `user` and `thisorgunit/user` resolve to the same context. For example, if the host running the process is a machine `altair` and `altair` is in the `east.sales` organizational unit, the name `user/medici` names the user `medici` in `east.sales`.

host

The namespace identifier `host` (or `_host`) is bound in the initial context to the hostname context organizational unit of the host running the process. This allows other hosts in the same organizational unit to be named from this context.

From the initial context, the names `host` and `thisorgunit/host` resolve to the same context. For example, if the host running the process is a machine named `sirius` and it is in the `east.sales` organizational unit, the name `host/sirius` names the machine `sirius` in the organizational unit `east.sales`.

org

The namespace identifier `org` (or `orgunit, _orgunit`) is bound in the initial context to the root context of the organization of the enterprise to which the host running the process belongs.

From the initial context, the names `org` and `thisens/orgunit` resolve to the same context. For example, if the host running the process is the machine `aldebaran` and `aldebaran` is in the enterprise `doc.com.`, the name `org/east.sales` names the organizational unit `east.sales` in `doc.com.`

site

The namespace identifier `site` (or `_site`) is bound in the initial context to the root of the site naming system of the top organizational unit of the enterprise to which the host running the process belongs.

From the initial context, the names `site` and `thisens/site` resolve to the same context. For example, if the host running the process is the machine `aldebaran` and `aldebaran` is in the enterprise `doc.com.`, the name `site/pine.bldg-5` names a conference room, pine in building 5 of `doc.com.`

FNS and Enterprise Level Naming

FNS provides a method for federating multiple naming services under a single, simple interface for basic naming operations. FNS is designed to work with three enterprise-level name services, NIS+, NIS and Files. FNS is also designed to work with applications such as printer and calendar service as described in "Target Client Applications of FNS Policies" on page 575

How FNS Policies Relate to NIS+

FNS stores bindings for enterprise objects in FNS tables which are located in domain-level `org_dir` NIS+ directories on NIS+ servers. FNS tables are similar to NIS+ tables. These FNS tables store bindings for the following enterprise namespaces:

- *Organization* namespaces as described in "NIS+ Domains and FNS Organizational Units" on page 572.
- *Hosts* namespaces as described in "NIS+ Hosts and FNS Hosts" on page 573
- *Users* namespace as described in "NIS+ Users and FNS Users" on page 573.
- *Sites* namespace which allows you to name geographical sites relative to the organization, hosts, and users.
- *Services* namespace which allows you to name services such a printer service and calendar service relative to the organization, hosts, and users.

NIS+ Domains and FNS Organizational Units

FNS names organization, user, and host enterprise objects within NIS+ which is the preferred Solaris enterprise name service. An NIS+ domain is comprised of logical collections of users and machines and information about them, arranged to reflect some form of hierarchical organizational structure within an enterprise.

FNS is implemented on NIS+ by mapping NIS+ domains to FNS organizations. An organizational unit name corresponds to an NIS+ domain name and is identified using either the fully qualified form of its NIS+ domain name, or its NIS+ domain name relative to the NIS+ root. The top of the FNS organizational namespace is mapped to the NIS+ root domain and is accessed using the name `org/` from the initial context.

In NIS+, users and hosts have a notion of a *home domain*. A host or user's home domain is the NIS+ domain that maintains information associated with them. A user or host's home domain can be determined directly using its NIS+ *principal name*. An NIS+ principal name is composed of the atomic user (login) name or the atomic host name and the name of the NIS+ home domain. For example, the user `sekou` with home domain `doc.com.` has an NIS+ principal name `sekou.doc.com` and the machine name `vega` has an NIS+ principal name `vega.doc.com`.

A user's NIS+ home domain corresponds to the user's FNS organizational unit. Similarly, a host's home domain corresponds to its FNS organizational unit.

Trailing Dot in Organization Names

The trailing dot in an organization name indicates that the name is a fully qualified NIS+ domain name. Without the trailing dot, the organization name is an NIS+ domain name to be resolved relative to the NIS+ root domain.

For example, if the NIS+ root domain is `doc.com.`, with a subdomain `sales.doc.com.`, the following pairs of names refer to the same organization:

TABLE A–28 Example of Relative and Fully Qualified Organization Names Under NIS+

Relative Name	Fully Qualified Name
org/	org/doc.com.
org/sales	org/sales.doc.com.

The name `org/manf.` (with trailing dot) would not be found, because there is no NIS+ domain with just the `manf.` name.

NIS+ Hosts and FNS Hosts

Hosts in the NIS+ namespace are found in the `hosts.org_dir` table of the host's home domain. Hosts in an FNS organization correspond to the hosts in the `hosts.org_dir` table of the corresponding NIS+ domain. FNS provides a context for each host in the `hosts` table.

NIS+ Users and FNS Users

Users in the NIS+ namespace are listed in the `passwd.org_dir` table of the user's home domain. Users in an FNS organization correspond to the users in the `passwd.org_dir` table of the corresponding NIS+ domain. FNS provides a context for each user in the `passwd` table.

NIS+ Security and FNS

The FNS `fncreate` command creates FNS tables and directories in the NIS+ hierarchy associated with the domain of the host on which the command is run. In order to run `fncreate`, you must be an authenticated NIS+ principle with credentials authorizing you to Read, Create, Modify, and Destroy NIS+ objects in that domain. You will be the *owner* of the FNS tables created by `fncreate`. One way to obtain this authorization is to be a member of the NIS+ group that has administrator privileges in the domain.

The `NIS_GROUP` environment variable should be set to name of the NIS+ administration group for the domain prior to running `fncreate`. You can specify whether or not individual users can make changes to FNS data that relates to them.

See Chapter 6, Security Overview, for a description of NIS+ security.

How FNS Policies Relate to NIS

FNS stores bindings for enterprise objects in FNS maps which are located in a `/var/yp/`*domainname* directory on the NIS master server (and NIS slave servers, if any). FNS maps are similar in structure and function to FNS maps. These NIS maps store bindings for the following enterprise namespaces:

- *Organization* which provides a namespace for naming objects relative to an entire enterprise. When NIS is the underlying naming service, there is a single organizational unit context that corresponds to the NIS domain. This organization unit context is identified in FNS by the NIS domain name or an empty name which defaults to the machines NIS domain name.

- *Hosts* namespace which correspond to the `hosts.byname` map of the NIS domain. FNS provides a context for each host in the `hosts.byname` map.
- *Users* namespace which correspond to the `passwd.byname` map. FNS provides a context for each user in the `passwd.byname` map of the domain.
- *Sites* namespace which allows you to name geographical sites relative to the organization, hosts, and users.
- *Services* namespace which allows you to name services such as a printer service and calendar service relative to the organization, hosts, and users.

  FNS provides contexts which allow other objects to be named relative to these five namespaces.

  The FNS `fncreate` command creates the FNS maps in the `/var/yp/`*domainname* directory of an NIS master server. This can be the same machine that is master server for the NIS naming service, or it can be a different machine that functions as an FNS master server. (If there are slave servers, NIS pushes the FNS maps to them as part of its normal operation.) To run `fncreate`, you must be a privileged user on the server that will host the FNS maps. Individual users cannot make changes to FNS data.

How FNS Policies Relate to Files-Based Naming

FNS stores bindings for enterprise objects in files which are located in a `/var/fn` directory which is normally NFS mounted on each machine. These FNS files store bindings for the following enterprise namespaces:

- *Organization* which provides a namespace for naming objects relative to the entire enterprise. When local files are the underlying naming service, there is a single organizational unit context that represents the entire system. This organization unit context is always identified in FNS as `org//`.
- *Hosts* namespace which correspond to the `/etc/hosts` file. FNS provides a context for each host in the `/etc/hosts` file.
- *Users* namespace which correspond to the `/etc/passwd` file. FNS provides a context for each user in the `/etc/passwd` file.
- *Sites* namespace which allows you to name geographical sites relative to the organization, hosts, and users.
- *Services* namespace which allows you to name services such as a printer service and calendar service relative to the organization, hosts, and users.

  FNS provides contexts which allow other objects to be named relative to these five namespaces.

  The FNS `fncreate` command creates the FNS files in the `/var/fn` directory of the machine on which the command is run. To run `fncreate`, you must have super-user privileges on that machine. Based on UNIX user IDs, individual users are allowed to modify their own contexts, bindings, and attributes using FNS

commands.

Target Client Applications of FNS Policies

One goal of the FNS policies is to maintain coherence across the most commonly used tools, including the file system, the DeskSet tools, such as Calendar Manager, Print Tool, File Manager, and Mail Tool, and services that support these tools, such as RPC, email, and print subsystems.

Note – Some of these examples are not currently implemented in the Solaris operating environment. They are listed here to illustrate how FNS can be used.

- *Calendars*. Instead of using names of the form *username@hostname* to access someone's calendar, in most cases you simply supply a site, organization, or user's name. You should also be able to use composite names to name calendars. For example, when federated under FNS, names of the following form are acceptable to calendar manager:
  - `bernadette`
  - `user/bernadette`
  - `site/pine.bldg-5` (calendar for Pine conference room)
  - `org/sales` (calendar for the sales organization)
- *Printing*. Instead of naming a specific printer by its name, you should be able to name a printer relative to a user, site, or organization. For example:
  - `ilych` (`ilych`'s default printer)
  - `org/sales` (an organization's default printer)
  - `site/pine.bldg-5` (printer in the Pine conference room)
- *File access*. You should be able to use composite names to name file systems and files. The automounter should use FNS to make resolution of composite names possible. For example, you should be able to use a file name like `/xfn/user/baruch/fs/.cshrc` to reference the `.cshrc` file for user `baruch`.
- *RPC*. Instead of addressing services by their host name, program, and version numbers, you should be able to name the service using a composite name. For example, you should be able to name an RPC service relative to a user or an organization such as: `user/hatori/service/rpc`.
- Mail – Similarly, composite names can be used to name mail destinations. You should be able to use names such as the following:
  - `angus`
  - `user/angus`
  - `org/mlist` (an organization's mailing list)
  - `site/pine.bldg-5` (mailbox of the conference room coordinator)

- Other desktop applications – You should be able to pass composite names to other desktop applications such as spreadsheets, document preparation tools, fax tools, and so on. Some of these applications attach their own namespace to the service namespace, thus becoming part of the FNS federation.

Example Applications: Calendar Service

This is a description of how one application, a calendar service, could be modified to use FNS policies. This example illustrates how FNS composite names might be presented to and accepted from users.

The DeskSet's calendar service is typical of client-server applications. Calendar servers run on some set of machines and maintain the users' calendars. Calendar Manager (`cm`) runs on the desktop and contacts the appropriate server to obtain the calendars of interest.

The calendar service could benefit from FNS using a simple registry/lookup model as follows:

- *Binding* – Upon startup, the server registers the calendars that it manages by binding a reference containing its own ONC+ RPC address (*host, program, version*) to the composite name for each calendar it manages, such as `user/jsmith/service/calendar`.
- *Lookup* – When using `cm`, the user specifies another user's calendar simply by entering the user's name (for example, `hirokani`) or selecting it from a list of names previously entered. Given the user name `hirokani`, `cm` composes the composite name `user/hirokani/service/calendar` and uses this to look up the RPC address that it needs to communicate with the server that manages that calendar.

  In the previous example, we used the name "`calendar`" to denote a calendar binding. The developers of the calendar service should register the name "`calendar`" with the FNS administrator, much as RPC programs are registered with the RPC administrator. Refer to "Service Name and Reference Registration" on page 555.

Note – The name "`calendar`" used here is an example. FNS policy does not specify the names of specific services.

The calendar service could take further advantage of FNS policy by allowing calendars to be associated with sites, organizations, and hosts, while still naming them in a uniform way. For example, by allowing calendars to be associated with a conference room (a site), the service can be used to "multibrowse" the conference room's calendar as well as a set of user calendars to find an available time for a

meeting in that room. Similarly, calendars can be associated with organizations for group meetings and hosts for keeping maintenance schedules.

The `cm` calendar manager could simplify what the user needs to specify by following some simple steps.

1. `cm` uses a tool for accepting composite names from the user and constructing the name of the object whose calendar is of interest.

   The object is the name of a user, a site, a host, or an organization. For example, the user might enter the name `kuanda` and the calendar manager generates the composite name `user/kuanda`. This tool could be shared among a group of DeskSet applications.
2. `cm` uses the XFN interface to compose this name with the suffix `/service/calendar` to obtain the name of the calendar.
3. This calendar name is then resolved relative to the process's initial context.

   Continuing with the example, this results in the resolution of the name `user/kuanda/service/calendar`. Similarly, if the user enters the name of a site, `pine.bldg-5`, `cm` generates the name `site/pine.bldg-5/service/calendar` for resolution.

   Other services such as printing and mail could take advantage of the FNS policies in a similar way.

FNS File System Namespace

Files may be named relative to users, hosts, organizations, and sites in FNS by appending the `fs` enterprise namespace identifier to the name of the object, and following this with the name of the file. For example, the file `draft96` in the sales division's `budget` directory might be named `org/sales/fs/budget/draft96`.

The initial context is located under `/xfn` in the file system's root directory. Thus a user might view the file by typing

```
% more /xfn/org/sales/fs/budget/draft96
```

Existing applications can access this directory just as they would any other directory. Applications do not need to be modified in any way or use the XFN API.

NFS File Servers

NFS is Sun's distributed file system. The files associated with an object will generally reside on one or more remote NFS file servers. In the simplest case, the namespace identifier `fs` corresponds to the root of an exported NFS file system, as shown in .Figure A–3.

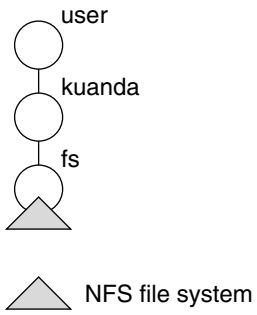


FIGURE A–3 NFS File System—Simple Case

In contrast, an object's file system may be composed of multiple—and possibly overlapping—remote mounts, woven together into a "virtual" directory structure managed by FNS.

Figure A–4 illustrates how this capability might be used to piece together an organization's file system from three separate file servers. The `project` directory, along with its `lib` subdirectory, resides on one file server, while the `src` subdirectory

resides on another. Users and applications need not be aware of the use of multiple servers; they see a single, seamless namespace.

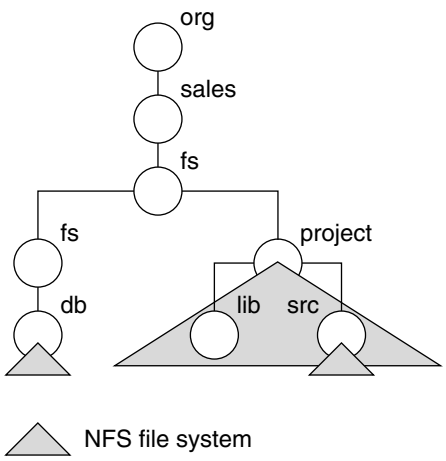


FIGURE A–4 NFS File System—Multiple Servers

The Automounter

For efficiency, the automounter is used to mount FNS directories on demand. The default `/etc/auto_master` configuration file contains the line:

```
/xfn -xfn
```

which tells the automounter that the FNS namespace is "mounted" under `/xfn`, as specified by XFN.

Since the automounter is used to mount directories named through FNS, the subdirectories of an FNS directory cannot be listed until they have been mounted. For example, suppose the file system of the sales organization is composed of multiple NFS file systems. The following `ls` command shows only two file systems that have been visited recently and are currently mounted:

```
% ls /xfn/org/sales/fs
customers products
```

To see the entire listing, use the `fnlist` command:

```
% fnlist org/sales/fs
Listing org/sales/fs:
products
goals
customers
incentives
```

The FNS Printer Namespace

The `printer` context is not part of the XFN policies. It is provided in FNS in order to store printer bindings.

FNS provides the capability to store printer bindings in the FNS namespace. This gives print servers the means to advertise their services and allow users to browse and choose among available printers without client-side administration.

Printer bindings are stored in printer contexts, which are associated with organizations, users, hosts, and sites. Hence, each organization, user, host, and site has its own `printer` context.

The `printer` context is created under the `service` context of the respective composite name. For example, the composite name shown below has the following `printer` context:

```
org/doc.com./service/printer
```

The name of a printer for a host, `deneb`, with a printer context might look like this:

```
host/deneb/service/printer/laser
```

Policies for the Global Namespace

Global name services have worldwide scope. This section describes the policies for naming objects that use global naming systems.

In regard to naming, an enterprise links to the federated global namespace by binding the root of the enterprise in the global namespace. This enables applications and users outside the enterprise to name objects within that enterprise. For example, a user within an enterprise can give out the global name of a file to a colleague in another enterprise to use.

DNS and X.500 contexts provide global-level name service for naming enterprises. FNS provides support for both DNS and X.500 contexts. Without FNS, DNS and X.500 allow outside access to only limited portions of the enterprise namespace. FNS enables outside access to the entire enterprise namespace including services such as calendar manager.

Initial Context Bindings for Global Naming

The atomic name "`. . .`" (three dots) appears in the initial context of every FNS client. The atomic name "`. . .`" is bound to a context from which global names can be resolved.

TABLE A–29 Initial Context Bindings for Global Naming

Atomic Name	Binding
`. . .`	Global context for resolving DNS or X.500 names
`/ . . .`	Synonym for three dots

Global names can be either fully qualified Internet domain names, or X.500 distinguished names.

- Internet domain names appear in the syntax specified by Internet RFC 1035. For example, `. . . /doc.com`. (See "Federating DNS" on page 581.)
- X.500 names appear in the syntax determined by the X/Open DCE Directory. For example, `. . . /c=us/o=doc`. (See "Federating X.500/LDAP" on page 582.)

  The names "`. . .`" and "`/ . . .`" are equivalent when resolved in the initial context. For example, the names `/ . . . /c=us/o=doc` and `. . . /c=us/o=doc` resolve in the initial context to the same object.

Federating DNS

Any fully qualified DNS name can be used in the global context. When a DNS name is encountered in the global namespace, it is resolved using the resolver library. The resolver library is the DNS name-resolution mechanism. A DNS name typically resolves to an Internet host address or to DNS domain records. When the global context detects a DNS name, the name is passed to the DNS resolver for resolution. The result is converted into an XFN reference structure and returned to the requester.

The contents of DNS domains can be listed. However, the listing operations might be limited by practical considerations such as connectivity and security on the Internet. For example, listing the global root of the DNS domain is generally not supported by the root DNS servers. Most entities below the root, however, do support the list operation.

DNS hosts and domains are distinguished from each other by the presence or absence of name service (NS) resource records associated with DNS resource names.

- *DNS domain names.* If an NS record exists for a resource name, then that name is considered to be the name of a domain, and the returned reference is of type `inet_domain`.

- *DNS host names.* If no NS record exists for a resource name, then that name is considered to be the name of a host, and the returned reference is of type `inet_host`.

DNS can be used to federate other naming systems by functioning as a non-terminal naming system.

For example, an enterprise naming system can be bound to `doc.com` in DNS such that the FNS name `. . ./doc.com/` refers to the root of that enterprise's FNS namespace.

The enterprise naming system is bound to a DNS domain by adding the appropriate text (TXT) records to the DNS map for that domain. When the FNS name for that domain includes a trailing slash (/), the TXT resource records are used to construct a reference to the enterprise naming system.

For general information about DNS, see the `in.named` man page or the DNS chapters in this guide.

Federating X.500/LDAP

X.500 is a global directory service. It stores information and provides the capability to look up information by name as well as to browse and search for information.

X.500 information is held in a directory information base (DIB). Entries in the DIB are arranged in a tree structure. Each entry is a named object and comprises a defined set of attributes. Each attribute has a defined attribute type and one or more values.

An entry is unambiguously identified by a *distinguished name* that is the concatenation of selected attributes from each entry in the tree along a path leading from the root down to the named entry. For example, using the DIB shown in Figure A–5,

`c=us/o=doc` is a distinguished name of the `doc` organization in the U.S. Users of the X.500 directory can interrogate and modify the entries and attributes in the DIB.

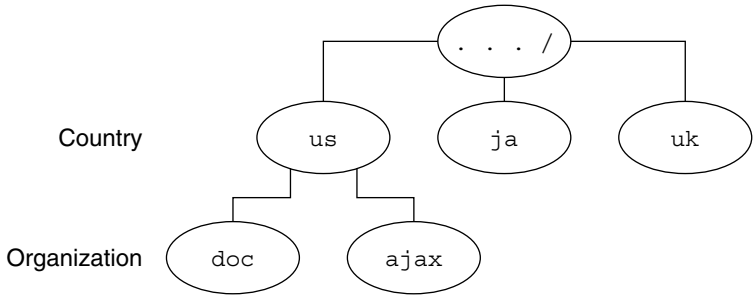


FIGURE A–5 Example of an X.500 Directory Information Base

FNS federates X.500 by supplying the necessary support to permit namespaces to appear to be seamlessly attached below the global X.500 namespace.

For example, FNS facilitates linking the enterprise naming system for the `doc` organization below X.500. Starting from the initial context, an FNS name to identify the `sales` organizational unit of the `doc` organization might be

```
.../c=us/o=doc/orgunit/sales
```

The name within the enterprise is simply concatenated onto the global X.500 name. (Note that FNS names use the name `"..."` in the initial context to indicate that a global name follows.)

Name resolution of FNS names takes place as follows. When an X.500 name is encountered in the global namespace, it is resolved using the X.500 name- resolution mechanism. One of three outcomes is possible:

- The full name resolves to an X.500 entry. This indicates that the entry is held in X.500. The requested FNS operation is then performed on that entry.
- A prefix of the full name resolves to an X.500 entry. This indicates that the remainder of the name belongs to a subordinate naming system.

  The next naming system pointer (NNSP) to the subordinate naming system is examined to return the XFN reference. Name resolution then continues in the subordinate naming system.
- An error is reported.

  X.500 entries can be examined and modified using FNS operations (subject to access controls). However, it is not currently possible to list the subordinate entries under the root of the X.500 namespace by using FNS.

FNS Problems and Solutions

This section presents problem scenarios with a description of probable causes, diagnoses, and solutions.

See [below]for general information about FNS error messages

Cannot Obtain Initial Context

Symptom:

You get the message `Cannot obtain initial context`.

Possible Cause:

This is caused by an installation problem.

Diagnosis:

Check that FNS has been installed properly by looking for the file, `/usr/lib/fn/fn_ctx_initial.so`.

Solution:

Install the `fn_ctx_initial.so` library.

Nothing in Initial Context

Symptom:

When you run `fnlist` to see what is in the initial context, you see nothing.

Possible Cause:

This is caused by an NIS+ configuration problem. The organization associated with the user and machine running the `fn*` commands do not have an associated `ctx_dir` directory.

Diagnosis:

Use the `nisls` command to see whether there is a `ctx_dir` directory.

Solution:

If there is no `ctx_dir` directory, run `fncreate -t org/`*`nis+_domain_name`*`/` to create the `ctx_dir` directory.

"No Permission" Messages (FNS)

Symptom:

You get `no permission` messages.

Possible Cause:

"No permission" messages mean that you do not have access to perform the command.

Diagnosis:

Check permission using the appropriate NIS+ commands, described in "Advanced FNS and NIS+ Issues" on page 538. Use the `nisdefaults` command to determine your NIS+ principal name.

Another area to check is whether you are using the right name. For example, `org//` names the context of the root organization. Make sure you have permission to manipulate the root organization. Or maybe you meant to specify `myorgunit/`, instead.

Solution:

If you do have permission, then the appropriate credentials probably have not been acquired.

This could be caused by the following:

- A `keylogin` has not been performed (defaults to NIS+ principal "nobody")
- A `keylogin` was made to a source other than NIS+

Check that the `/etc/nsswitch.conf` file has a `publickey: nisplus` entry. This might manifest itself as an authentication error.

`fnlist` Does not List Suborganizations

Symptom:

You run `fnlist` with an organization name, expecting to see suborganizations, but instead see nothing.

Possible Cause:

This is caused by an NIS+ configuration problem. Suborganizations must be NIS+ domains. By definition, an NIS+ domain must have a subdirectory named `org_dir`.

Diagnosis:

Use the `nisls` command to see what subdirectories exist. Run `nisls` on each subdirectory to verify which subdirectories have an `org_dir`. The subdirectories with an `org_dir` are suborganizations.

Solution:

Not applicable.

Cannot Create Host- or User-related Contexts

Symptom:

When you run `fncreate -t` for the `user`, `username`, `host`, or `hostname` contexts, nothing happens.

Possible Cause:

You have not set the `NIS_GROUP` environment variable. When you create a user or host context it is owned by the host or user, and not by the administrator who set up the namespace. Therefore, `fncreate` requires that the `NIS_GROUP` variable be set to enable the administrators who are part of that group to subsequently manipulate the contexts.

Diagnosis:

Check the `NIS_GROUP` environment variable.

Solution:

The `NIS_GROUP` environment variable should be set to the group name of the administrators who will administer the contexts.

Cannot Remove a Context You Created

Symptom:

When you run `fndestroy` on the `host` or `user` context the context is not removed.

Possible Cause:

You do not own the `host` or `user` context. When you create a `user` or `host` context it is owned by the host or user, and not by the administrator who set up the namespace.

Diagnosis:

Check the `NIS_GROUP` environment variable.

Solution:

The `NIS_GROUP` environment variable needs to be set to the group name of the administrator who will administer the contexts.

Name in Use with fnunbind

Symptom:

You get "name in use" when trying to remove bindings. It works for certain names but not for others.

Possible Cause:

You cannot unbind the name of a context. This restriction is in place to avoid leaving behind contexts that have no name ("orphaned contexts").

Diagnosis:

Run the `fnlist` command on the name to verify that it is a context.

Solution:

If the name is a context, use the `fndestroy` command to destroy the context.

Name in Use with fnbind/fncreate -s

Symptom:

You use the `-s` option with `fnbind` and `fncreate`, but for certain names you get "name in use."

Possible Cause:

`fnbind -s` and `fncreate -s`overwrite the existing binding if it already exists; but if the old binding is one that must be kept to avoid orphaned contexts, the operation fails with a "name in use" error because the binding could not be removed. This is done to avoid orphaned contexts.

Diagnosis:

Run the `fnlist` command on the name to verify that it is a context.

Solution:

Run the `fndestroy` command to remove the context *before* running `fnbind` or `fncreate` on the same name.

`fndestroy/fnunbind` Does Not Return `Operation Failed`

Symptom:

When you do an `fndestroy` or `fnunbind` on certain names that you know do *not* exist, you receive no indication that the operation failed.

Possible Cause:

The operation did not fail. The semantics of `fndestroy` and `fnunbind` are that if the terminal name is not bound, the operation returns success.

Diagnosis:

Run the `fnlookup` command on the name. You should receive the message, "name not found."

Solution:

Not applicable.

Some Common Error Messages

`attribute no permission`
:. The caller did not have permission to perform the attempted attribute operation.

`attribute value required`
:. The operation attempted to create an attribute without a value, and the specific naming system does not allow this.

`authentication failure`
:. The operation could not be completed because the principal making the request cannot be authenticated with the name service involved. If the service is NIS+, check that you are identified as the correct principal (run the command

nisdefaults) and that your machine has specified the correct source for publickeys. Check that the /etc/nsswitch.conf file has the entry, publickey: nisplus.

bad reference
:. FNS could not interpret the contents of the reference. This can result if the contents of the reference have been corrupted or when the reference identifies itself as an FNS reference, but FNS doesn't know how to decode it.

Cannot obtain Initial Context
:. Indicates an installation problem. See "Cannot Obtain Initial Context" on page 584.

communication failure
:. FNS could not communicate with the name service to complete the operation.

configuration error
An error resulted because of configuration problems. Examples:

(1) The bindings table is removed out-of-band (outside of FNS).

(2) A host is in the NIS+ hosts directory object but does not have a corresponding FNS host context.

context not empty
:. An attempt has been made to remove a context that still contains bindings.

continue operation using status values
:. The operation should be continued using the remaining name and the resolved reference returned in the status.

error
:. An error that cannot be classified as one of the other errors listed above occurred while processing the request. Check the status of the naming services involved in the operation and see whether any of them are experiencing extraordinary problems.

illegal name
:. The name supplied is not a legal name.

incompatible code sets
:. The operation involved character strings from incompatible code sets, or the supplied code set is not supported by the implementation.

`invalid enumeration handle`
:. The enumeration handle supplied is invalid. The handle could have been from another enumeration, an update operation might have occurred during the enumeration, or there might have been some other reason.

`invalid syntax attributes`
:. The syntax attributes supplied are invalid or insufficient to fully specify the syntax.

`link error`
:. An error occurred while resolving an XFN link with the supplied name.

`malformed link`
:. A malformed link reference was found during a `fn_ctx_lookup_link()` operation. The name supplied resolved to a reference that was not a link.

`name in use`
:. The name supplied is already bound in the context.

`name not found`
:. The name supplied was not found.

`no permission`
:. The operation failed because of access control problems. See ""No Permission" Messages (FNS)" on page 585. See also "No Permission" on page 445.

`no such attribute`
:. The object did not have an attribute with the given identifier.

`no supported address`
:. No shared library could be found under the `/usr/lib/fn` directory for any of the address types found in the reference bound to the FNS name. Shared libraries for an address type are named according to this convention: `fn_ctx_`*address_type*`.so`. Typically there is a link from `fn_ctx_`*address_type*`.so` to `fn_ctx_`*address_type*`.so.1`.

For example, a reference with address type `onc_fn_nisplus` would have a shared library in the path name: `/usr/lib/fn/fn_ctx_onc_fn_nisplus.so`.

`not a context`
:. The reference does not correspond to a valid context.

`partial result returned`
:. The operation returned a partial result.

`Success`
(1) The request was successful. This message is generated by the NIS+ error code constant: `NIS_SUCCESS`. See the `nis_tables` man page for additional information.

(2) :. Operation succeeded.

`syntax not supported`
:. The syntax type is not supported.

`too many attribute values`
:. The operation attempted to associate more values with an attribute than the naming system supports.

`unavailable`
:. The name service on which the operation depends is unavailable.

`link loop limit reached`
:. A nonterminating loop was detected due to XFN links encountered during composite name resolution, or the implementation-defined limit was exceeded on the number of XFN links allowed for a single operation.

APPENDIX **B**

Transitioning from NIS to NIS+

This appendix introduces the issues involved in converting from the NIS naming service to the NIS+ naming service. It describes the differences between the two name services and outlines a suggested transition process.

Differences Between NIS and NIS+

NIS and NIS+ have several differences with an impact on a transition. For example, NIS uses a flat, non-hierarchical namespace with only one domain (or several disconnected domains), while NIS+ provides a domain hierarchy similar to that of DNS. This means that before you can convert to NIS+, you must design the NIS+ namespace. NIS+ also provides security, which limits access not only to the information in the namespace but also to the structural components of the namespace.

These and other differences demonstrate that NIS+ is not only an upgrade to NIS but is an entirely new product. Therefore, the transition from NIS to NIS+ is largely directed by the differences between the products.

These differences aRe described in broad terms in the remainder of this chapter. Understanding them is critical to a successful transition to NIS+. They are:

- Domain structure.
- Interoperability.
- Server configuration.
- Information management.
- Security.

Domain Structure

NIS+ is not only an upgrade to NIS; it is designed to *replace* NIS. This becomes evident when you examine its domain structure. NIS domains are flat and lack the ability to have a hierarchy. NIS+ domains *may* be flat, but you can also construct hierarchical NIS+ domains. Such hierarchies consist of a root domain with an infinite number of subdomains under them.

The NIS domain structure addressed the administration requirements of client-server computing networks prevalent in the 1980s, in other words, client-server networks with a few hundred clients and a few multipurpose servers.

NIS+ is designed to support networks with 100 to 10,000 clients supported by 10 to 100 specialized servers located in sites throughout the world, connected to several "untrusted" public networks. The size and complexity of these networks requires new, autonomous administration practices. The NIS+ domain structure was designed to address these requirements. It consists of hierarchical domains similar to those of DNS, as shown in the following diagram:

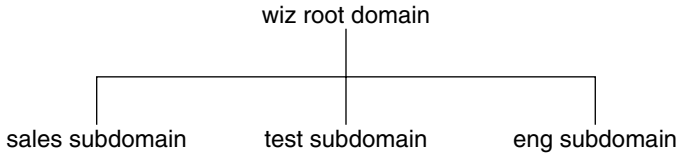


FIGURE B–1 NIS+ Domains

Hierarchical domains allow NIS+ to be used in a range of networks, from small to very large. They also allow the NIS+ service to adapt to the growth of an organization. The NIS+ domain structure is thoroughly described in "Domains" on page 63.

DNS, NIS, and NIS+ Interoperability

NIS+ provides Interoperability features designed for upgrading from NIS and for continuing the interaction with DNS originally provided by the NIS service. To help convert from NIS, NIS+ provides an NIS-compatibility mode and an information-transfer utility. The NIS-compatibility mode enables an NIS+ server running in the Solaris operating environment to answer requests from NIS clients while continuing to answer requests from NIS+ clients. The information-transfer utility helps administrators keep NIS maps and NIS+ tables synchronized.

NIS-compatibility mode requires slightly different setup procedures than those used for a standard NIS+ server. Also, NIS-compatibility mode has security implications for tables in the NIS+ namespace.

NIS client machines interact with the NIS+ namespace differently from NIS+ client machines when NIS+ servers are running in NIS-compatibility mode. The differences are:

- NIS client machines cannot follow NIS+ table paths or links, or do read operations in other domains.
- NIS client machines can have their unsatisfied host requests forwarded to DNS if you run `rpc.nisd` with the `-Y -B` options, but the NIS+ server will not forward these requests for an NIS+ client. DNS request forwarding for NIS+ client machines is controlled by the `/etc/resolv.conf` and `/etc/nsswitch.conf` files' configurations. See Chapter 1for more information.
- Authorized NIS+ administrators can use the `passwd` command to perform the full range of password-related administrative tasks, including password aging and locking. NIS+ client users can use the `passwd` command to change their own passwords.
- Even if all the servers on a local subnet no longer respond, the NIS+ client machines can still have their name service calls answered if they can contact any of the replicas of that domain. NIS client machines do not have access to information on the network outside their subnet unless the server names have been set with `ypset` or, for Solaris NIS clients only, with `ypinit`.
- NIS client machines cannot be sure that the data they are receiving comes from an authorized NIS server, while authorized NIS+ clients are certain that the data is coming from an authorized NIS+ server.
- Under NIS, if the server is no longer responding, the NIS `yp_match()` call continues to retry this call until the server responds and answers the request. The NIS+ API (Application Programming Interface) returns an error message to the application when this situation occurs.

In the Solaris 2.3 release, the NIS-compatibility mode *supports* DNS forwarding. In the Solaris 2.2 release, support for DNS forwarding is available as a *patch* (patch `#101022-06`). The DNS forwarding patch is *not* available in the Solaris 2.0 and 2.1 releases.

Although an NIS+ domain cannot be connected to the Internet directly, the NIS+ client machines can be connected to the Internet with the name service switch. The client can set up its switch-configuration file (`/etc/nsswitch.conf`) to search for information in either DNS zone files or NIS maps—in addition to NIS+ tables.

Server Configuration

The NIS+ client-server arrangement is similar to those of NIS and DNS in that each domain is supported by a set of servers. The main server is called the *master* server,

and the backup servers are called *replicas*. Both master and replica servers run NIS+ server software and both maintain copies of NIS+ tables.

However, NIS+ uses an update model that is completely different from the one used by NIS. At the time NIS was developed, it was assumed that most of the information NIS would store would be static. NIS updates are handled manually, and its maps have to be remade and fully propagated every time any information in the map changes.

NIS+, however, accepts *incremental* updates to the replicas. Changes must still be made to the master database on the master server, but once made, they are automatically propagated to the replica servers. You do not have to "make" any maps or wait hours for propagation. Propagation now takes a matter of minutes.

Information Management

NIS+ stores information in *tables* instead of maps or zone files. NIS+ provides 17 types of predefined or *system* tables, as shown in Figure B–2 .

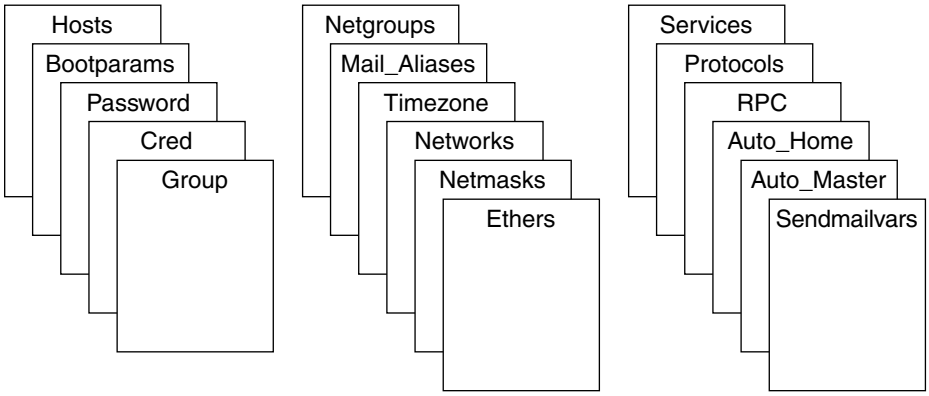


FIGURE B–2 NIS+ Standard Tables

NIS+ tables are not ASCII files, but are tables in the NIS+ relational database. You can view and edit their contents only by using the NIS+ commands.

NIS+ tables provide two major improvements over the maps used by NIS. First, an NIS+ table can be searched by any searchable column, not just the first column (sometimes referred to as the "key"). To know whether a particular column is searchable, run the `niscat -o` command on a table. The command returns a list of the table's columns and their attributes, one of which is whether a column is searchable. This search ability eliminates the need for duplicate maps, such as the

`hosts.byname` and `hosts.byaddr` maps used by NIS. Second, the information in NIS+ tables has access controls at three levels: the table level, the entry (row) level, and the column level.

NIS maps are located on the server in `/var/yp/`*domainname*, whereas NIS+ directories are located in `/var/nis/data`. The NIS+ tables are contained in the database. The tables' information is loaded into memory as requests are made to the database. Keeping data in memory in the order requested minimizes calls to the disk, thereby improving request response time.

Security

The security features of NIS+ protect the information in the namespace and the structure of the namespace itself from unauthorized access. NIS+ security is provided by two means: *authentication* and *authorization*. Authentication is the process by which an NIS+ server identifies the NIS+ *principal* (a client user or client machine) that sent a particular request. Authorization is the process by which a server identifies the access rights granted to that principal, whether a client machine or client user.

In other words, before users can access anything in the namespace, they must be authenticated NIS+ clients and they must have the proper permission to access that information. Furthermore, requests for access to the namespace are only honored if they are made either through NIS+ client library routines or NIS+ administration commands. The NIS+ tables and structures cannot be edited directly.

Suggested Transition Phases

The following outline is a suggested NIS-to-NIS+ transition:

1. Review basic transition principles.
2. Become familiar with NIS+.
3. Design your final NIS+ namespace.
4. Select security measures.
5. Decide how to use NIS-compatibility mode.
6. Complete prerequisites to transition.
7. Implement the transition.

The remainder of this chapter is a detailed discussion of these transition phases.

Transition Principles

Before you begin the transition, you should review the following basic principles:

Consider the Alternatives to Making the Transition Immediately

You can defer the upgrade to NIS+ until after your site has completed its transition to the Solaris operating environment. This allows you to focus your resources on one transition effort at a time. You can continue to run NIS under the Solaris operating environment until you are ready to make the transition to NIS+.

Keep Things Simple

You can take several steps to simplify the transition. While these steps will diminish the effectiveness of NIS+, they will consume fewer servers and less administrative time. After the transition is complete, you can change the NIS+ setup to better suit your needs. Here are some suggestions:

- Do not change domain names.
- Do not use any hierarchies; keep a flat NIS+ namespace.
- Use the NIS-compatibility features.
- Use default tables and directory structures.
- Do not establish credentials for clients, if you are running the Solaris 2.5 Release or later.

Use a Single Release of Software

Decide which version of the Solaris operating environmenta and NIS+ you will use for the transition. Because there are slight differences between versions, using multiple versions could needlessly complicate the transition process. Choose one version of the Solaris product and use its corresponding version of NIS+.

The current release has the most features (such as setup scripts). Make sure you compile a list of the Solaris operating environment patches that are required for normal operation, and make sure that all servers and clients have the same patches loaded.

Minimize Impact on Client Users

Consider the two major user-related factors: First, users should not notice any change in service. Second, the transition phase itself should cause minimal disruption to client users. To ensure the second consideration, be sure the administrators responsible for each domain migrate their client machines to NIS+, rather than ask the users to implement the migration. This ensures that proper procedures are implemented, that procedures are consistent across client machines, and that irregularities can be dealt with immediately by the administrator.

Things You Should Not Do

- Do not change the name services currently provided by NIS or change the way NIS functions.
- Do not change the structure of DNS.
- Do not change the IP network topology.
- Do not upgrade applications that use NIS to NIS+; leave the migration to NIS+ APIs for the future.
- Do not consider additional uses for NIS+ during the implementation phase; add them later.

Become Familiar With NIS+

Familiarize yourself with NIS+, particularly with the concepts summarized earlier in this chapter and discussed in the remainder of this book.

One of the best ways to become familiar with NIS+ is to build a prototype namespace. There is no substitute for hands-on experience with the product; administrators need the opportunity to practice in a forgiving test environment.

Note – Do not use your prototype domain as the basis for your actual running NIS+ namespace. Deleting your prototype after you have learned all you can from it will avoid namespace configuration problems. Start anew to create the real namespace after following all the planning steps.

When you create the test domains, make small, manageable domains. See “Creating a Sample NIS+ Namespace” on page 89, which describes how to plan and create a simple test domain and subdomain (with or without NIS-compatibility mode), using the NIS+ setup scripts.

Note – The NIS+ scripts described in are the recommended method for setting up an NIS+ namespace. The recommended procedure is to first set up your basic NIS+ namespace using the scripts, then customize that namespace for your particular needs, using the NIS+ command set.

Design Your Final NIS+ Namespace

Design the final NIS+ namespace, following the guidelines in“PLANNING THE NIS+ NAMESPACE: Identifying the Goals of Your Administrative Model” on page 601 . While designing the namespace, do not worry about limitations imposed by the transition from NIS. You can add those later, after you know what your final NIS+ goal is.

Plan Security Measures

NIS+ security measures provide a great benefit to users and administrators, but they require additional knowledge and setup steps on the part of both users and administrators. They also require several planning decisions. “PLANNING NIS+ SECURITY MEASURES: Understanding the Impact of NIS+ Security” on page 622 describes the implications of NIS+ security and the decisions you need to make for using it in your NIS+ namespace.

Decide How to Use NIS-Compatibility Mode

The use of parallel NIS and NIS+ namespaces is virtually unavoidable during a transition. Because of the additional resources required for parallel namespaces, try to develop a transition sequence that reduces the amount of time your site uses dual services or the extent of dual services within the namespace (for example, convert as many domains as possible to NIS+ only).

“BEFORE YOU TRANSITION TO NIS+: Gauge the Impact of NIS+ on Other Systems” on page 642 explains the transition issues associated with the NIS-compatibility mode and suggests a way to make the transition from NIS, through NIS compatibility, to NIS+ alone.

Implement the Transition

" IMPLEMENTING NIS+: Introduction" on page 648 provides suggested steps to implement the transition you have planned in the previous steps.

PLANNING THE NIS+ NAMESPACE: Identifying the Goals of Your Administrative Model

When designing the namespace, do not worry about limitations imposed by the transition from NIS. You can modify your NIS+ domain later, after you know how your final NIS+ configuration will look.

Select the model of information administration, such as the domain structure, that your site will use. Without a clear idea of how information at your site will be created, stored, used, and administered, it is difficult to make the design decisions suggested in this section. You could end up with a design that is more expensive to operate than necessary. You also run the risk of designing a namespace that does not suit your needs. Changing the namespace design after it has been set up is costly.

Designing the Namespace Structure

Designing the NIS+ namespace is one of the most important tasks you can perform, since changing the domain structure after NIS+ has been set up is a time-consuming, complex job. It is complex because information, security, and administration policies are woven into the domain structure of the namespace. Rearranging domains requires rearranging information, reestablishing security, and recreating administration policies.

When designing the structure of an NIS+ namespace, consider the factors which are discussed in the following sections of this chapter:

Domain Hierarchy

The main benefit of an NIS+ domain hierarchy is that it allows the namespace to be divided into more easily managed components. Each component can have its own security, information management, and administration policies. It is advisable to have a hierarchy when the number of clients you have exceeds 500, if you want to set up different security policies for a set of users, or if you have geographically distributed sites.

Unless there is a need for a domain hierarchy, not having a hierarchy can simplify your transition to NIS+. When all users were in the same NIS domain, they were directly visible to each other without using fully qualified names. Creating an NIS+ hierarchy, however, puts users in separate domains, which means that the users in one domain are not directly visible to users in another domain, unless you use fully qualified names or paths.

For example, if there are two subdomains, `sales.com.` and `factory.com.`, created out of the earlier `.com.` domain, then for user `juan` in the `sales.com.` domain to be able to send mail to user `myoko` in `factory.com.`, he would have to specify her name as `myoko@hostname.factory.com.` (or `myoko@hostname.factory`) instead of just `myoko`, as was sufficient when they were in the same domain. Remote logins also require fully qualified names between domains.

You could use the table path to set up connections between tables in one domain and another domain, but to do so would negate the advantages of having a domain hierarchy. You would also be reducing the reliability of the NIS+ service because now clients would have to depend upon the availability of not only their own home domains, but also of other domains to which their tables are pathed. Using table paths may also slow request response time.

Domain Hierarchy – Solaris 2.6 and Earlier

In Solaris 2.6 and earlier, the NIS+ servers for each subdomain are not part of the subdomain that they serve, with the exception of the root domain. The NIS+ servers are in the parent domain of the subdomain they serve. This relationship of server to subdomain creates problems for applications that expect the servers to be able to get their name-service data from the subdomain. For example, if a subdomain NIS+ server is also an NFS server, then the server does not get its netgroups information from the subdomain; instead, it retrieves the information from its domain, which is the domain above the subdomain; this can be confusing. Another example of when a hierarchy can cause problems is where the NIS+ server is also used by users to log in remotely and to execute certain commands that they cannot execute from their own machines. If you have only a single root domain, you do not have these problems because NIS+ root servers live in the domain that they serve.

Domain Hierarchy – Solaris 9

In the Solaris operating environment, the NIS+ server for a domain can be in the same domain it serves. This allows a server to set its domain name to the same as that used by its clients without affecting the server's ability to securely communicate with the rest of the domain hierarchy.

Designing a Domain Hierarchy

If you are unfamiliar with domain hierarchies, first read Chapter 2. It describes NIS+ domain structure, information storage, and security.

After you are familiar with the components of a domain hierarchy, make a diagram of how you expect the hierarchy to look when you are finished. The diagram will be a useful reference when you are in the midst of the setup procedure. At a minimum, you will need to consider the following issues:

- Organizational or geographical mapping
- Connection to higher domain.
- Client support in the root domain.
- Domain size compared to number of domains.
- Number of levels.
- Security levels.
- Replicas and number of replicas.
- Information management.

Remember that a domain is not an object, but a reference to a collection of objects. Therefore, a server that supports a domain is not actually associated with the domain

but with the domain's directories. A domain consists of four directories: *domain*, `ctx_dir.`*domain*, `org_dir.`*domain*, and `groups_dir.`*domain*, as shown below.

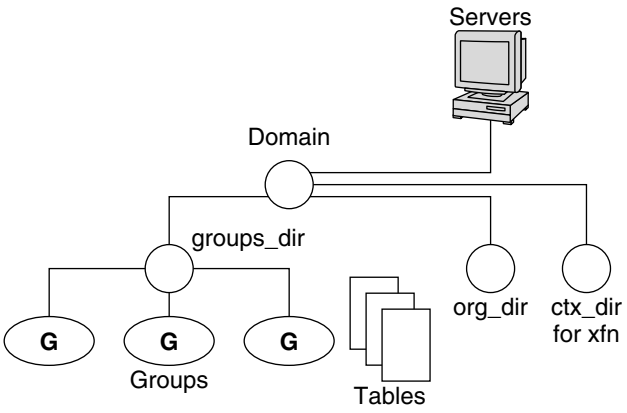


FIGURE B–3 Server Relationship to Domain

Organizational or Geographical Mapping

One of the major benefits of NIS+ is its capability of dividing the namespace into smaller, more manageable parts. You could create a hierarchy of organizations, such as those of the hypothetical corporation, Doc Inc., as shown below.

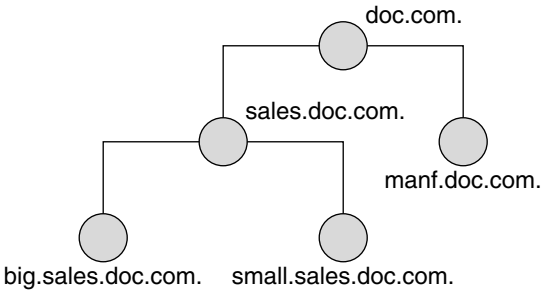


FIGURE B–4 Sample NIS+ Hierarchy by Logical Organization

You could also organize the hierarchy by buildings instead of organizations, as shown below.

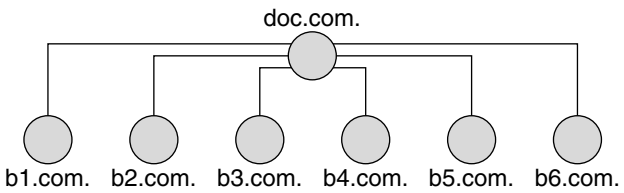


FIGURE B–5 Sample NIS+ Hierarchy by Physical Location

The scheme you select depends primarily on how you prefer to administer the namespace and how clients will tend to use the namespace. For example, if clients of `factory.com.` will be distributed throughout the buildings of Doc Inc., you should not organize the namespace by building. Because the clients constantly need to have access to other domains, you need to add their credentials to the other domains and you increase traffic flow through the root master server. A better scheme would be to arrange clients by organization. On the other hand, building-sized domains are immune to the reorganizations that require organization-based domains to be restructured.

Do not be limited by the physical layout of the network; an NIS+ namespace does not have to be congruent with the physical network, except where it has to support NIS clients. The number of domains your namespace needs depends on the kind of hierarchy you select.

Consider future expansion plans. Will today's NIS+ root domain be beneath another NIS+ domain in the future? Changing this arrangement would entail a great deal of work. Try to estimate the need for future domains in the namespace and design a structure that can accommodate them without disruption.

Connection to Higher Domains?

Consider whether the NIS+ namespace will be connected to higher domains, such as those of the Internet or DNS. If you currently use NIS under a DNS hierarchy, do you want to replace only the NIS domains or do you want to replace the entire company-wide DNS/NIS structure with an NIS+ namespace?

Client Support in the Root Domain

In the two Doc Inc., domain hierarchies illustrated in Figure B–4 and Figure B–5, are all the clients placed in domains beneath the root domain? Or do some belong to the root domain? Is the purpose of the root domain to act only as the root for its subdomains, or will it support its own group of clients? You could place all clients in the lowest layer of domains, and only those used for administration in the root and any intermediate domains. For example, if you implemented the plan in Figure B–4,

all clients would belong to the `big.sales.com.`, `small.sales.com.`, and `factory.com.` domains, and only clients used for administration would belong to the `.com.` and `sales.com.` domains.

Or you could place the clients of general-purpose departments in higher-level domains. For example, in Figure B–5, where the domain is organized by building, you could put the clients of the Facilities Department in the `.com.` domain. It is not recommended that you do so, however, because the root domain should be kept simple and relatively unpopulated.

Domain Size Compared With Number of Domains

The current NIS+ implementation is optimized for up to 1000 NIS+ clients per domain and for up to 10 replicas per domain. Such a domain would typically have 10,000 table entries. The limitations come from the current server discovery protocol. If you have more than 1000 NIS+ clients, you should divide your namespace into different domains and create a hierarchy.

Creating a hierarchy, however, may introduce more complexity than you are prepared to handle. You may still prefer to create larger domains rather than a hierarchy; because one large domain requires less administration than multiple smaller domains. Larger domains need fewer skilled administrators to service them, since tasks can be automated more readily (with scripts you create), thus lowering the administrative expense. Smaller domains provide better performance, and you can customize their tables more easily. You also achieve greater administrative flexibility with smaller domains.

Number of Levels

NIS+ was designed to handle multiple levels of domains. Although the software can accommodate almost any number of levels, a hierarchy with too many levels is difficult to administer. For example, the names of objects can become long and unwieldy. Consider 20 to be the limit for the number of subdomains for any one domain and limit the levels of the NIS+ hierarchy to 5.

Security Level

Typically, you will run the namespace at security level 2. However, if you plan to use different security levels for different domains, you should identify them now. “PLANNING NIS+ SECURITY MEASURES: Understanding the Impact of NIS+ Security” on page 622 provides more information about security levels.

Domains Across Time Zones

Geographically-dispersed organizations may determine that organizing their domain hierarchy by functional groups causes a domain to span more than one time zone. It is *strongly* recommended that you do *not* have domains that span multiple time zones. If you do need to configure a domain across time zones, be aware that a replica's time is taken from the master server, so the database updates will be synchronized properly, using Greenwich mean time (GMT). This may cause problems if the replica machine is used for other services that are time critical. To make domains across time zones work, the replica's `/etc/TIMEZONE` file has to be set locally to the master server's time zone when you are installing NIS+. After the replica is running, some time-critical programs may run properly and some may not, depending on whether these programs use universal or local time.

Information Management

It is best to use a model of local administration within centralized constraints for managing the information in an NIS+ namespace. Information should be managed, as much as possible, from within its home domain, but according to guidelines or policies set at the global namespace level. This provides the greatest degree of domain independence while maintaining consistency across domains.

Domain Names

Consider name length and complexity. First, choose names that are descriptive. For example, "Sales" is considerably more descriptive than "BW23A." Second, choose short names. To make your administrative work easier, avoid long names such as `administration_services.corporate_headquarters.doc.com.`

A domain name is formed from left to right, starting with the local domain and ending with the root domain. The root domain must always have at least two labels and must end in a dot. The second label can be an Internet domain name, such as "`com.`"

Also consider implications of particular names for email domains, both within the company and over the Internet.

Depending on the migration strategy, a viable alternative is to change domain names on NIS to the desired structure, then migrate to NIS+ domain by domain.

Email Environment

Because NIS+ can have a domain hierarchy while NIS has a flat domain space, changing to NIS+ can have effects on your mail environment. With NIS, only one mail

host is required. If you use a domain hierarchy for NIS+, you may need one mail host for each domain in the namespace because names in separate domains may be no longer unique.

Therefore, the email addresses of clients who are not in the root domain may change. As a general rule, client email addresses can change when domain names change or when new levels are added to the hierarchy.

In earlier Solaris releases, these changes required a great deal of work. This release provided several `sendmail` enhancements to make the task easier. In addition, NIS+ provides a `sendmailvars` table. The `sendmail` program first looks at the `sendmailvars` table (see Figure B–7, then examines the local `sendmail.cf` file.

Note – Be sure that mail servers reside in the NIS+ domain whose clients they support. For performance reasons, do not use paths to direct mail servers to tables in other domains.

Consider the impact of the new mail addresses on DNS. You may need to adjust the DNS MX records.

Determining Server Requirements

Each NIS+ domain is supported by a set of NIS+ servers. Each set contains one master and one or more replica servers. These servers store the domain's directories, groups, and tables, and answer requests for access from users, administrators, and applications. Each domain is supported by only one set of servers. While a single set of servers can support more than one domain, this is not recommended.

The NIS+ service requires you to assign at least one server, the master, to each NIS+ domain. How many replica servers a domain requires is determined by the traffic load, the network configuration, and whether NIS clients are present. The amount of server memory, disk storage, and processor speed is determined by the number of clients and the traffic load they place on the servers.

Any machine, running in the Solaris operating environment, can be an NIS+ server, as long as it has its own hard disk of sufficient size. The software for both NIS+ servers and clients is included in the Solaris product. Therefore, any machine that has the Solaris operating environment installed can become a server or a client, or both.

When determining what servers are needed to support your NIS+ namespace, consider these factors, discussed in the following sections:

Number of Supported Domains

To begin, you assign one master server to each domain in the hierarchy.The following figure shows one possible assignment.

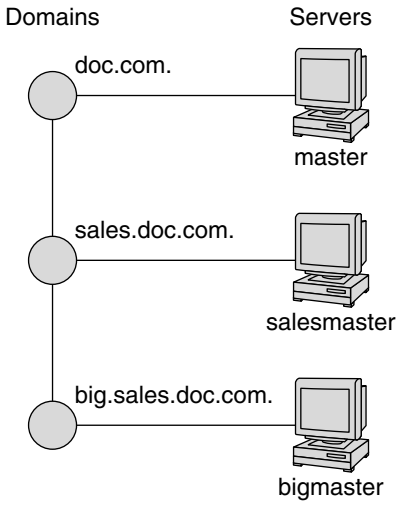


FIGURE B–6 Assigning Servers to Domains

Add one or more replicas to each domain. Replicas allow requests to be answered even if the master server is temporarily out of service. (See "Number of Replica Servers" on page 610 for information on how many replicas to use.)

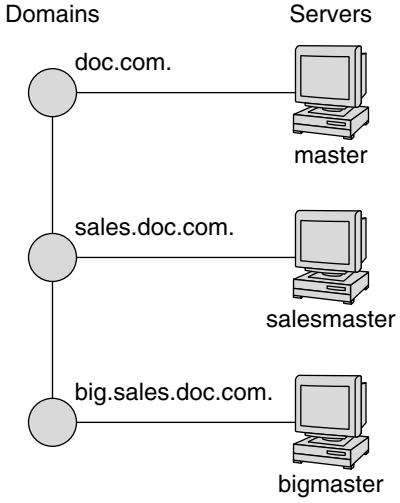


FIGURE B–7 Adding Replicas to a Domain

Number of Replica Servers

The optimum number of servers (master plus replicas) for a domain is determined by a number of factors:

- NIS+ master servers require fewer replicas than NIS servers, since NIS+ does not depend on broadcasts on the local subnet.
- Every domain should have at least one replica server so that NIS+ service is not disrupted when the master server is temporarily unavailable.
- No domain should have more than 10 replicas. This is because of the increased network traffic and server load when information updates are propagated to many replicas.
- The type of clients. Older, slower client machines require fewer replicas than do newer, faster machines.
- If the domain hierarchy that you design spans a wide area network (WAN) link, it is prudent to place a replica on either side of the WAN link. In other words, have a master server and one or more replicas on one side of the link and one or more replicas on the other side. This could possibly enable clients on the other side of the link to continue with NIS+ service even if the WAN link were temporarily disabled. (Putting servers on either side of a WAN, however, does change the structure of a namespace that is organized by group function rather than by physical layout, since the replica might physically reside within the geographic perimeter of a different domain.)

  In organizations with many distributed sites, each site often needs its own subdomain. The subdomain master is placed in a higher-level domain. As a result, there can be a great deal of traffic between point-to-point links. Creating local replicas can speed request response and minimize point-to-point traffic across the link. In this configuration, lookups may be handled locally.
- The number of subnets in a domain. If you can, put one replica on each subnet (but do not use more than 10 replicas for the entire domain). Note that you do not *have* to have a replica for every subnet unless you have Solaris 1.x NIS clients and you want NIS+ servers in NIS-compatibility mode to support the NIS clients. NIS clients do not have access to servers that are not on the same subnet. The only exceptions are Solaris NIS clients, which can use `ypinit`(1M) to specify a list of NIS servers. The netmask number in these cases would have to be set appropriately.
- How users and administrators perform lookups. A `niscat` *table* | `grep` *name* command uses far more server resources than does a `nismatch` *name table*command.

- The type of server. Newer, faster servers provide quicker, more efficient service than do older, slower machines. Thus, the more powerful your servers, the fewer of them you need.
- Number of clients. The more clients you have in a domain, the more replica servers you need. Try to keep fewer than 1000 clients in a domain. NIS+ clients present a higher load on servers than NIS clients. A large number of clients served by only a few servers can impact network performance.

  The table below summarizes the peak number of busy clients that a set of servers can handle without any slowing of response time. In the benchmark tests that produced these results, the clients were designed to make intensive use of NIS+ services. Each client made many NIS+ calls to simulate a peak load, rather than the average load experienced by normal production domains. Thus, the numbers shown in in the table below, illustrate configurations designed to meet peak load (as opposed to average load) without any slowing of response time.

  TABLE B–1 Server Configurations and Number of NIS+ Clients

Server and Replica Configuration	Peak Number of "Busy" Clients
Master: SS5-110	120
Master: SS5-110 Replica: SS10-40	220
Master: SS5-110 Replica: SS10-40 Replica: SS20-50	580
Master: Ultra-167	420
Master: Ultra-167 Replica: SS10-40	840

  These numbers indicate that if your clients make extensive use of NIS+ services, you should add an extra replica for approximately every 100–400 clients. If your replicas are SS5s, you should add a new replica for every 100 clients; if your replicas are Ultras, you should add a new replica for every 400 clients. You should adjust these figures according to your needs.

One way you can have a sufficient number of replicas per domain without using a multiplicity of machines is to create multihomed servers. A multihomed server is a machine with multiple ethernet or network interfaces. A multihomed server can serve multiple subnets in a domain. (While it is possible to have a master or replica serve multiple domains, that is not recommended.)

Server Speed

The faster the server, the better NIS+ performs. (However, at this time NIS+ servers cannot take advantage of SMP multithreaded hardware.) Your NIS+ servers should be

as powerful, or *more* powerful, than your average client. Using older machines as servers for newer clients is not recommended.

In addition to server speed, many other factors affect NIS+ performance. The numbers and kinds of users and hosts, the kinds of applications being run, network topology, load densities, and other factors, all affect NIS+ performance. Thus, no two networks can expect identical performance from the same server hardware.

The benchmark figures presented in the table below, are for comparison purposes only; performance on your network may vary. These benchmark figures are based on a test network with typical table sizes of 10,000 entries..

TABLE B–2 Hardware Speed Comparison NIS+ Operations

Machine	Number of Match Operations Per Second	Number of Add Operations Per Second
SS5-110	400	6
SS20-50	440	6
PPro-200	760	13
Ultra-167	800	11
Ultra-200	1270	8

Server Memory Requirements

Although 32 Mbytes is the *absolute minimum* memory requirement for servers, it is better to equip servers of medium-to-large domains with *at least* 64 Mbytes.

Ideally, an NIS+ server should have enough memory to hold all the entries of all the searchable columns of all the operative NIS+ tables in RAM at one time. In other words, optimal server memory is equal to the total memory requirements of all the NIS+ tables.

For illustration purposes, the table below shows memory requirements for the `netgroup` table with five searchable columns, and Table B–4 shows the approximate memory requirements for the `passwd`, `t`, and `cred` tables.

TABLE B–3 Server Memory Required for `netgroups` Table

Number of Entries	Server Memory Usage in Mbytes
6,000	4.2
60,000	39.1
120,000	78.1

TABLE B–3 Server Memory Required for `netgroups` Table *(Continued)*

Number of Entries	Server Memory Usage in Mbytes
180,000	117.9
240,000	156.7
300,000	199.2

TABLE B–4 Approximate Memory Required for `passwd` Table

Number of Entries	Server Memory Usage in Mbytes
6,000	3.7
60,000	31.7
120,000	63.2
180,000	94.9
240,000	125.8
300,000	159.0
1,000,000	526.2

For the other tables, you can estimate the memory size by multiplying the estimated number of entries times the average number of bytes per entry for each searchable column. For example, suppose you have a table with 10,000 entries and two searchable columns. The average number of bytes per entry in the first column is 9, the average number of bytes per entry in the second column is 37. Your calculation is: (10,000x9)+(10,000x37)=460,000.

Note – When estimating the number of entries in the `cred` table, keep in mind that every *user* will have *two* entries (one for the user's Local credential and one for the user's DES credential). Each machine will have only one entry.

See "NIS+ Standard Tables" on page 615 for the number of searchable columns in each of the standard NIS+ tables.

Server Disk Space Requirements

How much disk space you need depends on four factors:

- Disk space consumed by the Solaris operating environment
- Disk space for `/var/nis` (and `/var/yp` if using NIS compatibility).

- Amount of server memory.
- Swap space required for NIS+ server processes.

The Solaris operating environment can require over 220 Mbytes of disk space, depending on how much of it you install. For exact numbers, see your Solaris installation guides. You should also count the disk space consumed by other software the server might use. The NIS+ software itself is part of the Solaris operating environment distribution, so it does not consume additional disk space.

NIS+ directories, groups, tables, and client information are stored in `/var/nis`. The `/var/nis` directory uses about 5 Kbytes of disk space per client. For example purposes only, if a namespace has 1000 clients, `/var/nis` requires about 5 Mbytes of disk space. However, because transaction logs (also kept in `/var/nis`) can grow large, you may want additional space per client—an additional 10–15 Mbytes is recommended. In other words, for 1000 clients, allocate 15 to 20 Mbytes for `/var/nis`. You can reduce this if you checkpoint transaction logs regularly. You should also create a separate partition for `/var/nis`. This separate partition will help during an operating system upgrade.

If you will use NIS+ concurrently with NIS, allocate space equal to the amount you are allocating to `/var/nis` for `/var/yp` to hold the NIS maps that you transfer from NIS.

You also need swap space equal to twice the size of `rpc.nisd`—in addition to the server's normal swap space requirements. To see the amount of memory being used by `rpc.nisd` on your system, run the `nisstat` command. See the `rpc.nisd` man page for more information. Most of this space is used during callback operations or when directories are checkpointed (with `nisping -C`) or replicated, because during such procedures, an entire NIS+ server process is forked. In no case should you use less than 64 Mbytes of swap space.

Determining Table Configurations

NIS+ tables provide several features not found in simple text files or maps. They have a column-entry structure, accept search paths, can be linked together, and can be configured in several different ways. You can also create your own custom NIS+ tables. When selecting the table configurations for your domains, consider the following factors discussed in the following sections:

Differences Between NIS+ Tables and NIS Maps

NIS+ tables differ from NIS maps in many ways, but two of those differences should be kept in mind during your namespace design:

- NIS+ uses fewer standard tables than NIS.
- NIS+ tables interoperate with `/etc` files differently than NIS maps did in the SunOS 4.x releases.

NIS+ Standard Tables

Review the 17 standard NIS+ tables to make sure they suit the needs of your site. They are listed in "NIS+ Standard Tables" on page 615. Table B–6 lists the correspondences between NIS maps and NIS+ tables.

Do not worry about synchronizing related tables. The NIS+ tables store essentially the same information as NIS maps, but they consolidate similar information into a single table (for example, the NIS+ hosts table stores the same information as the `hosts.byaddr` and `hosts.byname` NIS maps). Instead of the key-value pairs used in NIS maps, NIS+ tables use columns and rows. (See Table B–6.) Key-value tables have two columns, with the first column being the key and the second column being the value. Therefore, when you update any information, such as host information, you need only update it in one place, such as the hosts table. You no longer have to worry about keeping that information consistent across related maps.

Note the new names of the automounter tables:

- `auto_home` (old name: `auto.home`)
- `auto_master` (old name: `auto.master`)

The dots were changed to underscores because NIS+ uses dots to separate directories. Dots in a table name can cause NIS+ to mistranslate names. For the same reason, machine names cannot contain any dots. You must change any machine name that contains a dot to something else. For example, a machine named `sales.alpha` is not allowed. You could change it to `sales_alpha` or `salesalpha` or any other name that does not contain a dot.

To make the transition from NIS to NIS+, you must change the dots in your NIS automounter maps to underscores. You may also need to do this on your clients' automounter configuration files. Refer to the following table:

TABLE B–5 NIS+ Tables

NIS+ Table	Information in the Table
`hosts`	Network address and host name of every machine in the domain

TABLE B–5 NIS+ Tables *(Continued)*

NIS+ Table	Information in the Table
bootparams	Location of the root, swap, and dump partition of every diskless client in the domain
passwd	Password information about every user in the domain
cred	Credentials for principals who belong to the domain
group	The group password, group ID, and members of every UNIX® group in the domain
netgroup	The netgroups to which machines and users in the domain may belong
mail_aliases	Information about the mail aliases of users in the domain
timezone	The time zone of the domain
networks	The networks in the domain and their canonical names
netmasks	The networks in the domain and their associated netmasks
ethers	The ethernet address of every machine in the domain
services	The names of IP services used in the domain and their port numbers
protocols	The list of IP protocols used in the domain
rpc	The RPC program numbers for RPC services available in the domain
auto_home	The location of all user's home directories in the domain
auto_master	Automounter map information
sendmailvars	Stores the mail domain

TABLE B–6 Correspondences Between NIS Maps and NIS+ Tables

NIS Map	NIS+ Table	Notes
auto.home	auto_home	
auto.master	auto_master	
bootparams	bootparams	
ethers.byaddr	ethers	
ethers.byname	ethers	
group.bygid	group	Not the same as NIS+ groups
group.byname	group	Not the same as NIS+ groups
hosts.byaddr	hosts	

TABLE B–6 Correspondences Between NIS Maps and NIS+ Tables *(Continued)*

NIS Map	NIS+ Table	Notes
hosts.byname	hosts	
mail.aliases	mail_aliases	
mail.byaddr	mail_aliases	
netgroup	netgroup	
netgroup.byhost	netgroup	
netgroup.byuser	netgroup	
netid.byname	cred	
netmasks.byaddr	netmasks	
networks.byaddr	networks	
networks.byname	networks	
passwd.byname	passwd	
passwd.byuid	passwd	
protocols.byname	protocols	
protocols.bynumber	protocols	
publickey.byname	cred	
rpc.bynumber	rpc	
services.byname	services	
ypservers		Not needed

NIS+ has one new table for which there is no corresponding NIS table: `sendmailvars`. The `sendmailvars` table stores the `mail` domain used by `sendmail`.

NIS+ Tables Interoperate Differently With `/etc` Files

The manner in which NIS and other network information services interacted with `/etc` files in the SunOS 4.x environment was controlled by the `/etc` files using the `+/-` syntax. How NIS+, NIS, DNS and other network information services interact with `/etc` files in the Solaris operating environment is determined by the *name service switch*. The *switch* is a configuration file, `/etc/nsswitch.conf`, located on every Solaris operating environment client. It specifies the sources of information for that

client: /etc files, DNS zone files (hosts only), NIS maps, or NIS+ tables. The nsswitch.conf configuration file of NIS+ clients resembles the simplified version in the following example.

EXAMPLE B–1 Simplified Name Service Switch File

```
passwd: files

group: compat

group_compat: nisplus

hosts: nisplus dns [NOTFOUND=return] files

services: nisplus [NOTFOUND=return] files

networks: nisplus [NOTFOUND=return] files

protocols: nisplus [NOTFOUND=return] files

rpc: nisplus [NOTFOUND=return] files

ethers: nisplus [NOTFOUND=return] files

netmasks: nisplus [NOTFOUND=return] files

bootparams: nisplus [NOTFOUND=return] files

publickey: nisplus

netgroup: nisplus

automount: files nisplus

aliases: files nisplus
```

In other words, for most types of information, the source is first an NIS+ table, then an /etc file. For the passwd and group entries, the sources can either be network files or from /etc files and NIS+ tables as indicated by +/- entries in the files.

You can select from three versions of the switch-configuration file or you can create your own. For instructions, see Chapter 1 .

Use of Custom NIS+ Tables

Determine which nonstandard NIS maps you use and their purpose. Can they be converted to NIS+ or replaced with NIS+ standard maps?

Some applications may rely on NIS maps. Will they still function the same way with NIS+, and can they function correctly in a mixed environment?

To build a custom table in NIS+, use `nistbladm`. Remember that you cannot use dots in the table names.

If you want to use NIS+ to support your custom NIS maps, you should create a key-value table, a table with two columns. The first column is the key and the second column is the value. If you then run the NIS+ servers in NIS-compatibility mode, the NIS clients will not notice any change in functionality.

Connections Between Tables

NIS+ tables contain information only about the resources and services in their home domain. If a client tries to find information that is stored in another domain, the client has to provide the other domain name. You can make this "forwarding" automatic by connecting the local table to the remote table. NIS+ tables can be connected in two different ways:

- Through *paths*.
- Through *links*.

Do not use paths and links if you are going to have NIS clients in the NIS+ namespace, because NIS clients are unable to follow the paths or links to find the appropriate information.

Paths

If information in a particular NIS+ table is often requested by clients in other domains, consider establishing a path from the local NIS+ table to the one in the other domain. Refer to the following figure:

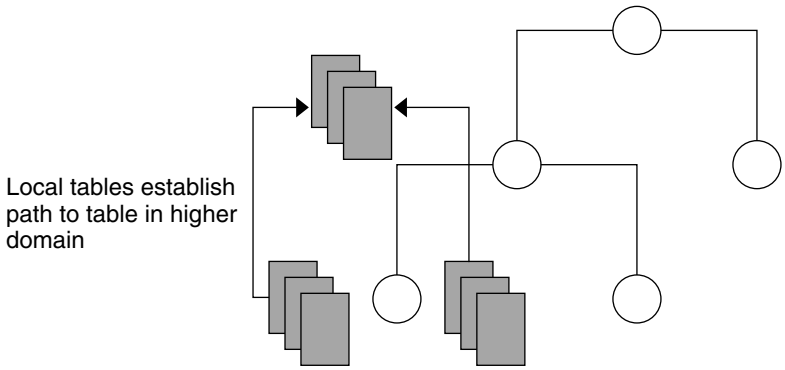


FIGURE B–8 Establishing a Path to Tables in a Higher Domain

Such a path has two main benefits. First, it saves clients in lower domains the trouble of explicitly searching through a second table. Second, it allows the administrator in the higher-level domain to make changes in one table and render that change visible to clients in other domains. However, such a path can also hurt performance. Performance is especially affected when searches are unsuccessful, because the NIS+ service must search through two tables instead of one. When you use paths, a table lookup now also depends upon the availability of other domains. This dependence can reduce the net availability of your domain. For these reasons, use paths only if you do not have any other solution to your problem.

You should also be aware that since "mailhost" is often used as an alias, when trying to find information about a specific mail host, you should use its fully qualified name in the search path (for example, `mailhost.sales.com.`); otherwise NIS+ will return *all* the "mailhosts" it finds in all the domains it searches through.

The path is established in the local table, with the `-p` option to the `nistbladm` command. To change a table's path, you must have modify access to the table object. To find a table's search path, use the `niscat -o` command (you must have read access to the table).

Links

Links between tables produce an effect similar to paths, except that the link involves a search through only one table: the remote table. With a search path, NIS+ first searches the local table, and only if it is unsuccessful does it search the remote table. With a

link, the search moves directly to the remote table. In fact, the remote table virtually replaces the local table. The benefit of a link is that it allows a lower domain to access the information in a higher domain without the need to administer its own table.

To create a link, use the `nisln` command. You must have modify rights to the table object.

Deciding whether to use a path or to link NIS+ tables in a domain is a complex decision, but here are some basic principles:

- Every domain must have access to every standard table.
- Volatile, frequently accessed data should be located lower in the hierarchy. Such data should be located closer to where it is used most often.
- Data that is accessed by several domains should be located higher in the hierarchy, unless the domains need to be independent.
- The lower in the hierarchy you place data, the easier it is to administer autonomously.
- Only NIS+ clients can see tables connected by paths and links. They cannot be seen by NIS clients, as illustrated by the following figure:

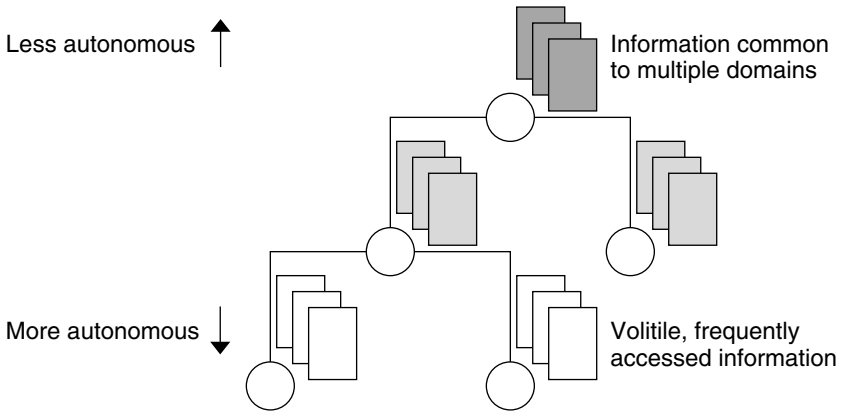


FIGURE B–9 Information Distribution Across an NIS+ Hierarchy

Resolving User/Host Name Conflicts

NIS+ cannot distinguish between a human principal and a machine principal when requests are made. Therefore, all user names must be different from machine names in

the same namespace. In other words, within a given namespace, no user can have the same user name as a machine name, and no machine can have the same name as any user ID.

For example, under NIS it was acceptable to have a user with the login name of `irina` whose local machine is also named `irina`. Her network address would be `irina@irina`. This is not allowed under NIS+. When the site is converted to NIS+, either the user will have to change her login name or her machine name. Identical user and machine names are a problem even when the machine with the duplicate name does not belong to the user with the same name. The following examples illustrate duplicate name combinations not valid with NIS+:

- `jane@jane` in the same namespace
- `patna@peshawar` and `rani@patna` in the same namespace

The best solution to this problem is to check all `/etc` files and NIS maps before you use the data to populate NIS+ tables. If you find duplicate names, change the machine names rather than the login names, and later create an alias for the machine's old name.

PLANNING NIS+ SECURITY MEASURES: Understanding the Impact of NIS+ Security

Because NIS+ provides security that NIS did not, it requires more administrative work. It may also require more work from users who are not accustomed to performing `chkey`, `keylogin`, or `keylogout` procedures. Furthermore, the protection provided by NIS+ is not entirely secure. Given enough computing power and the right knowledge, the Diffie-Hellman public-key cryptography system can be broken.

Using Diffie-Hellman keys longer than 192 bits significantly increases NIS+ security. You might, however, experience a degradation in performance as the longer key length requires more time to authenticate.

Note – Use `nisauthconf` to configure the type of Diffie-Hellman key. See `nisauthconf`(1M) for information about using longer keys.

In addition, the secret key stored with the key server process is not automatically removed when a credentialed nonroot user logs out unless that user logs out with

keylogout(1). Security may be compromised even if the user logs out with keylogout(1) because the session keys may remain valid until they expire or are refreshed. (See keylogout(1) for more information.) Root's key, created by keylogin -r and stored in /etc/.rootkey, remains until the .rootkey file is explicitly removed. The superuser cannot use keylogout. Nevertheless, NIS+ is much more secure than NIS.

How NIS+ Security Affects Users

NIS+ security benefits users because it improves the reliability of the information they obtain from NIS+ and it protects their information from unauthorized access. However, NIS+ security requires users to learn about security and requires them to perform a few extra administrative steps.

Although NIS+ requires a network login, users are not required to perform an additional key login because the login command automatically gets the network keys for the client when the client has been correctly configured. Clients are correctly configured when their login password and their Secure RPC password are the same. The secret key for the user root is normally made available in the /etc/.rootkey file (with a possible security problem, as noted earlier). When the NIS+ user password and credential are changed with the passwd command, the credential information is automatically changed for the user.

- To change the NIS+ machine's local root password, run the passwd command.
- To change the root credential, run the chkey command.

However, if your site allows users to maintain passwords in their local /etc/passwd files in addition to their Secure RPC passwords, and if these passwords are different from the Secure RPC passwords, then users must run keylogin each time they run login.

How NIS+ Security Affects Administrators

Because the Solaris operating environment includes the DES encryption mechanism for authentication, administrators who require secure operation do not need to purchase a separate encryption kit. However, administrators must train users how to use the passwd and the passwd -r commands, and when to use them.

Furthermore, setting up a secure NIS+ namespace is more complex than setting up a namespace without any security. The complexity comes not only from the extra steps required to set up the namespace, but from the job of creating and maintaining user and machine credentials for all NIS+ principals. Administrators have to remove obsolete credentials just as they remove inactive account information from the passwd and hosts tables. Also, when servers' public keys change, administrators have to

update the keys throughout the namespace (using `nisupdkeys`). Administrators also have to add LOCAL credentials for users from other domains who want to remote login to this domain and have authenticated access to NIS+.

How NIS+ Security Affects Transition Planning

After you become familiar with the benefits and the administrative requirements of NIS+ security, you must decide whether to implement NIS+ security during or after the transition. It is recommended that you use full NIS+ security even if you operate some or all servers in a domain in NIS-compatibility mode. (All servers in a domain should have the same NIS-compatibility status.) However, this entails a heavy administrative burden. If you prefer a simpler approach, you could set up the NIS+ servers and namespace with NIS-compatible security, but decline to create credentials for NIS+ clients. Administrators and servers would still require credentials. The NIS+ clients would be relegated to the nobody class, along with the NIS clients. This reduces training and setup requirements, but it has the following drawbacks:

- Users lose the ability to update any NIS+ tables, but they retain their ability to change their login password. (Solaris 2.5 through Solaris 9 only.)
- Users are not able to verify that the name service information is coming from an authenticated NIS+ server.

Selecting Credentials

NIS+ provides two types of credential: LOCAL and DES.

Note – In this manual, the term, DES credentials, applies to the extended 640–bit Diffie-Hellman keys as well as to the original 192–bit Diffie-Hellman (default) key length. In the `cred` table, the extended keys use designations such as `DH640-0`, rather than the `DES` keyword. See `nisauthconf`(1M) for information about using longer keys.

All NIS+ principals need at least one of these credentials. When the namespace is running at security level 2 (the default), all NIS+ principals (clients) must have DES credentials in their home domains. In addition, all users (not machines) must have LOCAL credentials in their home domains and in every other domain for which they need login access.

To determine the credential needs of your namespace, consider the:

- Type of principal
- Type of credential

NIS+ principals can be users or the superuser identity on the client machine. See Figure B–10.

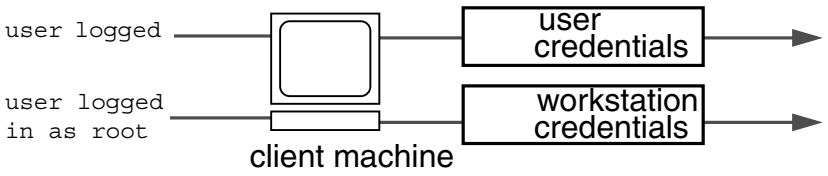


FIGURE B–10 NIS+ Principals

When you determine the credentials you need to create, make sure you know which type of principal needs the credential. For instance, when you set up an NIS+ client with the `nisclient` script, you create credentials for both the machine and for the user. Unless credentials for the user are also created, the user only has the access rights granted to the nobody class. This can work very well. But if you don't give any access rights to the nobody class, the namespace won't be available to users.

Choosing a Security Level

NIS+ is designed to be run at security level 2, which is the default. Security levels 0 and 1 are provided only for the purposes of testing and debugging. Do not run an operational network with real users at any level other than level 2. See Chapter 11 for more information.

Establishing Password-aging Criteria, Principles, and Rules

Password-aging is a mechanism that you can use to force users to periodically change their passwords. Password-aging allows you to:

- Specify the maximum number of days that a password can be used before it has to be changed.

- Specify the minimum number of days that a password has to be in existence before it can be changed.
- Specify a warning message to be displayed whenever a user logs in a specified number of days before the user's password time limit is reached.
- Specify the maximum number of days that an account can be inactive. If that number of days pass without the user logging in to the account, the user's password is locked.

Keep in mind that users who are already logged in when the various maximums or dates are reached are not affected by the above features. They can continue to work as normal. Password-aging limitations and activities are activated only when a user logs in or performs one of the following operations:

- `login`
- `rlogin`
- `telnet`
- `ftp`

These password-aging parameters are applied on a user-by-user basis; you can have different password-aging requirements for different users. You can also set general default password-aging parameters that apply to all users except those you have individually set.

When planning your NIS+ namespace, decide which password-aging features you want to implement, and the default values you want to specify. For additional information on password-aging, see Chapter 16.

Planning NIS+ Groups

NIS+ introduces a new type of group to name service administration, which NIS does not have. An NIS+ group is used only as a means to provide NIS+ access rights to several NIS+ principals at one time; it is used only for NIS+ authorization.

An NIS+ group is one of the four authorization classes on which access rights are based. The four classes are:

- *Owner*. Every NIS+ object has one owner who is a single user. The owner is usually the person who created the object, but ownership can be transferred to another user.
- *Group*. A collection of users grouped together under a group name for the purpose of granting that collection of users specified NIS+ access rights.

- *World*. All *authenticated* users. In other words, any user with valid DES credentials. By definition, an object's owner and members of an object's group are also part of the world class so long as their credentials are valid.
- *Nobody*. Anyone who does not have a valid DES credential. If the credentials of some member of one of the other classes are invalid or missing or corrupted or not found, then that user is placed in the nobody class.

The default name of the group created by NIS+ scripts for such purposes is the *admin* group. You can create other groups with different names, and assign different groups to different NIS+ objects.

Member users of an object's group usually have special privileges to access that object, such as permission to make certain changes to the object. For example, you could add several junior administrators to the admin group so that they can only modify the `passwd` and `hosts` tables, but they would be unable to modify any other tables. By using an admin group, you can distribute administration tasks across many users and not just reserve them for the superuser of the entire hierarchy. The NIS+ admin group must have credentials created for its members, even if you are running the domain in NIS-compatibility mode, because only authenticated users have permission to modify NIS+ tables.

After identifying the type of credentials you need, you should select the access rights that are required in the namespace. To make that task easier, you should first decide how many administrative groups you need. Using separate groups is useful when you want to assign them different rights. Usually, you create groups by domain. Each domain should have only one admin group.

Planning Access Rights to NIS+ Groups and Directories

After arranging your principals into groups, determine the kinds of access rights granted by the objects in the namespace to those groups, as well as to the other classes of principal (nobody, owner, group, and world). Planning these assignments ahead of time will help you establish a coherent security policy.

As shown in Table B–7, NIS+ provides different default access rights for different namespace objects.

TABLE B–7 Default Access Rights for NIS+ Objects

Object	Nobody	Owner	Group	World
Root-directory object	`r---`	`rmcd`	`rmcd`	`r---`
Non-root directory object	`r---`	`rmcd`	`rmcd`	`r---`
groups_dir directory objects	`r---`	`rmcd`	`rmcd`	`r---`
org_dir directory objects	`r---`	`rmcd`	`rmcd`	`r---`
NIS+ groups	`----`	`rmcd`	`r---`	`r---`
NIS+ tables	*varies*	*varies*	*varies*	*varies*

You can use the default rights or assign your own. If you assign your own, you must consider how the objects in your namespace will be accessed. Keep in mind that the nobody class accepts all requests from NIS+ clients, whether authenticated or not. The world class comprises all authenticated requests from NIS+ clients. Therefore, if you don't want to provide namespace access to unauthenticated requests, don't assign any access rights to the nobody class; reserve them only for the world class. On the other hand, if you expect some clients—through applications, for instance—to make unauthenticated read requests, you should assign read rights to the nobody class. If you want to support NIS clients in NIS-compatibility mode, you must assign read rights to the nobody class.

Also consider the rights that each type of namespace object assigns to the NIS+ groups you specified earlier. Depending on how you plan to administer the namespace, you can assign all or some of the available access rights to the group. A good solution is to have the user root on the master server be the owner of the admin group. The admin group should have create and destroy rights on the objects in the root domain. If you want only one administrator to create and modify the root domain, then put just that administrator in the admin group. You can always add additional members to the group. If several administrators are involved in the setup process, put them all in the group and assign full rights to it. That is easier than switching ownership back and forth.

Finally, the owner of an object should have full rights, although this is not as important if the group does. A namespace is more secure if you give only the owner full rights, but it is easier to administer if you give the administrative group full rights.

Planning Access Rights to NIS+ Tables

NIS+ objects other than NIS+ tables are primarily structural. NIS+ tables, however, are a different kind of object: they are informational. Access to NIS+ tables is required by all NIS+ principals and applications running on behalf of those principals. Therefore, their access requirements are a somewhat different.

Table B–8 lists the default access rights assigned to NIS+ tables. If any columns provide rights in addition to those of the table, they are also listed. You can change these rights at the table and entry level with the `nischmod` command, and at the column level with the `nistbladm -u` command. "Protecting the Encrypted Passwd Field" on page 630 provides just one example of how to change table rights to accommodate different needs.

TABLE B–8 Default Access Rights for NIS+ Tables and Columns

Table/Column	Nobody	Owner	Group	World
hosts table	r---	rmcd	rmcd	r---
bootparams table	r---	rmcd	rmcd	r---
passwd table	----	rmcd	rmcd	r---
name column	r---	----	----	----
passwd column	----	-m--	----	----
uid column	r---	----	----	----
gid column	r---	----	----	----
gcos column	r---	-m--	----	----
home column	r---	----	----	----
shell column	r---	----	----	----
shadow column	----	----	----	----
group table	----	rmcd	rmcd	r---
name column	r---	----	----	----
passwd column	----	-m--	----	----
gid column	r---	----	----	----
members column	r---	-m--	----	----
cred table	r---	rmcd	rmcd	r---

TABLE B–8 Default Access Rights for NIS+ Tables and Columns *(Continued)*

Table/Column	Nobody	Owner	Group	World
cname column	----	----	----	----
auth_type column	----	----	----	----
auth_name column	----	----	----	----
public_data column	----	-m--	----	----
private_data column	----	-m--	----	----
networks table	r---	rmcd	rmcd	r---
netmasks table	r---	rmcd	rmcd	r---
ethers table	r---	rmcd	rmcd	r---
services table	r---	rmcd	rmcd	r---
protocols table	r---	rmcd	rmcd	r---
rpc table	r---	rmcd	rmcd	r---
auto_home table	r---	rmcd	rmcd	r---
auto_master table		rmcd	rmcd	r---

Note – NIS-compatible domains give the nobody class read rights to the `passwd` table at the table level.

Protecting the Encrypted Passwd Field

As you can see in Table B–8, default read access is provided to the nobody class by all tables except the `passwd` table. NIS+ tables give the nobody class read access because many applications that need to access NIS+ tables run as unauthenticated clients. However, if this were also done for the passwd table, it would expose the encrypted passwd column to unauthenticated clients.

The configuration shown in Table B–8 is the default set of access rights for NIS-compatible domains. NIS-compatible domains must give the nobody class read access to the `passwd` column because NIS clients are unauthenticated and would otherwise be unable to access their `passwd` column. Therefore, in an NIS-compatible domain, even though passwords are encrypted, they are vulnerable to decoding. They would be much more secure if they were not readable by anyone except their owner.

Standard NIS+ domains (not NIS-compatible) provide that extra level of security. The default configuration (provided by `nissetup`) uses a column-based scheme to hide the `passwd` column from unauthenticated users, while still providing access to the rest of the `passwd` table. At the table level, no unauthenticated principals have read access. At the column level, they have read access to every column except the `passwd` column.

How does an entry owner get access to the passwd column? Entry owners have both read and modify access to their own entries. They obtain read access by being a member of the world class. (Remember that at the table level, the world class has read rights.) They obtain modify access by explicit assignment at the column level.

Keep in mind that table owners and entry owners are rarely and not necessarily the same NIS+ principals. Thus, table-level read access for the owner does not imply read access for the owner of any particular entry.

As mentioned earlier, this is the default setup from the Solaris 2.3 release through Solaris 9. For a more complete explanation and discussion of table-, entry-, and column level-security, see . Chapter 16

USING NIS COMPATABILITY MODE: An Introduction

Deciding whether and how to run NIS+ in parallel to NIS—and when to stop—is probably one of the most difficult transition issues you will face. NIS+ provides several features that allow it to operate in parallel with NIS, notably, the NIS-compatibility mode.

If you plan to use NIS-compatibility mode, you have to consider the essential benefit provided by NIS-compatibility mode. You need not make any changes to NIS clients. The essential drawback is that you cannot take advantage of full NIS+ security and hierarchy and you may have to change those clients' domain names.

Figure B–11 illustrates how you convert from an NIS-only namespace to an NIS-compatible namespace that responds to both NIS and NIS+ requests.

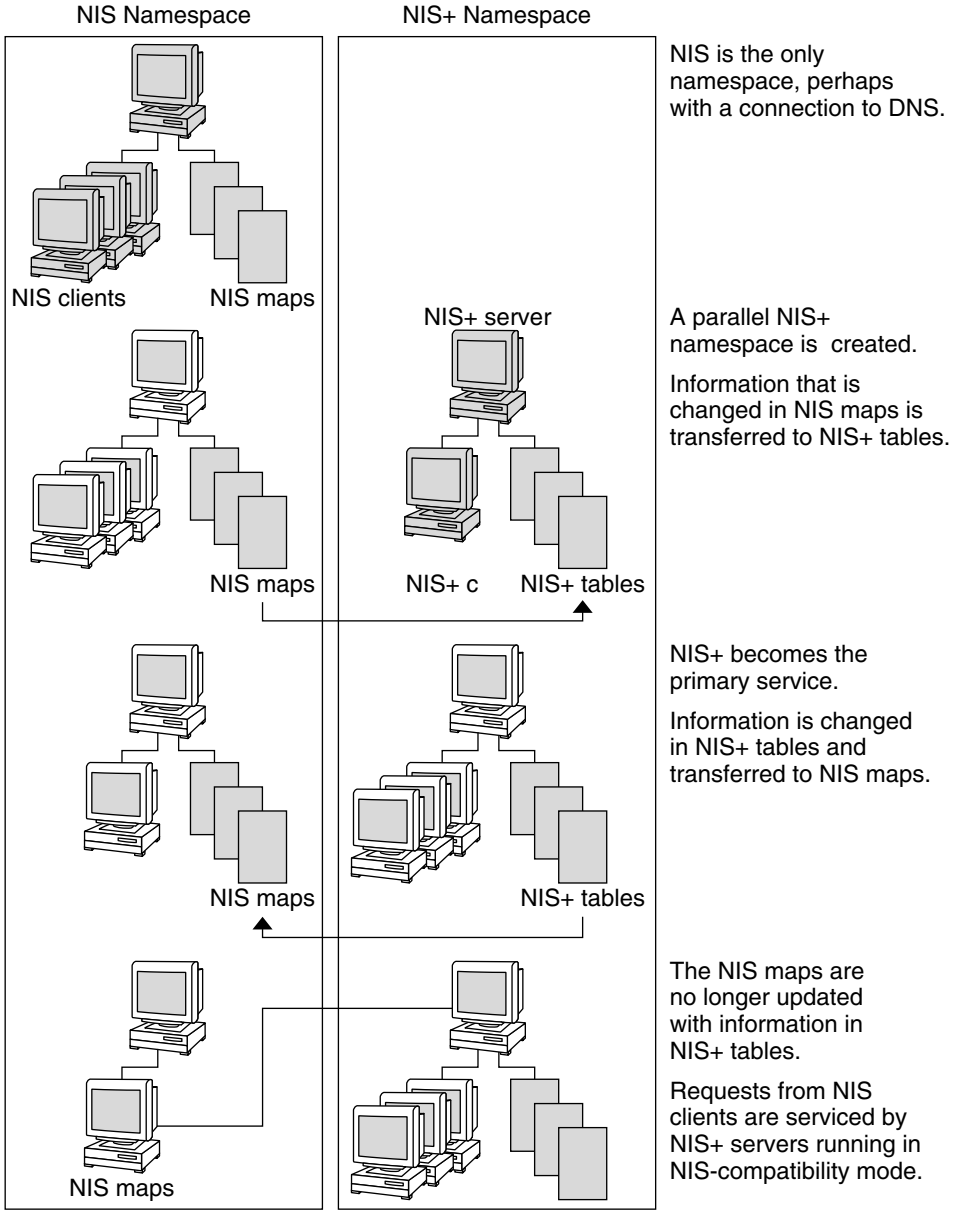


FIGURE B–11 Transition to NIS-Compatibility Mode

Selecting Your NIS-Compatible Domains

Make a list of your NIS clients and group them in their eventual NIS+ domains. If the NIS+ domain running in NIS-compatibility mode does not have the same name as its NIS clients' original NIS domain, you must change the NIS clients' domain name to the NIS+ domain name that is being supported by the NIS-compatible NIS+ server.

At first, NIS will no doubt be the primary service. As you become familiar with the intricacies of sharing information, you can plan a transition to make NIS+ the primary service. Some NIS+ users may want the capability of switching back and forth between the main NIS domain and the new NIS+ domain. The `nisclient` script can help them do this when backup files are made.

Determining NIS-Compatible Server Configuration

Take stock of your NIS servers, keeping in mind the requirements for your NIS+ servers. If you plan to eventually use them for the NIS+ service, upgrade them to the NIS+ recommendations. Identify which NIS servers will be used to support which NIS+ domains, and in what capacity (either master or replica). Remember that NIS+ servers belong to the domain *above* the one they support (except for the root domain servers). Since NIS+ servers do not belong to the domain they serve, you cannot use the same machines for other services that require domain-dependent information.

If possible, plan to use your NIS+ server machines only for NIS+. This arrangement can require you to transfer other network services, such as DNS name services, boot server, home directories, NFS servers, and so on, to non-NIS+ server machines.

At many sites, the NIS server plays multiple roles, such as NFS server, compute server, `rlogin` server, and mail host server. Because the NIS server uses the same information to resolve its names as do its clients, the NIS server can provide other services as well. As discussed in "Domain Hierarchy" on page 602, except for root domains, all NIS+ servers live in the domain above the ones that they serve. So either do not run services on an NIS+ server that require access to the name service, or use other means, such as files in `nsswitch.conf`, to acquire this same information. This problem would be solved if there were no hierarchy; the NIS+ root servers would live in the domain that they serve. The resource requirements of an NIS+ server are greater than those of an NIS server; therefore, it is advisable to avoid running other services along with NIS+.

If you have non-Solaris machines on your network, then you can either continue to run your NIS+ servers in NIS-compatibility mode or you can move all such machines into their own domain. If you move all non-Solaris machines to one subnet, you can remove the restriction of having NIS+ servers on the same subnet as their NIS-compatible clients. This will reduce the number of replicas required for any domain.

Deciding How to Transfer Information Between Services

To keep information synchronized, be sure to make one namespace subordinate to the other. At first, the NIS namespace may be the dominant one, in which case you would make changes to the NIS maps and load them into the NIS+ tables. In effect, the NIS namespace would be the master database.

An NIS+ server in NIS-compatibility mode supports standard NIS maps. An exhaustive list of these maps is in the Notes section of the `ypfiles`(4) man page. However, there are some limitations on map support: The NIS+ server serves `ypmatch` requests only on the netgroup map, and not on the reverse maps. It does not support enumeration requests on the netgroup map (for example, `ypcat`). The `passwd.adjunct` map is not supported, either.

Eventually, the NIS+ namespace should be dominant. When that is the case, you make changes in the NIS+ tables and copy them to the NIS maps.

The NIS+ `nisaddent` command and the NIS+ `nispopulate` script transfer information between NIS maps and NIS+ tables, as summarized in Table B–9.

TABLE B–9 Commands for Changing Information in the Passwd Table

NIS+ Command	Description
`/usr/lib/nis/nisaddent -y`	Transfers information from an NIS map to an NIS+ table after you run `ypxfr` to transfer maps from an NIS server to the local disk. Nonstandard NIS maps can be transferred to NIS+ tables if the information is in key-value pairs. Multicolumned maps will be not be transferred.
`/usr/lib/nis/nisaddent -d`	Copies information from an NIS+ table to a file, which can then be transferred to an NIS map with standard NIS utilities.

TABLE B–9 Commands for Changing Information in the Passwd Table *(Continued)*

NIS+ Command	Description
`/usr/lib/nis/nispopulate -Y`	Transfers information from NIS maps to NIS+ tables.

In versions of NIS+ previous to the Solaris 2.5 release, it was necessary to use separate password commands (`passwd`, `yppasswd`, `nispasswd`) to handle password matters, depending on whether a user's password information was stored in `/etc` files, NIS maps, or NIS+ tables. Starting with the Solaris 2.5 release, all of these matters are handled automatically by the `passwd` or `passwd -r nisplus` commands and are controlled by the `passwd` entry in the user's `nsswitch.conf` file.

In order to properly implement the `passwd` command and password aging on your NIS+ or NIS-compatible network, the `passwd` entry of the `nsswitch.conf` file on every machine must be correct. This entry determines where the `passwd` command goes for password information and where it updates password information.

Only five `passwd` entry configurations are permitted:

EXAMPLE B–2 Permitted `passwd` `nsswitch.conf` Entries

```
passwd:files

passwd: files nis

passwd: files nisplus

passwd: compat

passwd_compat: nisplus
```

Caution – All of the `nsswitch.conf` files on all of your network's machines must use one of the `passwd` configurations shown above. If you configure the `passwd` entry in any other way, users may not be able to log in.

In domains created with NIS-compatibility mode, the permissions are slightly different: permissions at the table level must be set to provide read rights to the world class, and at the column level, permissions must provide read access to the nobody class.

Deciding How to Implement DNS Forwarding

NIS servers can forward DNS requests made from Solaris 1.x NIS clients. NIS+ servers running in NIS-compatibility mode also provide DNS forwarding, starting with the Solaris 2.3 releases. (This feature is available in the Solaris 2.2 release patch `#101022-06`.) As a result, NIS clients, runnig under the Solaris 2 or Solaris 9 operating environment, must have appropriate `/etc/nsswitch.conf` and `/etc/resolv.conf` files installed locally.

Solaris 1.x NIS clients supported by Solaris 2.0 or 2.1 servers running in NIS-compatibility mode are not able to take advantage of DNS forwarding. You must upgrade those servers to Solaris 2.3 releases.

If the DNS domains are repartitioned, you must redefine new DNS zone files. Clients, however, may require updates to their `/etc/resolv.conf` file. A client, if it is also a DNS client, can set up its name service switch configuration file to search for host information in either DNS zone files or NIS maps—in addition to NIS+ tables.

DNS Forwarding for NIS+ Clients

NIS+ clients do *not* have implicit DNS-forwarding capabilities like NIS clients do. Instead, they take advantage of the name service switch. To provide DNS capabilities to an NIS+ client, change its hosts entry to:

```
hosts: nisplus dns [NOTFOUND=return] files
```

DNS Forwarding for NIS Clients Running under the Solaris 2 or Solaris 9 Operating Environment

If an NIS client is using the DNS forwarding capability of an *NIS-compatible* NIS+ server, the client's `nsswitch.conf` file should *not* have the following syntax in the hosts file:

```
hosts: nis dns files
```

Since DNS-forwarding automatically forwards host requests to DNS, this syntax causes both the NIS+ server and the name service switch to forward unsuccessful requests to the DNS servers, slowing performance.

NIS and NIS+ Command Equivalents in the Solaris 1, Solaris 2, and Solaris 9 Releases

The tables in this section give a quick overview of the differences between NIS commands running in the Solaris 1 operating environment, NIS commands running in the Solaris 2 or Solaris 9 operating environment, and their NIS+ equivalents.

- Table B–10 describes which NIS commands are supported in the Solaris 2 and Solaris 9 releases.
- Table B–11 and Table B–12 describe the NIS+ equivalents to NIS client and server commands in the Solaris 2 and Solaris 9 releases.
- Table B–13 contains a list of the NIS application programming interface functions and their NIS+ API equivalents, if they exist. See the appropriate man pages for details.

NIS Commands Supported in the Solaris 2 and Solaris 9 Releases

Only some NIS commands are supported in the Solaris 2 and Solaris 9 releases. NIS server commands are not shipped with the Solaris 2 and Solaris 9 releases. Only the NIS client commands are included. Whether these NIS commands run also depends on whether a Solaris 2 or Solaris 9 NIS client is making requests of an NIS server or of an NIS+ server in NIS-compatibility mode. NIS clients cannot make updates to NIS+ servers that are running in NIS-compatibility mode. For example, such clients cannot run the `chkey` and `newkey` commands. Table B–10 lists the NIS commands supported in the Solaris 2 and Solaris 9 operating environments.

TABLE B–10 NIS Commands Supported in the Solaris 2 and Solaris 9 Operating Environments

Command Type	NIS Commands Supported in the Solaris 2 and Solaris 9 Operating Environments	NIS Commands Not Supported in the Solaris 2 and Solaris 9 Operating Environments

Utilities	`ypinit`
	`ypxfr`
	`ypcat`
	`ypmatch`
	`yppasswd`
	`ypset`
	`ypwhich`
		`yppush`
		`yppoll`
		`ypchsh`
		`ypchfn`
		`ypmake`

Daemons	`ypbind`	`ypserv`
		`ypxfrd`
		`rpc.ypupdated`
		`rpc.yppasswdd`

NIS API	`yp_get_default_domain()`
	`yp_bind()`
	`yp_unbind()`
	`yp_match()`
	`yp_first yp_next()`
	`yp_all()`
	`yp_master()`
	`yperr_string()`
	`ypprot_err()`
		`yp_order() yp_update()`

Client and Server Command Equivalents

The two tables in this section contain NIS commands and their approximate NIS+ equivalents. The commands have been divided into two categories: Table B–11 contains name service client commands and Table B–12 contains name service server commands.

Client Command Equivalents

Table B–11 shows client-to-name server commands. These commands are typed on name service client machines and request information of name service servers. The commands in column 1 run on Solaris 1, Solaris 2 or Solaris 9 NIS clients connected to Solaris 1 NIS servers. The commands in column 2 run on Solaris 1, Solaris 2, or Solaris 9 NIS clients connected to Solaris 2 or Solaris 9 NIS+ servers running in NIS-compatibility mode. The commands in column 3 only run on Solaris 2 or Solaris 9 NIS+ clients connected to Solaris 2 or Solaris 9 NIS+ servers. Commands are approximately equivalent across rows. “N/A” indicates that an equivalent command does not exist for that case.

TABLE B–11 NIS Client Commands and Equivalent NIS+ Commands

SunOS 4.x NIS Server	NIS+ Server in NIS-Compatibility Mode	NIS+ Server
`ypwhich -m`	`ypwhich -m`	`niscat -o org_dir`
`ypcat`	`ypcat`	`niscat`
`ypwhich`	`ypwhich`	N/A
`ypmatch`	`ypmatch`	`nismatch/nisgrep`
`yppasswd`	`passwd`	`passwd`
`ypbind`	`ypbind`	N/A
`yppoll`	N/A	N/A
`ypset`	`ypset`	N/A
N/A	`ypinit -c`	`nisclient -c`

Note that:

- In the Solaris 2.5 release, the `passwd` command should be used regardless of NIS or NIS+ status. The functions previously performed by `nispasswd` and `yppasswd` have now been included in the `passwd` command.
- The `ypinit -c` command is available only on Solaris 2 or Solaris 9 NIS clients.
- The `ypcat` command is not supported for queries directed to the netgroup table. The NIS client's request times out before an answer is received because this table's format is so different from the `netgroup` NIS map's format.

Server Command Equivalents

Table B–12 shows name server-to-name server commands. The NIS server commands are not included in the Solaris 2 or Solaris 9 releases, so they are not available to either NIS+ servers or NIS+ servers in NIS-compatibility mode. In addition, an NIS server cannot make updates to an NIS+ server, nor can an NIS+ server make updates to an NIS server. Column 3 lists the NIS+ server commands that are equivalent to the NIS server commands in column 1. Servers in NIS-compatibility mode have no exact equivalents because NIS-compatibility mode refers only to client commands.

TABLE B–12 NIS Server Commands and Equivalent NIS+ Commands

SunOS 4.x NIS Server	NIS+ Server in NIS-Compatibility Mode	NIS+ Server
`ypxfr`	N/A	N/A

TABLE B–12 NIS Server Commands and Equivalent NIS+ Commands *(Continued)*

SunOS 4.x NIS Server	NIS+ Server in NIS-Compatibility Mode	NIS+ Server
`makedbm`	N/A	`nisaddent`
`ypinit -m ypinit -s`	N/A	`nisserver`
`ypserv`	`rpc.nisd -Y`	`rpc.nisd`
`ypserv -d`	`rpc.nisd -Y -B`	No DNS forwarding needed; use `/etc/nsswitch.conf`
`ypxfrd`	N/A	N/A
`rpc.ypupdated`	N/A	N/A
`rpc.yppasswd`	`rpc.nispasswdd`	`rpc.nispasswdd`
`yppush`	N/A	`nisping`
`ypmake`	N/A	`nissetup, nisaddent`
`ypxfr`	N/A	N/A

NIS and NIS+ API Function Equivalents

To completely convert your site to NIS+, you must both change the name service and port all applications to NIS+. Any internally created applications that make NIS calls have to be modified to use NIS+ calls. Otherwise, you always have to run your NIS+ servers in NIS-compatibility mode, with all the drawbacks that this mode entails. External applications may force you to run your namespace in NIS-compatibility mode until they are updated, as well.

Table B–13 contains a list of the NIS API functions and their NIS+ API equivalents, if they exist.

TABLE B–13 NIS API and NIS+ API Equivalent Functions

NIS API Functions	NIS+ API Functions
`yp_get_default_domain()`	`nis_local_directory()`
`ypbind()`	N/A
`ypunbind()`	N/A
`ypmatch()`	`nis_list()`
`yp_first()`	`nis_first_entry()`
`yp_next()`	`nis_next_entry()`

TABLE B–13 NIS API and NIS+ API Equivalent Functions *(Continued)*

NIS API Functions	NIS+ API Functions
`yp_all()`	`nis_list()`
`yp_master()`	`nis_lookup()`
`yperr_string()`	`nis_perror() nis_sperrno()`
`ypprot_err()`	`nis_perror() nis_sperrno()`
`yp_order()`	N/A
`yp_update()`	`nis_add_entry(), nis_remove_entry(), nis_modify_entry()`

NIS-Compatibility Mode Protocol Support

Table B–14 shows which NIS protocols are supported by NIS+ servers in NIS-compatibility mode.

TABLE B–14 Support for NIS Protocols by NIS+ Servers

NIS Protocols	Compatibility Description
NIS client V2 protocol	Supported
NIS server-to-server protocol	Unsupported
NIS client update protocol	`yppasswd` protocol supported
NIS client V1 protocol	Not supported except for `YPPROC_NULL`, `YPPROC_DOMAIN`, and `YPPROC_DOMAIN_NONACK`

INSERT 5

BEFORE YOU TRANSITION TO NIS+: Gauge the Impact of NIS+ on Other Systems

Develop a formal introduction, testing, and familiarization program for your site, not only to train administrators, but also to uncover dependencies of other systems or applications on NIS that will be affected by a transition to NIS+.

For example, some applications may rely on some of the NIS maps. Will they function with standard or custom NIS+ tables? How will their need for access affect your overall security plan?

What nonstandard NIS maps are being used at your site? Can you convert them to NIS+ tables or create nonstandard NIS+ tables to store their information? Be sure to check their access rights.

Does your site use locally built applications that depend on NIS? Do you have commands or applications that make direct NIS calls, such as embedded `yp_match()` function calls? (See "NIS and NIS+ API Function Equivalents" on page 640 for more information.)

Do you have any duplicate user and host names in your namespace? (See "Resolving User/Host Name Conflicts" on page 621 for more information.)

How will the network installation procedures be affected by the transition to NIS+? Analyze the changes required, if any. Gauging the impact of NIS+ on your site administrative practices can help uncover potential roadblocks.

Train Administrators

Another goal of the introduction and familiarization program discussed in "Become Familiar With NIS+" on page 599 is to give the administrators at your site an opportunity to become familiar with NIS+ concepts and procedures. Classroom instruction alone is insufficient. Administrators need a chance to work in a safe test environment. The training should consist of:

- A formal course in NIS+ concepts and administration
- Basic NIS+ troubleshooting information and practice
- Information about your site's implementation strategy and plans

Write a Communications Plan

Prepare a plan to communicate your intentions to users long before you actually begin converting clients to NIS+. Tell them about the implementation plan and give them a way to obtain more information. As mentioned in "Suggested Transition Phases" on page 597, a typical transition goal is to keep the impact of the transition on clients to a minimum, but users might become concerned about the upcoming change. Send out email notices, conduct informative seminars, and designate email aliases or individuals to whom users can send questions.

Identify Required Conversion Tools and Processes

Consider creating or obtaining transition tools to help with the implementation. If your site already uses automated tools to administer individual systems or network services, consider porting them to operate under the versions of Solaris software and NIS+ that you will be using for the transition (see "Use a Single Release of Software" on page 598). Here are some suggestions for scripts you might want to write:

- A script to convert users to NIS+—make additions to the `nisclient` shell script
- A check script to verify the correctness of a user's NIS+ environment
- Backup and recovery scripts
- `crontab` entries for routine NIS+ maintenance
- Procedures for notification of outages

Scripts such as these ensure that the transition is carried out uniformly across domains, speed the transition, and reduce complaints. You should also prepare a set of standard configuration files and options, such as `nsswitch.conf`, that all clients across the namespace can use.

Identify Administrative Groups Used for Transition

Be sure that the NIS+ groups created as part of your namespace design (see "Establishing Password-aging Criteria, Principles, and Rules" on page 625) correspond to the administrative resources you have identified for the transition. You could require a different set of NIS+ groups for the transition than for routine operation of an NIS+ namespace. Consider adding remote administrators to your groups in case you need their help in an emergency.

Make sure that group members have the proper credentials, that namespace objects grant the proper access rights to groups, and that the right group is identified as the group owner of the right namespace objects.

The following table provides a summary of commands that operate on NIS+ groups and group permissions.

TABLE B–15 NIS+ Commands for Groups

Command	Description
`nisgrpadm`	Creates or deletes groups, adds, changes, lists, or deletes members
`niscat -o`	Displays the object properties of an NIS+ group
`nissetup`	Creates the basic structure of the directory in which a domain's groups are stored
`nisls`	Lists the contents of a directory
`NIS_GROUP`	Environment variable that overrides the value of `nisdefaults` for the shell in which it is set
`nischmod`	Changes an object's access rights
`nischown`	Changes the owner of an NIS+ object
`nischgrp`	Changes the group owner of an NIS+ object
`nistbladm -u`	Changes access rights to NIS+ table columns
`nisdefaults`	Displays or changes the current NIS+ defaults

Determine Who Will Own the Domains

To take complete advantage of the features inherent in a domain hierarchy, distribute the ownership of domains to the organizations they are dedicated to supporting. This will free the administrators of the root domain from performing rudimentary tasks at the local level. When you know who owns what, you can provide guidelines for creating administrative groups and setting their access rights to objects.

Consider how to coordinate the ownership of NIS+ domains with the ownership of DNS domains. Here are some guidelines:

- The administration of the DNS domain structure should remain the responsibility of the highest-level administrative group at the site.
- This same administrative group also owns the top-level NIS+ domain.
- Responsibility for the administration of lower-level DNS and NIS+ domains is delegated to individual sites by the top-level administrative group. If the NIS+ domains are created along the same principles as the DNS domains (for instance, organized geographically), this delegation will be simple to explain.

Determine Resource Availability

Determine what administrative resources are required for the implementation. These are above and beyond the resources required for normal operation of NIS+. If your transition involves a long period of NIS+ and NIS compatibility, additional resources may be required.

Consider not only the implementation of the namespace design, but also conversion for the numerous clients and dealing with special requests or problems. Keep in mind that NIS+ has a steep learning curve. Administrators may be less efficient for awhile at performing support functions with NIS+ than they were with NIS. Consider not only formal training, but extensive lab sessions with hands-on experience.

Finally, even after the transition is complete, administrators will require extra time to become familiar with the everyday work flow of supporting NIS+.

Consider hardware resources. NIS servers are often used to support other network services, such as routing, printing, and file management. Because of the potential load on an NIS+ server, you should use dedicated NIS+ servers. This load-balancing simplifies the transition because it simplifies troubleshooting and performance monitoring. Of course, you incur the cost of additional systems. The question of how

many servers you will need and how they should be configured is addressed in “PLANNING THE NIS+ NAMESPACE: Identifying the Goals of Your Administrative Model” on page 601.

Remember, these servers are required in *addition* to the NIS servers. Although the NIS servers might be decommissioned or recycled after the transition is complete, the NIS+ servers will continue to be used.

Resolve Conflicts Between Login Names and Host Names

The NIS+ authentication scheme does not allow machines and users to use the same names within a domain; for example, joe@joe is not permitted. Since NIS+ does not distinguish between credentials for hosts and login names, you can only use one credential type per name. If you have duplicate names in your namespace and you must keep the duplicate host name for some other reason, make this change: retain the user login name and alias the duplicate host names. Create a new name for the host and use the old name as an alias for the new name. See“Resolving User/Host Name Conflicts” on page 621 for examples of illegal name combinations.

You must resolve name conflicts before the implementation can begin, but you should also plan on permanently checking new machines and user names during routine NIS+ operation. The `nisclient` script does name comparisons when you use it to create a client credential.

Examine All Information Source Files

Check all `/etc` files and NIS maps for empty fields or corrupted data before configuring NIS+. The NIS+ table-populating scripts and commands might not succeed if the data source files contain empty fields or extraneous characters. Fill blank fields or fix the data before you start. It is better to delete questionable users or machines from the `/etc` files or NIS maps before running NIS+ scripts, then add them back later after NIS+ is installed, than to proceed with the scripts and possibly corrupt data.

Remove the "." from Host Names

Because NIS+ uses dots (periods) to delimit between machine names and domains and between parent and sub-domains, you cannot have a machine (host) name containing a dot. Before converting to NIS+ you must eliminate any dots in your hostnames. You can convert hostname dots to hyphens (-). For example, you cannot have a machine named `sales.alpha`. You can convert that name to `sales-alpha`. (See the `hosts` man page for detailed information on allowable hostnames.)

Remove the "." from NIS Map Names

As described in "PLANNING THE NIS+ NAMESPACE: Identifying the Goals of Your Administrative Model" on page 601, NIS+ automounter tables have replaced the "." (dot) in the table name with an underscore. You also need to make this change to the names of NIS maps that you will use during the transition. If you do not, NIS+ will confuse the dot in the name with the periods that distinguish domain levels in object names.

Note – Be sure to convert the dot to underscores for *all* NIS maps, not just those of the automounter. Be aware, however, that changing the names of nonstandard NIS maps from dots to underscores may cause applications that use those nonstandard maps to fail unless you also modify the applications to recognize NIS+ syntax.

Document Your Current NIS Namespace

Documenting your current configuration will give you a clear point of departure for the transition. Make a list of the following items:

- Name and location of all current NIS domains and networks
- Host name and location of all current NIS servers, both master and slave
- Configuration of all current NIS servers, including:
  - Host name
  - CPU type
  - Memory size

    - Disk space available
    - Name of administrators with root access
- Nonstandard NIS maps

Correlate the list of your NIS clients with their eventual NIS+ domains. They must be upgraded to the current Solaris operating environment.

Create a Conversion Plan for Your NIS Servers

Take stock of your NIS servers. Although you can recycle them after the transition is complete, keep in mind that you will go through a stage in which you will need servers for *both* services. Therefore, you cannot simply plan to satisfy all your NIS+ server needs with your existing NIS servers.

You might find it helpful to create a detailed conversion plan for NIS servers, identifying which NIS servers will be used for NIS+ and when they will be converted. Do not use the NIS servers as NIS+ servers during the first stages of NIS-to-NIS+ transition. As described in " IMPLEMENTING NIS+: Introduction" on page 648, the implementation is most stable when you check the operation of the entire namespace as a whole before you convert any clients to NIS+.

Assign NIS servers to NIS+ domains and identify each server's role (master or replica). When you have identified the servers you plan to convert to NIS+ service, upgrade them to NIS+ requirements (see "Server Memory Requirements" on page 612).

IMPLEMENTING NIS+: Introduction

After you have performed the tasks described in the previous chapters, most of the hard work is done. Now all you have to do is set up the namespace you designed and add the clients to it. This chapter describes how to do that. Before performing these steps, verify that all pre-transition tasks have been completed and that users at your site are aware of your plans.

If you plan to run NIS+ domains alongside DNS domains, you must set up one NIS+ sub-domain with each DNS domain. After you have set up a complete NIS+ namespace along with the first DNS domain and have verified that everything is working right, then you can set up the other NIS+ namespaces in parallel.

Phase I-Set Up the NIS+ Namespace

Set up the namespace with full DES authentication, even if the domains will operate in NIS-compatibility mode. Use the NIS+ scripts described in Chapter 4 for more explanation of NIS+ structure and concepts. Then perform the following steps:

1. **Set up the root domain.**

   If you are going to run the root domain in NIS-compatibility mode, use `nisserver`. (If you choose not to use the setup scripts, use the `-Y` flag of `rpc.nisd` and `nissetup`.)

2. **Populate the root domain tables.**

   You can use `nispopulate` to transfer information from NIS maps or text files. Of course, you can also create entries one at a time with `nistbladm` or `nisaddent`.

3. **Set up clients of the root domain.**

   Set up a few clients in the root domain so that you can properly test its operation. Use full DES authentication. Some of these client machines will later be converted to root replica servers and some will serve as machines for the administrators who support the root domain. NIS+ servers should never be an individual's machine.

4. **Create or convert site-specific NIS+ tables.**

   If the new NIS+ root domain requires custom, site-specific NIS+ tables, create them, with `nistbladm` and transfer the NIS data into them with `nisaddent`.

5. **Add administrators to root domain groups.**

   Remember, the administrators must have LOCAL and DES credentials (use `nisaddcred`). Their machines should be root domain clients and their root identities should also be NIS+ clients with DES credentials.

6. **Update the sendmailvars table, if necessary.**

   If your email environment has changed as a result of the new domain structure, populate the root domain's `sendmailvars` table with the new entries.

7. **Set up root domain replicas.**

   First convert the clients into servers (use `rpc.nisd` with `-Y` for NIS compatibility and also use `-B` if you want DNS forwarding), then associate the servers with the root domain by running `nisserver -R`.

   For NIS compatibility, run `rpc.nisd` with the `-Y` and edit the `/etc/init.d/rpc` file to remove the comment symbol (#) from the `EMULYP` line. For DNS forwarding, use the `-B` option with `rpc.nisd`.

8. **Test the root domain's operation.**

   Develop a set of installation-specific test routines to verify a client's functioning after the switch to NIS+. This will speed the transition work and reduce complaints. You should operate this domain for about a week before you begin converting other users to NIS+.

9. **Set up the remainder of the namespace.**

   Do not convert any more clients to NIS+, but go ahead and set up all the other domains beneath the root domain. This includes setting up their master and replica servers. Test each new domain as thoroughly as you tested the root domain until you are sure your configurations and scripts work properly.

10. **Test the operation of the namespace.**

    Test all operational procedures for maintenance, backup, recovery, and other scenarios. Test the information-sharing process between all domains in the namespace. Do not proceed to Phase II until the entire NIS+ operational environment has been verified.

11. **Customize the security configuration of the NIS+ domains.**

    This may not be necessary if everything is working well; but if you want to protect some information from unauthorized access, you can change the default permissions of NIS+ tables so that even NIS clients are unable to access them. You can also rearrange the membership of NIS+ groups and the permissions of NIS+ structural objects to align with administrative responsibilities.

Phase II-Connect the NIS+ Namespace to Other Namespaces

1. **[Optional] Connect the root domain to the DNS namespace.**

   An NIS+ client can be connected to the Internet using the name service switch. machines, if they are also DNS clients, can have their name service switch configuration files set to search for information in DNS zone files—in addition to NIS+ tables or NIS maps.

   Configure each client's `/etc/nsswitch.conf` and `/etc/resolv.conf` files properly. The `/etc/nsswitch.conf` file is the client's name service switch configuration file. The `/etc/resolv.conf` lists the IP addresses of the client's DNS servers..

2. **Test the joint operation of NIS+ with DNS.**

   Verify that requests for information can pass between the namespaces without difficulty.

3. **If operating NIS+ in parallel with NIS, test the transfer of information.**

   Use the `nispopulate` script to transfer information from NIS to NIS+. To transfer data from NIS+ to NIS, run `nisaddent -d` and then `ypmake`. (See the man pages for more information.) Use scripts to automate this process. Establish policies for keeping tables synchronized, particularly the hosts and `passwd` tables. Test the tools used to maintain consistency between the NIS and NIS+ environments. Decide when to make the NIS+ tables the real source of information.

4. **Test operation of NIS+ with both DNS and NIS.**

   Test all three namespaces together to make sure the added links do not create problems.

Phase III-Make the NIS+ Namespace Fully Operational

1. **Convert clients to NIS+.**

   Convert clients one workgroup at a time, and convert all workgroups in a subnet before starting on those of another subnet. That way, when you convert all the clients in a subnet, you can eliminate the NIS service on that subnet. Run the verification script after converting each client to make sure that the conversion worked properly. That verification script should inform the user which support structure is in place, to help with problems and how to report them. The actual steps required depend on the site.

   Use the `nisclient` script to convert NIS clients to NIS+ clients. If you need to modify the clients' DNS configuration, you must write your own scripts to automate that process.

   You can also save time if your site has a shared, mounted central directory similar to `/usr/local`. You could put the script in the central directory and, on the day of conversion, send email to clients asking them to run the script as superuser.

2. **Monitor the status of the transition as clients are being converted.**

   Track progress against your plan and all serious complications not anticipated in the planning stages. Announce your status so that interested parties can track it.

3. **Decommission NIS servers.**

   As all the clients on a subnet are converted to NIS+, decommission the NIS servers. If a particular subnet has some clients that require NIS service, use the NIS-compatibility feature of the NIS+ servers but do not retain the NIS servers.

4. **Evaluate NIS+ performance.**

   After the implementation is complete, test to see that NIS+ is working correctly.

5. **Optimize the NIS+ environment.**

   Based on the results of your performance evaluation, modify the NIS+ environment as needed. These improvements can be as simple as adding selected replicas in domains with high loads or as involved as rearranging the storage of NIS+ information for a group of domains.

6. **Clean up new domains.**

   If you did not change old domain names during the transition for the sake of simplicity, upgrade them now to the new NIS+ naming scheme. For example, if you left some domains with geographic labels while you converted to an organizational hierarchy, you now change the geographic names to their organizational versions.

Phase IV-Upgrade NIS-Compatible Domains

1. **Convert the last NIS clients to NIS+.**

   As soon as you can, eliminate the need for NIS-compatible NIS+ domains. Upgrading the last NIS clients to NIS+ will allow you to take advantage of NIS+ security features. You will not be able to eliminate the need for NIS-compatible NIS+ domains if you are running non-Solaris machines on your network.

2. **Adjust your security configuration.**

   When you have no more NIS clients, you can restart the NIS+ servers in standard mode and run `nischmod` on the NIS+ tables to change permission levels, eliminating the security hole caused by NIS compatibility. If you did not create credentials for NIS+ principals before, you must do that now. Restrict the access of unauthenticated principals.

3. **Establish miscellaneous evaluation and improvement programs.**

   Evaluate operational procedures to determine which ones can be improved, particularly procedures used to recover from problems. Plan for new NIS+ releases and possible functional enhancements. Track the development of Solaris components that might require new NIS+ tables. Look for automated tools that enable you to perform NIS+ administration functions more efficiently. Finally, work with internal developers to help them take advantage of the NIS+ API.

   This completes your transition to NIS+.

APPENDIX C

Transitioning from NIS+ to LDAP

Overview

The NIS+ server daemon,`rpc.nisd`, stores NIS+ data in proprietary-format files in the `/var/nis/data` directory. While it is entirely possible to keep NIS+ data synchronized with LDAP, such synchronization has previously required an external agent. However, the NIS+ daemon now offers the option to use an LDAP server as a data repository for NIS+ data. Since this makes it possible for NIS+ and LDAP clients to share the same naming service information, it is easier to transition from using NIS+ as the main naming service, to using LDAP for the same role. For more information on using LDAP as a naming service, see "LDAP: An Overview" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

By default, the `rpc.nisd` continues to work as before, relying only on the`/var/nis/data` NIS+ database. If desired, the system administrator can choose to use an LDAP server as the authoritative data repository for any subset of the NIS+ database. In this case, the `/var/nis/data` files serve as a cache for the`rpc.nisd`, reducing LDAP lookup traffic, and enabling the `rpc.nisd` to continue working if the LDAP server is temporarily unavailable. In addition to continuous synchronization between NIS+ and LDAP, the administrator can also perform uploads of NIS+ data to LDAP, or downloads of LDAP data to NIS+.

Mapping of data to and from LDAP is controlled by a flexible configuration file syntax. All standard NIS+ tables (except `client_info.org_dir` and `timezone.org_dir`) are covered by a template mapping file, `/var/nis/NIS+LDAP` mapping.template, which should require little or no change for most NIS+ installations. See "`client_info` and `timezone` Tables" on page 680.In addition to locations for NIS+ data in the LDAP Directory Information Tree (DIT), the mapping file also allows establishing time-to-live (TTL) for NIS+ data sourced from LDAP.

While there often is a 1-to-1 mapping between NIS+ column values and LDAP attribute values, the mapping file can be used to maintain more complicated relationships as well.

The new `/etc/default/rpc.nisd` file is used to select LDAP server and authentication, and controls some general `rpc.nisd` behavior. See the `rpc.nisd(4)` man page. The details of the mapping is specified via the `/var/nis/NIS+LDAPmapping` file. For more information, see the `NIS+LDAPmapping(4)` man page. The name of this file can be changed using the `-m rpc.nisd` command line option. For more information, see `rpc.nisd(1M)` .

The following terms are introduced in this appendix:

- Container

  The location in the LDAP DIT where all related entries are stored. For example, user account information is often stored in the `ou=People` container, while host address informaton may be stored in the `ou=Hosts` container.

- Netname

  An entity in secure RPC (user or machine) that can be authenticated.

- Mapping

  The relation between a NIS+ object and an LDAP entry. For example, data from the `name` column in the `passwd.org_dir` NIS+ table (i.e., the user name of an account) corresponds to the LDAP `uid` attribute of the `posixAccount` object class in the `ou=People` container. The configuration can establish a mapping between the `name` column and the `uid` attribute. You can also say that the `name` column is mapped to the `uid` attribute (or vice versa).

- Principal

  An entity in NIS+ (user or machine) that can be authenticated. Usually, there is a 1-to-1 correspondence between netnames and principal names.

Configuration Files

Two configuration file control `rpc.nisd` operation.

- `/etc/default/rpc.nisd`

  This file contains information regarding the LDAP server and authentication; NIS+ base domain; LDAP default search base; exception processing, and general `rpc.nisd` configuration, which applies whether or not LDAP mapping is in effect.)

- `/var/nis/NIS+LDAPmapping`

  This file contains information on mapping of NIS+ data to and from LDAP. The template file (`/var/nis/NIS+LDAPmapping`.template) covers all standard NIS+ objects (except `client_info.org_dir` and `timezone.org_dir`. See

"client_info and timezone Tables" on page 680and NIS+LDAPmapping(4).

Configuration is done by assigning values to pre-defined attributes. In addition to the configuration files, the configuration attributes can also be read from LDAP (see "Storing Configuration Information in LDAP" on page 688) or can be specified on the rpc.nisd command line via the -x option. If the same attribute is specified in more than one place, the priority order is (from higher to lower):

1. rpc.nisd -x option
2. Configuration file
3. LDAP

Creating Attributes and Object Classes

Depending on how you configure the NIS+/LDAP mapping, you may need to create a number of new LDAP attributes and object classes. The examples show how to do this by specifying LDIF data that can be used as input to the ldapadd(1) command. Create a file containing the LDIF data, and then invoke ldapadd:

```
# ldapadd -D -f ldif-file
```

This method works with the iPlanet Directory Server 5.x , and may work with other LDAP servers as well.

Note – Except for the defaultSearchBase, preferredServerList, and authenticationMethod attributes, as well and the SYNTAX specifications, the OIDs used in the follwing examples are intended for illustration only. As no official OIDs have been assigned, you are free to use any suitable OIDs.

Getting Started

For a quick introduction to the configuration necessary to get started using an LDAP repository for NIS+ data, see the "Getting Started" section on the NIS+LDAPmapping(4) man page. The remainder of this section goes into more detail about the organization of the confguration files.

General Configuration

All assignments of `/etc/default/rpc.nisd` file are of the `attributeName=value` type.

The following attributes control general configuration of the `rpc.nisd`, and are active whether or not LDAP mapping is in effect. They should generally be left at their default values. See `rpc.nisd(4)` for more information.

- `nisplusNumberOfServiceThreads`
- `nisplusThreadCreationErrorAction`
- `nisplusThreadCreationErrorAttempts`
- `nisplusThreadCreationErrorTimeout`
- `nisplusDumpErrorAction`
- `nisplusDumpErrorAttempts`
- `nisplusDumpErrorTimeout`
- `nisplusResyncService`
- `nisplusUpdateBatching`
- `nisplusUpdateBatchingTimeout`

Configuration Data from LDAP

Attributes controlling reading of other configuration attributes from LDAP. These attributes cannot themselves reside in LDAP. They are read only from the command line or the configuration file. See `rpc.nisd(4)` for more information.

- `nisplusLDAPconfigDN`
- `nisplusLDAPconfigPreferredServerList`
- `nisplusLDAPconfigAuthenticationMethod`
- `nisplusLDAPconfigTLS`
- `nisplusLDAPconfigTLSCertificateDBPath`
- `nisplusLDAPconfigProxyUser`
- `nisplusLDAPconfigProxyPassword`

Server Selection

`preferredServerList`

Specify the LDAP server and port number. For example:

```
127.0.0.1         LDAP server can be found at port 389
127.0.0.1:389         on the local machine

1.2.3.4:65042         LDAP server on the machine at IP
                         address "1.2.3.4", at port 65042
```

Authentication and Security

- `authenticationMethod`
- `nisplusLDAPproxyUser`
- `nisplusLDAPproxyPassword`

The authentication method and, if appropriate for the method selected, the proxy user (bind DN) and password (key or other shared secret) to be used between the `rpc.nisd` and the LDAP server. See section “Security and Authentication” on page 670for more information.

- `nisplusLDAPTLS`
- `nisplusLDAPTLSCertificateDBPath`

  Optionally use SSL, and specify location of certificate file. See section “Security and Authentication” on page 670 for more information.

Default location in LDAP and NIS+

`defaultSearchBase`

The point in the LDAP DIT where the containers for RFC 2307- style naming services data live. This is the default used when individual container specifications (see the `nisplusLDAPobjectDN` attribute below) do not specify a full search base specification.

`nisplusLDAPbaseDomain`

The default NIS+ domain name to use when NIS+ object specifications (see the `nisplusLDAPdatabaseIdMapping`attribute below) are not fully qualified.

Timeout/size Limits and Referral Action For LDAP Communication

`nisplusLDAPbindTimeout`

`nisplusLDAPmodifyTimeout`

`nisplusLDAPaddTimeout`

`nisplusLDAPdeleteTimeout`

Timeouts for the LDAP bind, modify, add, and delete operations, respectively. Should generally be left at their default values.

`nisplusLDAPsearchTimeout`

`nisplusLDAPsearchTimeLimit`

Sets the timeout for the LDAP search operation, and requests a server-side search time limit, respectively. Since the nisplusLDAPsearchTimeLimit will control how much time the LDAP server spends on the search request, make sure that `nisplusLDAPsearchTimeLimit` is not smaller than `nisplusLDAPsearchTimeout`. Depending on the performance of the NIS+ server, the LDAP server, and the connection between them, you may have to increase the search limits from the default values. Watch for timeout syslog messages from `rpc.nisd` as a clue to making these values larger.

`nisplusLDAPsearchSizeLimit`

Requests a limit on the amount of LDAP data returned for an LDAP search request. The default is to ask for no limitation. This is a server side limit. The LDAP server may impose restrictions on the maximum, and these restrictions may be tied to the proxy user (bind DN) used. Make sure that the LDAP server allows the `rpc.nisd` to transfer enough data to account for the largest container (depending on the site, often the container used for `passwd.org_dir`, `mail_aliases.org_dir`, or`netgroup.org_dir`). Consult your LDAP server documentation for more information.

`nisplusLDAPfollowReferral`

Action to be taken when an LDAP operation results in a referral to another LDAP server. The default is to *not* follow referrals. Enable follow referrals if you want or need referrals to be honored. Keep in mind that while referrals are convenient, they can also slow down operations by making the `rpc.nisd` talk to multiple LDAP servers for each reqeust. The `rpc.nisd` should generally be pointed directly to an LDAP server that can handle all LDAP requests that the `rpc.nisd` may make.

Error Actions

Actions to be taken when an error occurs during an LDAP operation. You should generally leave these at their defaults. See`rpc.nisd(4)` for more information.

- `nisplusLDAPinitialUpdateAction`
- `nisplusLDAPinitialUpdateOnly`
- `nisplusLDAPretrieveErrorAction`
- `nisplusLDAPretrieveErrorAttempts`
- `nisplusLDAPretrieveErrorTimeout`
- `nisplusLDAPstoreErrorAction`
- `nisplusLDAPstoreErrorAttempts`
- `nisplusLDAPstoreErrorTimeout`
- `nisplusLDAPrefreshErrorAction`
- `nisplusLDAPrefreshErrorAttempts`
- `nisplusLDAPrefreshErrorTimeout`

General LDAP operation control

`nisplusLDAPmatchFetchAction`

Determines whether or not LDAP data should be pre-fetched for NIS+ match operations. In most cases, leave this value at the default. See `rpc.nisd(4)` for more information.

/var/nis/NIS+LDAPmapping

The name of this configuration can be changed via the `-m` option of `rpc.nisd(1M)`. The presence of the `NIS+LDAPmapping` file serves as a master switch for NIS+/LDAP mapping.

If you use a name other than the default for the mapping file, you will have to edit the `/etc/init.d/rpc` boot script to specify the mapping file name on the `rpc.nisd` startup line.

For each NIS+ object that should be mapped to and/or from LDAP, the `NIS+LDAPmapping` file specifies two to five attributes, depending on the object and whether or not the default values are sufficient.

nisplusLDAPdatabaseIdMapping

You can establish an alias for a NIS+ object used in the other mapping attributes. If the NIS+ object name is not fully qualified (i.e., does notend in a dot), the value of the `nisplusLDAPbaseDomain` is appended.

For example,

```
nisplusLDAPdatabaseIdMapping    ethers:ethers.org_dir
```

defines the database id `ethers` as an alias for the NIS+ `ethers.org_dir` table.

Note that NIS+ table objects may appear twice with two different database ids. Once for the table object itself (if the object should be mapped to LDAP), and once for the table entries. For example,

```
nisplusLDAPdatabaseIdMapping    ethers_table:ethers.org_dir
nisplusLDAPdatabaseIdMapping    ethers:ethers.org_dir
```

defines the database ids `ethers_table` and `ethers` as aliases for the `ethers.org_dir` table. Later definitions will make it clear that `ethers_table` is used for the `ethers.org_dir` table object, and `ethers` for the entries in that table.

nisplusLDAPentryTtl

Since the `rpc.nisd`'s local database (in memory and on disk) functions as a cache for LDAP data, the `nisplusLDAPentryTtl` attribute allows us to set the time to live (TTL) values of entries in that cache. There are three TTLs for each database id. The first two control the initial TTL when the `rpc.nisd` first loads the corresponding NIS+ object data from disk, and the third one is the TTL assigned to an object when it is read or refreshed from LDAP.

For example,

```
nisplusLDAPentryTtl    ethers_table:21600:43200:43200
```

results in the `ethers.org_dir` table object getting an initial TTL randomly selected in the range 21600 to 43200 seconds. When that initial TTL expires and the table object is refreshed from LDAP, the TTL will be set to 43200 seconds.

Similarly,

```
nisplusLDAPentryTtl    ethers:1800:3600:3600
```

will assign an initial TTL between 1800 and 3600 seconds to the entries in the `ethers.org_dir` table when it is first loaded. Each entry gets its own randomly selected TTL in the range specified. When a table entry expires and is refreshed, the TTL is set to 3600 seconds.

When selecting TTL values, consider the trade-off between performance and consistency. If the TTLs used for LDAP data cached by the `rpc.nisd` are very long, performance is the same as if the `rpc.nisd` was not mapping data from LDAP at all. However, if the LDAP data is changed (by some entity other than `rpc.nisd`), it can also take a very long time before that change is visible in NIS+.

Conversely, selecting a very short (or even zero) TTL means that changes to LDAP data are quickly visible in NIS+, but can also impose a significant performance penalty. Typically, a NIS+ operation that also reads data from or writes data to LDAP will take at least two to three times longer (plus the LDAP lookup overhead) than the same operation without LDAP communication. Although performance can vary greatly depending on the hardware resources, scanning a large (tens or hundreds of thousands of entries) LDAP container in order to identify NIS+ entries that should be refreshed can take a long time. The `rpc.nisd` performs this scan in the background, continuing to serve possibly stale data while it is going on, but it still consumes CPU and memory on the NIS+ server.

Carefully consider how critical it is to have NIS+ data in close synchronization with LDAP, and select the longest TTL that is acceptable for each NIS+ object. The default (when no nisplusLDAPentryTtl is specified) is one hour. The template mapping file (`/var/nis/NIS+LDAPmapping.template`) changes this to twelve hours for objects other than table entries. However, there is no auto-recognition of non-entry objects, so if you add mapping for a non-entry object, the TTL will default to one hour.

Note – There are no TTLs for non-existent objects. Hence, no matter which TTLs are in effect for LDAP-mapped entries in a NIS+ table, a request for an entry that does notexist in NIS+ will query LDAP for that entry.

nisplusLDAPobjectDN

For each mapped NIS+ object, `nisplusLDAPobjectDN` establishes the location in the LDAP DIT where the object data resides. It also allows specification of the action to take when an LDAP entry is deleted. Each `nisplusLDAPobjectDN` value has three parts: the first specifies where LDAP data is read from, the second to where it is written, and the third what should happen when LDAP data is deleted. For example:

```
nisplusLDAPobjectDN    ethers_table:\
cn=ethers,ou=nisPlus,?base?\
objectClass=nisplusObjectContainer:\
cn=ethers,ou=nisPlus,?base?\
objectClass=nisplusObjectContainer,\
objectClass=top
```

The above example shows that the `ethers.org_dir` table object should be read from the DN `cn=ethers,ou=nisPlus`, (since the value ends in a comma, the value of the `defaultSearchBase` attribute is appended), with scope `base`. Entries with a value of `nisplusObjectContainer` for the `ObjectClass` attribute are selected.

The table object is written to the same place. The delete specification is missing, which implies the default action: if the NIS+ table object is deleted, the entire LDAP entry should also be deleted.

If data should be read from, but not written to, LDAP, omit the write portion (and the colon separating it from the read part):

```
nisplusLDAPobjectDN    ethers_table:\
                                    cn=ethers,ou=nisPlus,?base?\
                                    objectClass=nisplusObjectContainer
```

Note that the `nisplusObjectContainer` object class is not part of RFC 2307. In order to use it, you must configure your LDAP server as detailed in “Mapping NIS+ Objects Other Than Table Entries” on page 673.

For the `ethers.org_dir` table entries, you could use:

```
nisplusLDAPobjectDN ethers:\
                 ou=Ethers,?one?objectClass=ieee802Device:\
                 ou=Ethers,?one?objectClass=ieee802Device,\
                 ou=device,objectClass=top
```

which shows that the table entries are read from and written to the base `ou=Ethers`, (again, the trailing comma appends the `defaultSearchBase` value). On reading,

select entries that have an objectClass attribute value of `ieee802Device`. When creating an entry in the `ou=Ethers` container in LDAP, you also must specify `account` and `top` as objectClass values.

As an example showing a non-default delete specification, consider:

```
nisplusLDAPobjectDN    user_attr:\
                                    ou=People,?one?objectClass=SolarisUserAttr,\
                                        solarisAttrKeyValue=*:\


                                ou=People,?one?objectClass=SolarisUserAttr:\
                                        dbid=user_attr_del
```

The `user_attr.org_dir` data resides in the `ou=People` LDAP container, which it shares with account information from other sources, such as the `passwd.org_dir` NIS+ table.

When reading, select entries in that container that have the `solarisAttrKeyValue` attribute, since only those contain `user_attr.org_dir` data. The `dbid=user_attr_del` portion of the `nisplusLDAPobjectDN` shows that when an entry in the `user_attr.org_dir` NIS+ table entry is deleted, deletion of the corresponding LDAP entry (if any) should follow the rules in the rule set identified by the `user_attr_del` database id. See `nisplusLDAPcolumnFromAttribute` below for more information

`nisplusLDAPattributeFromColumn`

`nisplusLDAPattributeFromColumn` specifies the rules used to map NIS+ data to LDAP. Mapping rules for the other direction is controlled by `nisplusLDAPcolumnFromAttribute`.

nisplusLDAPcolumnFromAttribute

`nisplusLDAPcolumnFromAttribute` specifies the rules used to map LDAP data to NIS+.

The full entry mapping syntax can be found on the NIS+LDAPmapping(4) man page. However, a few examples should make things clearer.

The NIS+ `ethers.org_dir` table contains three columns called `addr`, `name`, and `comment`. Hence, a node with the name `xyzzy` and the and the MAC (Ethernet) address 8:0:20:42:42:42 could be represented by this NIS+ entry in `ethers.org_dir`:

```
8:0:20:42:42:42        xyzzy        Ethernet address for xyzzy
```

Assuming the `defaultSearchBase` value is `dc=some,dc=domain`, the corresponding LDAP entry, as listed by ldapsearch(1), would be:

```
cn=xyzzy,ou=Ethers,dc=some,dc=domain
objectclass=ieee802Device
objectclass=top
macaddress=8:0:20:42:42:42
cn=xyzzy
```

This makes for a simple one-to-one mapping between NIS+ and LDAP data, and the corresponding mapping attribute value going from NIS+ to LDAP is:

```
nisplusLDAPattributeFromColumn \
ethers:        dn=("cn=%s,", name), \
                macAddress=addr, \
                cn=name
```

This constructs the DN for the entry to be `cn=%s`, with the value of the `name` column substituted for `%s`:

```
cn=xyzzy,
```

Since the value ends in a comma, the read base value from the nisplusObjectDN is appended, and you have:

```
cn=xyzzy,ou=Ethers,dc=some,dc=domain
```

The `macAddress` and `cn` attribute values are just assignments of the corresponding NIS+ column values. Since RFC 2307 does not provide for a `description` attribute in the `ou=Ethers` container, the `comment` column in the NIS+ table cannot be represented in LDAP. (You could modify your LDAP server to allow a `description` attribute, but would then no longer be conformant with RFC 2307.)

Similarly, the mapping from LDAP to NIS+:

```
nisplusLDAPcolumnFromAttribute \
                     ethers:        addr=macAddress, \
                                    name=cn
```

assigns the `macAddress` and `cn` values to the corresponding NIS+ columns. The `comment` column is not specified (again, because the `ou=Ethers` container does notprovide for a comment), and remains unchanged; if the NIS+ entry is created, the `comment` column will have no value.

Finally, the following `nisplusLDAPattributeFromColumn` value:

```
nisplusLDAPattributeFromColumn \
user_attr_del:    dn=("uid=%s,", name), \
                        SolarisUserQualifier=, \
                        SolarisAttrReserved1=, \
                         SolarisAttrReserved2=, \
                        SolarisAttrKeyValue=
```

is an example of rule sets used for deletion. Again,, the `user_attr.org_dir` data shares the `ou=People` container with other account information (from the `passwd.org_dir` and other tables). If an entry in the `user_attr.org_dir` table is

deleted, you probably do not want to delete the entire `ou=People` entry. Instead, the delete entry above says that when a `user_attr.org_dir` entry is deleted, the `SolarisUserQualifier`, `SolarisAttrReserved1`, `SolarisAttrReserved2`, and `SolarisAttrKeyValue`'attributes (if any) are deleted from the `ou=People` entry specified by the

```
dn=("uid=%s,", name)
```

rule, but the rest of the LDAP entry is left unchanged.

`nisplusLDAPcolumnFromAttribute` specifies the rules used to map LDAP data to NIS+.

Synchonizing NIS+ and LDAP Data

There are many ways to approach a migration from NIS+ to LDAP. You can make NIS+ data authoritative over LDAP, or LDAP data authoritative over NIS+, or you can perserve both data types. One approach would be make LDAP authoritative over NIS+, so as to avoid data conflicts. That said, all of the following options are valid.

▼ How to Convert All NIS+ Data to LDAP in One Operation

- **Use the `rpc.nisd` to upload any NIS+ data that does not yet exist in LDAP. See the `nisplusLDAPinitialUpdateAction` attribute on the `rpc.nisd(4)` man page.**

EXAMPLE C–1 Using `rpc.nisd`

Assuming all NIS+/LDAP data mappings have been established in the default location (`/var/nis/NIS+LDAPmapping`), the following command:

```
# /usr/sbin/rpc.nisd -D \
                          -x nisplusLDAPinitialUpdateAction=to_ldap \
                          -x nisplusLDAPinitialUpdateOnly=yes
```

The above would make the `rpc.nisd` upload data to LDAP, and then exit. The NIS+ data would be unaffected by this operation.

▼ How to Migrate from NIS+ to LDAP Gradually

- **Use `nisplusLDAPinitialUpdateAction` to upload current NIS+ data to LDAP.**

Both NIS+ and LDAP clients could share the same naming service data, and let the `rpc.nisd` automatically keep NIS+ and LDAP data synchronized. Initially, perhaps, NIS+ would be authoritative, and the LDAP server(s) would maintain a duplicate of the NIS+ data for the benefit of LDAP clients. At a convenient time, LDAP can become the authoritative naming service, and NIS+ service gradually phased out, until there

are no more NIS+ clients.

▼ How to Merge NIS+ and LDAP Data, defering to either NIS+ or LDAP

- **Use** `/usr/bin/rpc.nisd`**to upload NIS+ data to LDAP, as seen in Step 1. Or, to download LDAP data to NIS+, do the following:**

```
# /usr/sbin/rpc.nisd -D \
            -x nisplusLDAPinitialUpdateAction=from_ldap \
            -x nisplusLDAPinitialUpdateOnly=yes
```

`rpc.nisd` exits once the dowload is complete.

Additionally, you could perform both commands to synchronize NIS+ and LDAP data Note that if NIS+ and LDAP have different data for one or more data, you must pay attention to the order in which you execute the uploads or downloads.

Note – Upload performed first: In this case, if there is a conflict between NIS+ and LDAP data, the NIS+ data will be authortative.

Note – Download performed first: In this case, if there's a conflict between NIS+ and LDAP data, the LDAP data will be authoritative.

EXAMPLE C–2 Resolving data conflict between NIS+ and LDAP entries

The NIS+ `group.org_dir` entry is:

```
agroup::123:member1
```

The corresponding LDAP entry in the `ou=Group` container is:

```
cn=agroup,ou=Group,dc=some,dc=domain
objectclass=posixGroup
objectclass=top
cn=agroup
gidnumber=123
memberuid=member2
```

Here, the group membership list entries are conflicting (`member1` and `member2`)To resolve this conflict by keeping the NIS+ entry, *upload* first. The LDAP entry would be changed to include`memberuid=member1`, where the final entry would be:

```
cn=agroup,ou=Group,dc=some,dc=domain
objectclass=posixGroup
objectclass=top
cn=agroup
gidnumber=123
```

EXAMPLE C–2 Resolving data conflict between NIS+ and LDAP entries *(Continued)*

```
memberuid=member1
memberuid=member2
```

To resolve the conflict by keeping the LDAP entry, *download* first. The NIS+ entry would be changed to: `agroup::123:member2`

Merging NIS+ and LDAP Data

"Synchonizing NIS+ and LDAP Data" on page 664 showed how to synchronize NIS+ and LDAP data when data conflicts between the two should be resolved by letting either the NIS+ or the LDAP data be authoritative. Merging data (for example, because the desired final result for the sample NIS+ entry in "General Configuration" on page 656 is `agroup::123:member1,member2`) requires a more complicated procedure.

The following example assumes:

- You are putting a backup of the NIS+ data in the `/nisbackup` directory.
- Valid mapping configuration already exists in `/etc/default/rpc.nisd` and `/var/nis/tmpmap`.
- Flat file representations of the NIS+ data before the merge are stored in `/before`, and after-merge representations in `/after`.
- The `niscat(1)` command is used to dump flat file representations of custom NIS+ tables not supported by `nisaddent(1M)`. You may have your own commands or scripts for dumping and loading such custom tables from and to NIS+. If so, those commands/ scripts should be used in preference to `niscat(1)`, since the latter has no convenient counterpart to load data back into NIS+.

  If you nevertheless are forced to dump data using `niscat(1)`,you can use `nistbladm(1)` to load entries back into NIS+ one by one.
- Your command path includes `/usr/lib/nis` (which is where `nisaddent`(1M) resides).

▼ How to merge data and keep both NIS+ and LDAP entries valid

1. **Back up all NIS+ data using the** `nisbackup(1M)` **command.**

```
# nisbackup -a /nisbackup
```

2. **Identify the NIS+ tables that have data which must be merged with LDAP. Dump the contents of these tables to flat files. For example, to dump the contents of** `group.org_dir`**:**

```
# nisaddent -d group | sort > /before/group
```

Piping the `nisaddent` output to sort will make for convenient comparison later on.

3. **Stop** `rpc.nisd`**.**

```
# pkill rpc.nisd
```

4. **Download LDAP data to NIS+.**

```
# /usr/sbin/rpc.nisd -D -m tmpmap \
                                        -x nisplusLDAPinitialUpdateAction=from_ldap \
                                        -x nisplusLDAPinitialUpdateOnly=yes
```

5. **Start** `rpc.nisd`**.**

```
# /usr/sbin/rpc.nisd
```

The `rpc.nisd` will now be serving the data downloaded from LDAP. If the conflicts to be resolved are such that NIS+ clients should not be exposed to them, make sure to perform this and the following steps when there are few (preferably no) active NIS+ clients.

6. **Dump the NIS+ data for the affected tables. For example, for the** `group.org_dir` **table:**

```
# nisaddent -d group | sort > /after/group
```

7. **Use your favorite file merge procedure to produce merged versions of the tables. If no other tools are available, you can use** `diff(1)` **to collect differences between the** `/before` **and** `/after` **files, and merge manually with a text editor.**

This assumes that the merged results are available in `/after`.

8. **Load the merged data into NIS+. For example, for the group table:**

```
# nisaddent -m -f /after/group group
```

9. **NIS+ now contains the merged data, which can be uploaded to LDAP. Stop** `rpc.nisd`**:**

```
# pkill rpc.nisd
```

and perform the upload.

```
# /usr/sbin/rpc.nisd -D -m tmpmap \
                                      -x nisplusLDAPinitialUpdateAction=to_ldap \
                                      -x nisplusLDAPinitialUpdateOnly=yes
```

10. **Restart `rpc.nisd`. If the `rpc.nisd` should use the LDAP repository, specify an appropriate mapping file. If the `rpc.nisd` provides NIS (YP) emulation, specify the `-Y` option.**

```
# /usr/sbin/rpc.nisd [ -m mappingfile ] [ -Y ]
```

(Alternatively, omit `-x nisplusLDAPinitialUpdateOnly=yes` from the upload command in step (9). This will make the `rpc.nisd` start serving NIS+ data when the upload is done.)

Caution – If the LDAP data has changed between the download in step (4) and the upload in step (9), the upload will overwrite those changes. For this reason, you should try to prevent modifications to the LDAP data during the above procedure. Consult you LDAP server documentation for more information.

Masters and Replicas

Only NIS+ masters are allowed to write data to LDAP. NIS+ replicas can obtain updates either from the NIS+ master (which may or may not have obtained it from LDAP), or they can read data directly from an LDAP server. A mixture of the two is also possible. Hence, there are two principal ways to arrange NIS+ replication.

- Leave NIS+ replicas unchanged, and let them obtain their data updates from the NIS+ master. This has the advantage of configurational simplicity (only the NIS+ master need have a connection to an LDAP server), and also maintains the old replication relationship (master knows about new data first, replicas later). It is probably the most convenient solution while NIS+ remains authoritative for naming service data. However, it also lengthens the path between LDAP and NIS+ replica servers.
- Let NIS+ replicas obtain their data directly from LDAP instead of from the NIS+ master. In this case, replicas may have updated data before or after the NIS+ master, depending on lookup traffic and TTLs for data derived from LDAP. This arrangement is more complicated, but can be convenient when LDAP is the authoritative naming services repository, and few or no updates are made directly to NIS+ data.

Replication Time Stamps

When a NIS+ replica is obtaining data for at least some objects in a particular NIS+ directory from LDAP, the update time stamps printed by `nisping(1M)` do not necessarily indicate the degree of data consistency between the NIS+ master and the

replica. For example, say that the NIS+ directory `dir1` contains the tables `table1` and `table2`. When the replica is obtaining data for both `table1` and `table2` from the NIS+ master, a nisping output such as:

```
# nisping dir1 Master server is "master.some.domain."
                         Last update occurred at Mon Aug  5 22:11:09 2002

Replica server is "replica.some.domain."
                         Last Update seen was Mon Aug  5 22:11:09 2002
```

The above indicates that the master and replica have exactly the same data. However, if the replica is getting data for either or both of `table1` and `table2` from LDAP, the output above only shows that the replica has received a NIS_PING from the master, and updated its resynchronization time stamp for housekeeping purposes. The data in the table(s) mapped from LDAP may differ from that on the NIS+ master if:

- The LDAP data differs from that on the NIS+ master, or
- The replica has data in its cache (its local version of the NIS+ database) that has not expired, but that is not up to date with LDAP.

If you cannot accept this type of data inconsistency, let all NIS+ replicas obtain their data from the NIS+ master only. Once you have configured the NIS+ master to get data from LDAP, there is no need to make modifications to the replicas.

The Directory Server

The LDAP mapping portion of `rpc.nisd` uses LDAP protocol version 3 to talk to the LDAP server. The default mapping configuration (`/var/nis/NIS+LDAPmapping.template`) expects that the LDAP server supports an extended version of RFC 2307. RFCs can be retrieved from "http://www.ietf.org/rfc.html". While the mapping between NIS+ and LDAP data can be modified using`NIS+LDAPmapping(4)` , there is a basic assumption that the LDAP data is organized along the principles laid out in RFC 2307.

For example, in order to share account information between direct LDAP clients and NIS+ clients, the LDAP server must support storing account (user) passwords in the Unix crypt format. If the LDAP server cannot be configured to do so, you can still store NIS+ data, including accounts, in LDAP. However, you will not be able to fully share account information between NIS+ users and LDAP bind DNs.

Configuring the iPlanet Directory Server, 5.x

Refer to the iPlanet Directory Server Documentation Set for detailed instructions on the installation, setup and administration of the iPlanet Directory Server.

The`idsconfig(1M)` command can be used to configure the iPlanet Directory Server (version 5.x) for LDAP clients using LDAP as a naming service. The setup provided by `idsconfig(1M)` is also appropriate when using NIS+ with an LDAP data repository.

Note – If you are using an LDAP server other than iPlanet Directory Server (version 5.x), you must manually configure it to support the RFC 2307 schemas.

For more information on `idsconfig`, refer to *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

Assigning Server Address and Port Number

The `/etc/default/rpc.nisd` file is set up to use a local LDAP server at port 389. If this is not correct in your configuration, establish a new value for the `preferredServerList` attribute. For example, to use an LDAP server at IP address 192.0.0.1 and port 65535:

```
preferredServerList=192.0.0.1:65535
```

Security and Authentication

Authentication between NIS+ clients and the NIS+ server is not affected when the NIS+ server is obtaining data from LDAP. However, in order to maintain the integrity of the NIS+ data when it is stored in LDAP, you should consider configuring authentication between the `rpc.nisd` and the LDAP server. Several different flavors of authentication are available, depending on the capabilities of the LDAP server.

The LDAP authentication supported by the `rpc.nisd` include:

- `none`

  No authentication. This is the default; while it requires no setup, it also provides no security. It is only suitable for use in environments that have no security requirements at all.

  To use use the `none` authentication, make sure that the `authenticationMethod` attribute has the value:

```
authenticationMethod=none
```

The authentication methods that actually provide at least some security typically require that you associate a shared secret (a password or key) with a DN in LDAP. The DN you select for use by the `rpc.nisd` can be unique, or can also be used for other purposes. It should have appropriate capabilities to support the expected LDAP traffic. For example, if the `rpc.nisd` should be able to write data to LDAP, the selected DN must have the right to add/update/delete LDAP data in the containers used for the NIS+ data. Also, the LDAP server may by default impose limitations on resource usage (such as search time limits or search result size limitations). If this is the case, the selected DN must have sufficient capabilities to support enumeration of the NIS+ data containers.

- `simple`

  Provides authentication by unencrypted exchange of a password string. Since the password is sent in the clear between the LDAP client (`rpc.nisd`) and LDAP server, the `SIMPLE` method is suitable only when information exchange between the NIS+ and LDAP servers is protected by some other method.

  For instance, transport layer encryption of LDAP traffic, or the special case where the NIS+ and LDAP server is one and the same system, and the NIS+/LDAP traffic stays in the kernel, protected from the eyes of unauthorized users.

  Modify the configuration of the `rpc.nisd` with the DN and password to use for the `SIMPLE` authentication. For example, if the DN is `cn=nisplusAdmin,ou=People,dc=some,dc=domain`, and the password `aword`, establish the following:

```
authenticationMethod=simple
nisplusLDAPproxyUser=cn=nisplusAdmin,ou=People,dc=some,dc=domain
nisplusLDAPproxyPassword=aword
```

  Be sure to protect the place where the password is stored from unauthorized access. Remember that if the password is specified on the `rpc.nisd` command line, it may be visible to any user on the system via commands such as `ps(1)`.

- `sasl/digest-md5`

  Provides authentication using the `digest/md5` algorithm.

  Consult your LDAP server documentation for information on how to set up an authorization identity for use with `digest-md5`, and modify the `/etc/default/rpc.nisd` file to specify this identity and its associated password:

```
authenticationMethod=sasl/digest-md5
nisplusLDAPproxyUser=cn=nisplusAdmin,ou=People,dc=some,dc=domain
nisplusLDAPproxyPassword=aword
```

  Be sure to protect the file where the password is stored from unauthorized access.

- `sasl/cram-md5`

  Authentication using the `cram/md5` algorithm. Probably only supported by the obsolete SunDS LDAP server.

Consult your LDAP server documentation for information on how to set up a bind DN for use with cram-md5, and modify the `/etc/default/rpc.nisd` file to specify this DN and its associated password:

```
authenticationMethod=sasl/cram-md5
nisplusLDAPproxyUser=cn=nisplusAdmin,ou=People,dc=some,dc=domain
nisplusLDAPproxyPassword=aword
```

Be sure to protect the file where the password is stored from unauthorized access.

Using SSL

In addition, `rpc.nisd` supports transport layer encryption of LDAP traffic using SSL. Consult your LDAP server documentation to generate an SSL certificate for LDAP server authentication. Store the certificate in a file on the NIS+ server (`/var/nis/cert7.db`, forexample) and modify `/etc/default/rpc.nisd` accordingly:

```
nisplusLDAPTLS=ssl
nisplusLDAPTLSCertificateDBPath=/var/nis/cert7.db
```

Be sure to protect the certificate file from unauthorized access. Note that the above provides session encryption and authentication of the LDAP server to the `rpc.nisd`. It does not provide authentication of the `rpc.nisd` to the LDAP server, since the certificate does not contain anything that identifies the LDAP client (`rpc.nisd`). However, you can combine SSL with another authentication method (simple, `sasl/digest-md5`) in order to achieve mutual authentication.

For more information regarding LDAP security issues, refer to *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

Performance and Indexing

When the `rpc.nisd` is asked to enumerate a NIS+ table (via `niscat(1)`, for example) that is mapped from LDAP, it will enumerate the corresponding LDAP container if at least one entry in the table has an expired TTL. Although this container enumeration is done in the background, so that LDAP performance is of limited importance, it can nevertheless be beneficial to establish LDAP indices to speed up container enumeration for large containers.

To obtain an estimate of the amount of time required for enumeration of a particular container, you can use a command like the following:

```
% /bin/time ldapsearch -h "server address" -D "bind DN" -w "password" \
        -b "container", "search base" 'cn=*' > /dev/null
```

where

- `server-address`

  IP address portion of preferredServerList value from `/etc/default/rpc.nisd`
- `bind-DN`

  `nisplusLDAPproxyUser` value from `/etc/default/rpc.nisd`
- `password`

  `nisplusLDAPproxyPassword` value from `/etc/default/rpc.nisd`
- `container`

  One of the RFC 2307 container names (`ou=Services`, `ou=Rpc`, etc.)
- `search-base`

  `defaultSearchBase` value from `/etc/default/rpc.nisd`

The "real" value printed by `/bin/time` is the elapsed (wall-clock) time. If this value exceeds a significant fraction (25 percent or more) of the TTL for the corresponding table entries (see“nisplusLDAPentryTtl” on page 660), it might be beneficial to index the LDAP container.

The `rpc.nisd` supports the "simple page” and VLV indexing methods. Refer to your LDAP server documentation to find out which indexing methods it supports, and how to create such indices.

Mapping NIS+ Objects Other Than Table Entries

You can elect to store NIS+ object other than table entries in LDAP. However, doing so has no particular value unless you also have NIS+ replicas that obtain those NIS+ objects from LDAP. The recommended choices are

- There are no replicas, or the replicas obtain their data from the NIS+ master only.

  Edit the mapping configuration file (see `NIS+LDAPmapping(4)`) to remove the following attribute values for all non-table-entry objects.

```
nisplusLDAPdatabaseIdMapping
nisplusLDAPentryTtl
nisplusLDAPobjectDN
```

  For example, if you started out from the `/var/nis/NIS+LDAPmapping.template` file, the sections you need to remove (or disable by commenting) are:

```
# Standard NIS+ directories
nisplusLDAPdatabaseIdMapping    basedir:
```

```
.
.
.
nisplusLDAPdatabaseIdMapping    user_attr_table:user_attr.org_dir
nisplusLDAPdatabaseIdMapping        audit_user_table:audit_user.org_dir

# Standard NIS+ directories
nisplusLDAPentryTtl             basedir:21600:43200:43200
.
.
.
nisplusLDAPentryTtl    user_attr_table:21600:43200:43200
nisplusLDAPentryTtl    audit_user_table:21600:43200:43200

# Standard NIS+ directories
nisplusLDAPobjectDN    basedir:cn=basedir,ou=nisPlus,?base?\
                    objectClass=nisplusObjectContainer:\
                                cn=basedir,ou=nisPlus,?base?\
                                    objectClass=nisplusObjectContainer,\
                                    objectClass=top
.
.
.
nisplusLDAPobjectDN    audit_user_table:cn=audit_user,ou=nisPlus,?base?\
                                objectClass=nisplusObjectContainer:\
                                cn=audit_user,ou=nisPlus,?base?\
                                    objectClass=nisplusObjectContainer,\
                                    objectClass=top
```

- NIS+ Replicas obtain their data from LDAP server.

  Create the `nisplusObject` attribute and `nisplusObjectContainer` object class as shown in the following example (LDIF data suitable for`ldapadd(1);` attribute and object class OIDs for illustration only)

```
dn: cn=schema
changetype: modify
add: attributetypes
attributetypes: ( 1.3.6.1.4.1.42.2.27.5.42.42.1.0 NAME 'nisplusObject' \
                                DESC 'An opaque representation of a NIS+ object' \
                                SYNTAX 1.3.6.1.4.1.1466.115.121.1.5 SINGLE-VALUE )

dn: cn=schema
changetype: modify
add: objectclasses

objectclasses( 1.3.6.1.4.1.42.2.27.5.42.42.2.0 NAME 'nisplusObjectContainer' \
                            SUP top STRUCTURAL DESC 'Abstraction of a NIS+ object' \
                            MUST ( cn $ nisplusObject ) )
```

You also need to create a container for the NIS+ objects. The following LDIF syntax shows how to create the `ou=nisPlus,dc=some,dc=domain` container, and can be used as input to the `ldapadd(1)` command.

```
dn: ou=nisPlus,dc=some,dc=domain
ou: nisPlus
objectClass: top
objectClass: organizationalUnit
```

NIS+ Entry Owner, Group, Access and TTL

When NIS+ table entries are created from LDAP data, the default behavior is to initialize the entry object owner, group, access rights and TTL using the corresponding values from the table object in which the entry object lives. This is normally sufficient, but there might be cases where these NIS+ entry attributes must be established individually. An example of this would be a site that didn't use the `rpc.nispasswdd(1M)` daemon. In order to allow individual users to change their NIS+ passwords (and re-encrypt their DES keys stored in the cred.org_dir table), `passwd.org_dir`and `cred.org_dir` entries for the user should be owned by the user, and have modify rights for the entry owner.

If you need to store table entry owner, group, access, or TTL in LDAP for one or more NIS+ tables, you need to do the following:

▼ How to Store Additional Entry Attributes in LDAP

1. **Consult your LDAP server documentation, and create the following new attributes and object class (LDIF data for `ldapadd(1)`; attribute and object class OIDs for illustration only):**

```
dn: cn=schema
changetype: modify
add: attributetypes
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.4.0 NAME 'nisplusEntryOwner' \
                                DESC 'Opaque representation of NIS+ entry owner' \
                                SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.4.1 NAME 'nisplusEntryGroup' \
                                DESC 'Opaque representation of NIS+ entry group' \
                                SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.4.2 NAME 'nisplusEntryAccess' \
                                DESC 'Opaque representation of NIS+ entry access' \
                                SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
```

```
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.4.3 NAME 'nisplusEntryTtl' \
                                DESC 'Opaque representation of NIS+ entry TTL' \
                                SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )

dn: cn=schema
changetype: modify
add: objectclasses

objectclasses:    ( 1.3.6.1.4.1.42.2.27.5.42.42.5.0 NAME 'nisplusEntryData' \
SUP top STRUCTURAL DESC 'NIS+ entry object non-column data' \
MUST ( cn ) MAY ( nisplusEntryOwner $ nisplusEntryGroup $ \
nisplusEntryAccess $ nisplusEntryTtl ) )
```

2. **Modify the** `nisplusLDAPobjectDN` **attribute value for the relevant table(s) so that the write portion includes the newly created** `nisplusEntryData` **object class. For example, for the** `passwd.org_dir` **table, assuming that you are using a mapping file based on** `/var/nis/NIS+LDAPmapping.template`**, edit:**

```
nisplusLDAPobjectDN    passwd:ou=People,?one?objectClass=shadowAccount,\
                     objectClass=posixAccount:\
                ou=People,?one?objectClass=shadowAccount,\
                     objectClass=posixAccount,\
                     objectClass=account,objectClass=top
```

   to read:

```
nisplusLDAPobjectDN    passwd:ou=People,?one?objectClass=shadowAccount,\
                     objectClass=posixAccount:\
                ou=People,?one?objectClass=shadowAccount,\
                     objectClass=posixAccount,\
                     objectClass=nisplusEntryData,\
                     objectClass=account,objectClass=top
```

3. **Edit the** `nisplusLDAPattributeFromColumn` **and** `nisplusLDAPcolumnFromAttribute` **attribute values to specify any desired subset of owner, group, access, or TTL. In Step 2, you created the LDAP attributes used to store these values. For NIS+, there are predefined pseudo-column names called** `zo_owner`**,** `zo_group`**,** `zo_access`**, and** `zo_ttl`**, respectively. For example, in order to store owner, group, and access for** `passwd.org_dir` **entries in LDAP, modify the**`nisplusLDAPattributeFromColumn` **value from:**

```
nisplusLDAPattributeFromColumn \
        passwd:        dn=("uid=%s,", name), \
                cn=name, \
                uid=name, \
                authPassword=("crypt$%s", passwd), \
                uidNumber=uid, \
                gidNumber=gid, \
                gecos=gcos, \
                homeDirectory=home, \
                loginShell=shell, \
                (shadowLastChange,shadowMin,shadowMax, \
                 shadowWarning, shadowInactive,shadowExpire)=\
                    (shadow, ":")
```

to read:

```
nisplusLDAPattributeFromColumn \
        passwd:         dn=("uid=%s,", name), \
                cn=name, \
                uid=name, \
                authPassword=("crypt$%s", passwd), \
                uidNumber=uid, \
                gidNumber=gid, \
                gecos=gcos, \
                homeDirectory=home, \
                loginShell=shell, \
                (shadowLastChange,shadowMin,shadowMax, \
                 shadowWarning, shadowInactive,shadowExpire)=\
                    (shadow, ":"), \
                nisplusEntryOwner=zo_owner, \
                nisplusEntryGroup=zo_group, \
                nisplusEntryAccess=zo_access
```

Similarly, to set NIS+ entry owner, group, and access from LDAP data for the `passwd.org_dir` table, modify:

```
nisplusLDAPcolumnFromAttribute \
        passwd:         name=uid, \
                ("crypt$%s", passwd)=authPassword, \
                uid=uidNumber, \
                gid=gidNumber, \
                gcos=gecos, \
                home=homeDirectory, \
                shell=loginShell, \
                shadow=("%s:%s:%s:%s:%s:%s", \
                    shadowLastChange, \
                    shadowMin, \
                    shadowMax, \
                    shadowWarning, \
                    shadowInactive, \
                    shadowExpire)
```

to read:

```
nisplusLDAPcolumnFromAttribute \
        passwd:         name=uid, \
                ("crypt$%s", passwd)=authPassword, \
                uid=uidNumber, \
                gid=gidNumber, \
                gcos=gecos, \
                home=homeDirectory, \
                shell=loginShell, \
                shadow=("%s:%s:%s:%s:%s:%s", \
                    shadowLastChange, \
                    shadowMin, \
                    shadowMax, \
                    shadowWarning, \
                    shadowInactive, \
                    shadowExpire), \
                zo_owner=nisplusEntryOwner, \
```

```
zo_group=nisplusEntryGroup, \
zo_access=nisplusEntryAccess
```

4. **Restart the `rpc.nisd` in order to make the mapping change take effect. First, however, you probably want to upload owner, group, access, and/or TTL entry data to LDAP. Perform an upload as shown in item (1) of "Synchonizing NIS+ and LDAP Data" on page 664.**

Principal Names and Netnames

NIS+ authentication relies on principal names (a user or host name, qualified by the domain name) and netnames (the secure RPC equivalent of principal names) to uniquely identify an entity (principal) that can be authenticated. While RFC 2307 provides for storing the DES keys used for NIS+ authentication, there is no specified place for the principal names or netnames.

The `/var/nis/NIS+LDAPmapping.template` file works around this problem by deriving the domain portion of principal and netnames from the owner name (itself a principal name) of the `cred.org_dir` table. Hence, if the NIS+ domain is `x.y.z.`, and the owner of the `cred.org_dir` table is `aaa.x.y.z.`, all principal names for NIS+ entries created from LDAP data will be of the form:

```
"user or system".x.y.z.
```

and netnames in the form:

```
unix.[uid]@x.y.z
unix.[nodename]@x.y.z
```

While this method of constructing principal and netnames probably is sufficient for most NIS+ installations, there are also some cases in which it fails:

- The owner name of the `cred.org_dir` table belongs to a different domain than the one shared by the principal and netnames in the `cred.org_dir` table. This could be the case for a `cred.org_dir` table in a sub-domain, if the owner is a principal from the parent domain. You can fix this problem in one of the following ways:

  1. Change the owner of the `cred.org_dir` table to match the domain of the entries in the table.
  2. Change the mapping rules for the `cred.org_dir` database id's to use the owner of some other NIS+ object (which could be created especially for that purpose, if no suitable object already exists).

     For example, if the `cred.org_dir` table in the domain `sub.dom.ain`.is owned by `master.dom.ain.`, but principal and netnames in

cred.org_dir.sub.dom.ain. should belong tosub.dom.ain, you could create a link object:

```
# nisln cred.org_dir.sub.dom.ain. \
credname.sub.dom.ain.
```

Set the owner of the link object to an appropriate principal in the sub.dom.ain.:

```
# nischown trusted.sub.dom.ain. credname.sub.dom.ain.
```

Edit the mapping file, changing the following specifications:

```
(nis+:zo_owner[]cred.org_dir, "*.%s")), \
```

to

```
(nis+:zo_owner[]credname.sub.dom.ain., "*.%s")), \
```

Note that the use of a link object called credname is an example. Any valid object type (except an entry object) and object name will do. The important point is to set the owner of the object to have the correct domain name.

3. If you do not want to give ownership even of a special purpose object to a principal from the domain used for the principal and netnames, create nisplusPrincipalName and nisplusNetname attributes as detailed below:

- The cred.org_dir table contains principal and netnames belonging to more than one domain.

  Consult the documentation for your LDAP server, and create the nisplusPrincipalName and nisplusNetname attributes, as well as the nisplusAuthName object class. LDIF data for ldapadd (attribute and object class OIDs for illustration only):

```
dn: cn=schema
changetype: modify
add: attributetypes
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.7.0 NAME 'nisplusPrincipalName' \
          DESC 'NIS+ principal name' \
          SINGLE-VALUE \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.15 )

attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.9.0 NAME 'nisplusNetname' \
          DESC 'Secure RPC netname' \
          SINGLE-VALUE \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.15 )

dn: cn=schema
changetype: modify
add: objectclasses
objectclasses:    ( 1.3.6.1.4.1.42.2.27.5.42.42.10.0 NAME 'nisplusAuthName' \
          SUP top AUXILLIARY DESC 'NIS+ authentication identifiers' \
          MAY ( nisplusPrincipalName $ nisplusNetname ) )
```

You now need to enable the cred.org_dir mapping to use the newly created `nisplusNetname` and `nisplusPrincipalName` attributes. The template mapping file, `/var/nis/NIS+LDAPmapping.template` contains commented-out lines for this purpose. See the `nisplusObjectDN` and `nisplusLDAPattributeFromColumn/ nisplusLDAPcolumnFromAttribute`'attribute values for the `credlocal`, `creduser`, and `crednode` database ids. Once you have edited your mapping file to this effect, restart `rpc.nisd`. Do not forget to add the `-m` option if your mapping file is not the default, and the `-Y` option if the `rpc.nisd` should provide NIS (YP) emulation.

```
# pkill rpc.nisd
        # /usr/sbin/rpc.nisd [-m mapping-file] [-Y]
```

`client_info` and `timezone` Tables

Because RFC 2307 does not provide schemas for the information kept in the NIS+ `client_info.org_dir` and `timezone.org_dir` tables, mapping of these tables is not enabled by default in the template mapping file (`/var/nis/NIS+LDAPmapping`). If you want to keep the client_info and timezone information in LDAP, consult your LDAP server documentation, and create the new attributes and object classes discussed in the following sections.

`client_info` Attributes and Object Class

Create attributes and object class as below, and then create the container for the client_info data. The suggested container name is `ou=ClientInfo`. LDIF data for `ldapadd(1)` (attribute and object class OIDs are examples only) :

```
dn: cn=schema
changetype: modify
add: attributetypes
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.12.0 \
          NAME 'nisplusClientInfoAttr' \
          DESC 'NIS+ client_info table client column' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.15 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.12.1 \
          NAME 'nisplusClientInfoInfo' \
          DESC 'NIS+ client_info table info column' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.12.2 \
          NAME 'nisplusClientInfoFlags' \
          DESC 'NIS+ client_info table flags column' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
```

```
dn: cn=schema
changetype: modify
add: objectclasses
objectclasses:    ( 1.3.6.1.4.1.42.2.27.5.42.42.13.0 \
          NAME 'nisplusClientInfoData' \
          DESC 'NIS+ client_info table data' \
          SUP top STRUCTURAL MUST ( cn ) \
          MAY ( nisplusClientInfoAttr $ nisplusClientInfoInfo $ nisplusClientInfoFlags ) )
```

To create the container, put the following LDIF data in a file. Substitute your actual search base for `[searchBase].`)

```
dn: ou=ClientInfo,[searchBase]
ou: ClientInfo
objectClass: top
objectClass: organizationalUnit
```

Use the above file as input to the `ldapadd(1)` command in order to create the `ou=ClientInfo` container. For example, if your LDAP administrator DN is `cn=directory manager`, and the file with the LDIF data is called `cifile`:

```
# ldapadd -D "cn=directory manager" -f cifile
```

Depending on the authentication required, the ldapadd command may prompt for a password.

The `/var/nis/NIS+LDAPmapping.template` file contains commented-out definitions for the `client_info.org_dir` table. Copy these to the actual mapping file, enable by removing the comment character '#', and restart `rpc.nisd`. If necessary, synchronize NIS+ and LDAP data as described in "Synchonizing NIS+ and LDAP Data" on page 664.

`timezone` attributes and object class

Create attributes and object class as below, and then create the container for the timezone data. The suggested container name is `ou=Timezone`. LDIF data suitable for `ldapadd(1)` (attribute and object class OIDs are examples only):

```
dn: cn=schema
changetype: modify
add: attributetypes
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.15.0 NAME 'nisplusTimeZone' \
          DESC 'tzone column from NIS+ timezone table' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )

dn: cn=schema
changetype: modify
add: objectclasses
objectclasses:    ( 1.3.6.1.4.1.42.2.27.5.42.42.16.0 NAME 'nisplusTimeZoneData' \
```

```
        DESC 'NIS+ timezone table data' \
        SUP top STRUCTURAL MUST ( cn ) \
        MAY ( nisplusTimeZone $ description ) )
```

To create the `ou=Timezone` container, put the following LDIF data in a file. (Substitute your actual search base for `"searchBase"`)

```
dn: ou=Timezone,"searchBase"
ou: Timezone
objectClass: top
objectClass: organizationalUnit
```

Use the above file as input to the `ldapadd(1)` command in order to create the `ou=Timezone` container. For example, if your LDAP administrator DN is `cn=directory manager`, and the file with the LDIF data is called `tzfile`:

```
# ldapadd -D "cn=directory manager" -f tzfile
```

Depending on the authentication required, the ldapadd command may prompt for a password.

The `/var/nis/NIS+LDAPmapping.template` file contains commented-out definitions for the `timezone.org_dir` table. Copy these to the actual mapping file, enable by removing the comment character '#', and restart `rpc.nisd`. If necessary, synchronize NIS+ and LDAP data as described in "Synchonizing NIS+ and LDAP Data" on page 664.

Adding New Object Mappings

The template mapping file, `/var/nis/NIS+LDAPmapping.template`, contains mapping information for all standard NIS+ objects. In order to support mapping of site or application specific objects, you will need to add new mapping entries. This is a simple task for non-entry (i.e., directory, group, link, or table) objects, but can become quite complex for entry objects, if the LDAP organization of the corresponding entry data differs greatly from that used by NIS+. Below is listed the simple case (non-entry objects), followed by an example of how to manage the complications of entry data mapping.

▼ How to Map Non-entry Objects

1. **Find the fully qualified name of the object to be mapped. If this name resides under the domain name specified by the `nisplusLDAPbaseDomain` attribute, you can omit the portion that equals the `nisplusLDAPbaseDomain` value.**

   For example, if `nisplusLDAPbaseDomain` has the value `some.domain.`, and the object to be mapped is a table called `nodeinfo.some.domain.`, the object name can be shortened to `nodeinfo`.

2. **Invent a database id to identify the object. The database id must be unique for the mapping configuration used, but is not otherwise interpreted; it does not show up in the LDAP data. In order to reduce confusion with entry object mappings, create a database id identifying the table object proper (not the table entries) using an explanatory string like `_table` at the end.**

   For this example, use the database id `nodeinfo_table`, and establish the connection between the database id and the object in the standard mapping file location (`/var/nis/NIS+LDAPmapping`) by adding:

```
nisplusLDAPdatabaseIdMapping    nodeinfo_table:nodeinfo.some.domain.
```

   Assuming that `nisplusLDAPbaseDomain` is `some.domain.`, the following would also work:

```
nisplusLDAPdatabaseIdMapping    nodeinfo_table:nodeinfo
```

3. **Decide on a TTL for the object. This is the time during which the `rpc.nisd` regards its local copy of the object as valid. When the TTL expires, the next reference to the object will initiate an LDAP lookup to refresh the object.**

   There are two different TTL values. The first is set when the `rpc.nisd` first loads the object from disk (after a reboot or restart), and the second pertains to all refreshes from LDAP. The first TTL is selected randomly from a configured range. For example, if `nodeinfo_table` should be valid for a period of between one and three hours following initial load, and for twelve hours thereafter, specify:

```
nisplusLDAPentryTtl        nodeinfo_table:3600:10800:43200
```

4. **Decide where the object data should be stored in LDAP. The template mapping file suggests putting non-entry object data in the `ou=nisPlus` container. If you use this scheme, and have not yet created the appropriate attribute, object class, and container, see "Mapping NIS+ Objects Other Than Table Entries" on page 673, item 2.**

   For example, assume you want to store the `nodeinfo` object in the `ou=nisPlus,dc=some,dc=domain` container, and that the LDAP entry should have the `cn nodeinfo`. Create the following `nisplusLDAPobjectDN`

```
nisplusLDAPobjectDN    nodeinfo_table:\
                cn=nodeinfo,ou=nisPlus,dc=some,dc=domain?base?\
                objectClass=nisplusObjectContainer:\
                cn=nodeinfo,ou=nisPlus,dc=some,dc=domain?base?\
                    objectClass=nisplusObjectContainer,\
```

```
    objectClass=top
```

Since NIS+ replicas do not write data to LDAP, you can use the `nisplusLDAPobjectDN` above for both master and replicas.

5. **(Skip this step if the NIS+ object to be mapped has not yet been created in NIS+.) Store the object data in LDAP. You could use `rpc.nisd` for this purpose, but it is easier to use the `nisldapmaptest(1M)` utility, as you can leave `rpc.nisd` running.**

```
# nisldapmaptest -m /var/nis/NIS+LDAPmapping -o -t nodeinfo -r
```

The —o option specifies the table object itself, not the table entries.

6. **Verify that the object data is stored in LDAP. (This example assumes the LDAP server is running on the local machine at port 389):**

```
#ldapsearch -b ou=nisPlus,dc=some,dc=domain cn=nodeinfo
```

The output would appear similar to:

```
cn=nodeinfo,ou=nisPlus,dc=some,dc=domain
nisplusobject=NOT ASCII
objectclass=nisplusObjectContainer
objectclass=top
cn=nodeinfo
```

7. **Restart `rpc.nisd` so that it will start using the new mapping information. Do not forget the `-m`option if the mapping file has a name other than the default one. Append the `-Y` option if your `rpc.nisd` is providing NIS (YP) service.**

```
# pkill rpc.nisd
    # /usr/sbin/rpc.nisd [-m mappinfile] [-Y]
```

Adding Entry Objects

The`NIS+LDAPmapping(4)` man page specifies the syntax and semantics of table entry mapping in detail, and also provides examples that show how to use each syntactic element. However, the simplest and least error-prone approach is usually to identify an already existing mapping that is similar to what you want to do, and then copy and modify that existing mapping.

For example, assume that you have a NIS+ table called `nodeinfo`, which is used to store inventory and owner information for nodes. Assume that the NIS+ table was created by the following command:

```
# nistbladm -c -D access=og=rmcd,nw=r -s : nodeinfo_tbl \
        cname=S inventory=S owner= nodeinfo.‘domainname‘.
```

The `cname` column is expected to contain the canonical name of the node. In other words, the same value as that of the `cname` column in the `hosts.org_dir` table for the node.

Also assume that the corresponding information is kept in the`ou=Hosts` container in LDAP, and that the `nodeInfo` object class (which is an invention for this example, and is not defined in any RFC) has `cn` as a MUST attribute, and that `nodeInventory` and `nodeOwner` are MAY attributes.

In order to upload existing `nodeinfo` data to LDAP, it will be convenient to create the new mapping attributes in a separate file. You could, for example, use `/var/nis/tmpmapping`.

1. Create a database id that identifies the NIS+ table to be mapped.

```
nisplusLDAPdatabaseIdMapping    nodeinfo:nodeinfo
```

2. Set the TTL for entries in the `nodeinfo` table. Since the information is expected to change only rarely, use a twelve hour TTL. When the `rpc.nisd` first loads the `nodeinfo` table from disk, the TTLs for entries in the table are randomly selected to be between six and twelve hours.

```
nisplusLDAPentryTtl        nodeinfo:21600:43200:43200
```

3. Identify an existing mapping that has similar properties to the one you want to create. In our example, mapping the attribute values is trivial (straight assignment). Instead, the complication is that you store the LDAP data in an existing container, so that you have to be careful during removal of the `nodeinfo` data. You do not want to remove the entire `ou=Hosts`entry, just the `nodeInventory` and `nodeOwner` attributes. You will need a special deletion rule set.

   To summarize, you are looking for a mapping that shares a container, and has a delete rule set. One possible candidate is the `netmasks` mapping, which shares the `ou=Networks`container, and does have a delete rule set.

4. The template `netmasks` mapping has the default mapping (from `/var/nis/NIS+LDAPmapping.template`):

```
nisplusLDAPobjectDN    netmasks:ou=Networks,?one?objectClass=ipNetwork,\
                                                    ipNetMaskNumber=*:\
                                          ou=Networks,?one?objectClass=ipNetwork:
                                                       dbid=netmasks_del
```

   Transferred to the new mapping for `nodeinfo`, the database id should be `nodeinfo`, the container `ou=Hosts`, and the object class `nodeInfo`. Thus, the first line of the nodeinfo mapping will be:

```
nisplusLDAPobjectDN    nodeinfo:ou=Hosts,?one?objectClass=nodeInfo,\
```

   The second line in the `netmasks` mapping is the part of the search filter that selects only those `ou=Networks` entries that contain the `ipNetMaskNumber` attribute. In this example, select the`ou=Hosts` entries that have the `nodeInventory` attribute:

```
nodeInventory=*:\
```

   The third and fourth lines are the write portion of the `nisplusLDAPobjectDN`, and they specify where in LDAP `nodeinfo`" data is written, as well as the rule set

that is used when nodeinfo data is deleted. In this case, create a delete rule set identified by the database id nodeinfo_del. Because you are always writing to an existing entry in ou=Hosts, you only need to specify the object class for the nodeinfo data proper:

```
ou=Hosts,?one?objectClass=nodeInfo:\
                              dbid=nodeinfo_del
```

Putting it all together, our nisplusLDAPobjectDN is:

```
nisplusLDAPobjectDN    nodeinfo:ou=Hosts,?one?objectClass=nodeInfo,\
                                                          nodeInventory=*:\
                                                ou=Hosts,?one?objectClass=nodeInfo:\
                                                           dbid=nodeinfo_del
```

5. Create the rule set that maps nodeinfo data from NIS+ to LDAP. The template (from netmasks) is:

```
nisplusLDAPattributeFromColumn \
        netmasks:    dn=("ipNetworkNumber=%s,", addr), \
                        ipNetworkNumber=addr, \
                        ipNetmaskNumber=mask, \
                        description=comment
```

The ou=Hosts container has an additional complication in this case, as RFC 2307 specifies the dn should contain the IP address. However, the IP address is not stored in the nodeinfo table, so you must obtain it in another manner. Fortunately, the crednode mapping in the template file shows the way:

```
nisplusLDAPattributeFromColumn \
        crednode:    dn=("cn=%s+ipHostNumber=%s,", \
                             (cname, "%s.*"), \
            ldap:ipHostNumber:?one?("cn=%s", (cname, "%s.*"))), \
```

Thus, you can copy that portion of the crednode mapping. In this case, however, the cname column value is the actual host name (not the principal name), so you do not need to extract just a portion of the cname. Making the obvious substitutions of attribute and column names, the nodeinfo mapping becomes:

```
nisplusLDAPattributeFromColumn \
        nodeinfo:    dn=("cn=%s+ipHostNumber=%s,", cname, \
            ldap:ipHostNumber:?one?("cn=%s", cname)), \
                nodeInventory=inventory, \
                nodeOwner=owner
```

6. When mapping data from LDAP to NIS+, the template netmasks entry is:

```
nisplusLDAPcolumnFromAttribute \
        netmasks:    addr=ipNetworkNumber, \
                mask=ipNetmaskNumber, \
                comment=description
```

Substituting attribute and column names, you get:

```
nisplusLDAPcolumnFromAttribute \
        nodeinfo:    cname=cn, \
                inventory=nodeInventory, \
                owner=nodeOwner
```

7. The delete rule set for `netmasks` is:

```
nisplusLDAPattributeFromColumn \
        netmasks_del:    dn=("ipNetworkNumber=%s,", addr), \
                ipNetmaskNumber=
```

which specifies that when a `netmasks` entry is deleted in NIS+, the `ipNetmaskNumber` attribute in the corresponding `ou=Networks` LDAP entry is deleted. In this case, delete the `nodeInventory` and `nodeOwner` attributes. Thus, (borrowing the `dn` specification from item (5) above):

```
nisplusLDAPattributeFromColumn \
        nodeinfo_del:    dn=("cn=%s+ipHostNumber=%s,", cname, \
            ldap:ipHostNumber:?one?("cn=%s", cname)), \
                nodeInventory=, \
                nodeOwner=
```

8. The mapping information is complete. In order to start using it stop (and later restart) the `rpc.nisd`.

```
# pkill rpc.nisd
```

9. If there already is data in the NIS+ `nodeinfo` table, upload that data to LDAP. Put the new `nodeinfo` mapping information into a separate file, `/var/nis/tmpmapping`.

```
        # /usr/sbin/rpc.nisd -D -m /var/nis/tmpmapping \
            -x nisplusLDAPinitialUpdateAction=to_ldap \
            -x nisplusLDAPinitialUpdateOnly=yes
```

10. Add the mapping information from the temporary file, `/var/nis/tmpmapping`, to the actual mapping file. Use an editor to do this, or append the data (assuming the actual mapping file is `/var/nis/NIS+LDAPmapping`):

```
# cp -p /var/nis/NIS+LDAPmapping /var/nis/NIS+LDAPmapping.backup
    # cat /var/nis/tmpmapping >> /var/nis/NIS+LDAPmapping
```

Note – Note the double arrow redirection, ">>". A single arrow, ">", would overwrite the target file.

---

11. Restart `rpc.nisd`. Add the `-Y` option if`rpc.nisd` also serves NIS (YP) data:

```
# /usr/sbin/rpc.nisd -m /var/nis/NIS+LDAPmapping
```

Storing Configuration Information in LDAP

In addition to keeping NIS+/LDAP configuration information in the configuration files and on the command line, configuration attributes can also be stored in LDAP. This is useful if the configuration information is shared by many NIS+ servers, and is anticipated to change on a regular basis.

To enable storing of configuration attributes in LDAP, consult your LDAP server documentation and create the following new attributes and object class. The configuration information is expected to reside at the location specified by the `nisplusLDAPconfigDN` value (from `rpc.nisd` command line, or from `/etc/default/rpc.nisd`), with a `cn` equal to the `nisplusLDAPbaseDomain` value (as it is known to the `rpc.nisd` before reading any configuration information from LDAP).

LDIF data suitable for`ldapadd(1)` (attribute and object class OIDs are examples only)

The `defaultSearchBase`, `preferredServerList`, and `authenticationMethod` attributes derive from a draft "DUA config" schema, which is intended to become an IETF standard. In any case, the following definitions are sufficient for the purposes of NIS+/LDAP mapping:

```
dn: cn=schema
changetype: modify
add: attributetypes
attributetypes:    ( 1.3.6.1.4.1.11.1.3.1.1.1 NAME 'defaultSearchBase' \
          DESC 'Default LDAP base DN used by a DUA' \
          EQUALITY distinguishedNameMatch \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.12 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.11.1.3.1.1.2 NAME 'preferredServerList' \
          DESC 'Preferred LDAP server host addresses to be used by a DUA' \
          EQUALITY caseIgnoreMatch \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.15 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.11.1.3.1.1.6 NAME 'authenticationMethod' \
          DESC 'A keystring which identifies the type of authentication method\
       used to contact the DSA' \
          EQUALITY caseIgnoreMatch \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.15 SINGLE-VALUE )
```

NIS+/LDAP configuration attributes:

```
dn: cn=schema
changetype: modify
add: attributetypes
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.0 \
          NAME 'nisplusLDAPTLS' \
          DESC 'Transport Layer Security' \
```

```
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.1 \
          NAME 'nisplusLDAPTLSCertificateDBPath' \
          DESC 'Certificate file' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.2 \
          NAME 'nisplusLDAPproxyUser' \
          DESC 'Proxy user for data store/retrieval' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.3 \
          NAME 'nisplusLDAPproxyPassword' \
          DESC 'Password/key/shared secret for proxy user' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.4 \
          NAME 'nisplusLDAPinitialUpdateAction' \
          DESC 'Type of initial update' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.5 \
          NAME 'nisplusLDAPinitialUpdateOnly' \
          DESC 'Exit after update ?' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.6 \
          NAME 'nisplusLDAPretrieveErrorAction' \
          DESC 'Action following an LDAP search error' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.7 \
          NAME 'nisplusLDAPretrieveErrorAttempts' \
          DESC 'Number of times to retry an LDAP search' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.8 \
          NAME 'nisplusLDAPretrieveErrorTimeout' \
          DESC 'Timeout between each search attempt' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.9 \
          NAME 'nisplusLDAPstoreErrorAction' \
          DESC 'Action following an LDAP store error' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.10 \
          NAME 'nisplusLDAPstoreErrorAttempts' \
          DESC 'Number of times to retry an LDAP store' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.11 \
          NAME 'nisplusLDAPstoreErrorTimeout' \
          DESC 'Timeout between each store attempt' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.12 \
          NAME 'nisplusLDAPrefreshErrorAction' \
          DESC 'Action when refresh of NIS+ data from LDAP fails' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.13 \
          NAME 'nisplusLDAPrefreshErrorAttempts' \
          DESC 'Number of times to retry an LDAP refresh' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.14 \
```

```
          NAME 'nisplusLDAPrefreshErrorTimeout' \
          DESC 'Timeout between each refresh attempt' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.15 \
          NAME 'nisplusNumberOfServiceThreads' \
          DESC 'Max number of RPC service threads' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.16 \
          NAME 'nisplusThreadCreationErrorAction' \
          DESC 'Action when a non-RPC-service thread creation fails' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.17 \
          NAME 'nisplusThreadCreationErrorAttempts' \
          DESC 'Number of times to retry thread creation' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.18 \
          NAME 'nisplusThreadCreationErrorTimeout' \
          DESC 'Timeout between each thread creation attempt' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.19 \
          NAME 'nisplusDumpErrorAction' \
          DESC 'Action when a NIS+ dump fails' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.20 \
          NAME 'nisplusDumpErrorAttempts' \
          DESC 'Number of times to retry a failed dump' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.21 \
          NAME 'nisplusDumpErrorTimeout' \
          DESC 'Timeout between each dump attempt' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.22 \
          NAME 'nisplusResyncService' \
          DESC 'Service provided during a resync' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.23 \
          NAME 'nisplusUpdateBatching' \
          DESC 'Method for batching updates on master' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.24 \
          NAME 'nisplusUpdateBatchingTimeout' \
          DESC 'Minimum time to wait before pinging replicas' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.25 \
          NAME 'nisplusLDAPmatchFetchAction' \
          DESC 'Should pre-fetch be done ?' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.26 \
          NAME 'nisplusLDAPbaseDomain' \
          DESC 'Default domain name used in NIS+/LDAP mapping' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 SINGLE-VALUE )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.27 \
          NAME 'nisplusLDAPdatabaseIdMapping' \
          DESC 'Defines a database id for a NIS+ object' \
```

```
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.28 \
          NAME 'nisplusLDAPentryTtl' \
          DESC 'TTL for cached objects derived from LDAP' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.29 \
          NAME 'nisplusLDAPobjectDN' \
          DESC 'Location in LDAP tree where NIS+ data is stored' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.30 \
          NAME 'nisplusLDAPcolumnFromAttribute' \
          DESC 'Rules for mapping LDAP attributes to NIS+ columns' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 )
attributetypes:    ( 1.3.6.1.4.1.42.2.27.5.42.42.18.31 \
          NAME 'nisplusLDAPattributeFromColumn' \
          DESC 'Rules for mapping NIS+ columns to LDAP attributes' \
          SYNTAX 1.3.6.1.4.1.1466.115.121.1.26 )

dn: cn=schema
changetype: modify
add: objectclasses
objectclasses:    ( 1.3.6.1.4.1.42.2.27.5.42.42.19.0 NAME 'nisplusLDAPconfig' \
          DESC 'NIS+/LDAP mapping configuration' \
          SUP top STRUCTURAL MUST ( cn ) \
          MAY ( preferredServerList $ defaultSearchBase $
authenticationMethod $ nisplusLDAPTLS $ nisplusLDAPTLSCertificateDBPath
$ nisplusLDAPproxyUser $ nisplusLDAPproxyPassword $ nisplusLDAPinitialUpdateAction
$ nisplusLDAPinitialUpdateOnly $ nisplusLDAPretrieveErrorAction
$ nisplusLDAPretrieveErrorAttempts $ nisplusLDAPretrieveErrorTimeout
$ nisplusLDAPstoreErrorAction $ nisplusLDAPstoreErrorAttempts
$ nisplusLDAPstoreErrorTimeout $ nisplusLDAPrefreshErrorAction
$ nisplusLDAPrefreshErrorAttempts $ nisplusLDAPrefreshErrorTimeout
$ nisplusNumberOfServiceThreads $nisplusThreadCreationErrorAction
$ nisplusThreadCreationErrorAttempts $ nisplusThreadCreationErrorTimeout
$ nisplusDumpErrorAction $ nisplusDumpErrorAttempts
$ nisplusDumpErrorTimeout $ nisplusResyncService $ nisplusUpdateBatching
$ nisplusUpdateBatchingTimeout $ nisplusLDAPmatchFetchAction
$ nisplusLDAPbaseDomain $ nisplusLDAPdatabaseIdMapping $ nisplusLDAPentryTtl
$ nisplusLDAPobjectDN $ nisplusLDAPcolumnFromAttribute !
$ nisplusLDAPattributeFromColumn ) )
```

Create a file containing the following LDIF data substitute your actual search base for `"searchBase"`, and your fully qualified domain name for`"domain"`):

```
dn: cn="domain","searchBase"
cn: [domain]
objectClass: top
objectClass: nisplusLDAPconfig
```

Use the above file as input to the `ldapadd(1)` command in order to create the NIS+/LDAP configuration entry. Initially, the entry is empty. Use the

`ldapmodify(1)` command to add configuration attributes. For example, to set the `nisplusNumberOfServiceThreads` attribute to "32", create the following file (for input to `ldapmodify`(1)):

```
dn: cn=[domain],[searchBase]
nisplusNumberOfServiceThreads: 32
```

APPENDIX **D**

Appendix: NIS+ Error Messages

This appendix alphabetically lists some common error messages for the DNS, NIS and NIS+ naming services in the Solaris operating environment. For each message there is an explanation and, where appropriate, a solution or a cross-reference to some other portion of this manual.

About Error Messages

Some of the error messages documented in this chapter are documented more fully in the appropriate man pages.

Error Message Context

Error messages can appear in pop-up windows, shell tool command lines, user console window, or various log files. You can raise or lower the severity threshold level for reporting error conditions in your `/etc/syslog.conf` file.

In the most cases, the error messages that you see are generated by the commands you issued or the container object (file, map, table or directory) your command is addressing. However, in some cases an error message might be generated by a server invoked in response to your command (these messages usually show in `syslog`). For example, a "`permission denied`" message most likely refers to you, or the machine you are using, but it could also be caused by software on a server not having the correct permissions to carry out some function passed on to it by your command or your machine.

Similarly, some commands cause a number of different objects to be searched or queried. Some of these objects might not be obvious. Any one of these objects could return an error message regarding permissions, read-only state, unavailability, and so forth. In such cases the message might not be able to inform you of which object the problem occurred in.

In normal operation, the naming software and servers make routine function calls. Sometimes those calls fail and in doing so generate an error message. It occasionally happens that before a client or server processes your most recent command, then some other call fails and you see the resulting error message. Such a message might appear as if it were in response to your command, when in fact it is in response to some other operation.

Note – When working with a namespace you might encounter error messages generated by remote procedure calls. These RPC error messages are not documented here. Check your system documentation.

Context-Sensitive Meanings

A single error message might have slightly different meanings depending on which part of various naming software applications generated the message. For example, when a "`Not Found`" type message is generated by the `nisls` command, it means that there are no NIS+ objects that have the specified name, but when it is generated by the `nismatch` command it means that no table entries were found that meet the search criteria.

How Error Messages Are Alphabetized

The error messages in this appendix are sorted alphabetically according to the following rules:

- Capitalization is ignored. Thus, messages that begin with "A" and "a" are alphabetized together.
- Nonalphabetic symbols are ignored. Thus, a message that begins with `_svcauth_des` is listed with the other messages that begin with the letter "S."
- Error messages beginning with (or containing) the word *NIS+* are alphabetized after messages beginning with (or containing) the word *NIS*.
- Some error messages might be preceded by a date or the name of the host, application, program, or routine that generated the error message, followed by a colon. In these cases, the initial name of the command is used to alphabetize the message/

- Many messages contain variables such as user IDs, process numbers, domain names, host names, and so forth. In this appendix, these variables are indicated by an *italic typeface*. Because variables could be anything, they are not included in the sorting of the messages listed in this appendix. For example, the actual message `sales: is not a table` (where `sales` is a variable) would be listed in this appendix as: *name*: is not a table and would be alphabetized as: `is not a table` among those messages beginning with the letter "I".
- Error messages that begin with asterisks, such as **ERROR: *domainname* does not exist, are generated by the NIS+ installation and setup scripts. Messages are alphabetized according to their first letter, ignoring the asterisks.

Numbers in Error Messages

- Many messages include an IP address. IP addresses are indicated by *n.n.n.n.*
- Some error messages include numbers such as process ID numbers, number of items, and so forth. Numbers in error messages are indicated: *nnnn*.

Common Namespace Error Messages

`abort_transaction: Failed to action NIS+` *objectname*
The `abort_transaction` routine failed to back out of an incomplete transaction due to a server crash or some other unrecoverable error. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for further information.

`abort_transaction: Internal database error abort_transaction: Internal error, log entry corrupt NIS+` *objectname*
These two messages indicate some form of corruption in a namespace database or log. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information.

`add_cleanup: Cant allocate more rags.`
This message indicates that your system is running low on available memory. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on insufficient memory problems.

`add_pingitem: Couldn't add` *directoryname* `to pinglist (no memory)`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on low memory problems.

`add_update: Attempt add transaction from read only child.`
`add_update Warning: attempt add transaction from read only child`
An attempt by a read-only child `rpc.nisd` process to add an entry to a log. An occasional appearance of this message in a log is not serious. If this message appears frequently, contact the Sun Solutions Center.

`Attempting to free a free rag!`
This message indicates a software problem with `rpc.nisd`. The `rpc.nisd` should have aborted. Run `ps -ef | grep rpc.nisd` to see if `rpc.nisd` is still running. If it is, kill it and restart it with the same options as previously used. If it is not running, restart it with the same options as previously used. Check `/var/nis` to see if a `core` file has been dumped. If there is a `core` file, delete it.

Note – If you started `rpc.nisd` with the `-YB` option, you must also kill the `rpc.nisd_reply` daemon.

`Attempt to remove a non-empty table`
An attempt has been made by `nistbladm` to remove an NIS+ table that still contains entries. Or by `nisrmdir` to remove a directory that contains files or subdirectories.

- If you are trying to delete a table, use `niscat` to check the contents of the table and `nistbladm` to delete any existing contents.
- If you are trying to delete a directory, use `nisls -l -R` to check for existing files or subdirectories and delete them first.
- If you are trying to dissociate a replica from a domain with `nisrmdir -s`, and the replica is down or otherwise out of communication with the master, you will get this error message. In such cases, you can run `nisrmdir -f -s` *replicaname* on the master to force the dissociation. Note, however, that if you use `nisrmdir -f -s` to dissociate an out-of-communication replica, you *must* run `nisrmdir -f -s` *again* as soon as the replica is back on line in order to clean up the replica's `/var/nis` file system. If you fail to rerun `nisrmdir -f -s` *replicaname* when the replica is back in service, the old out-of-date information left on the replica could cause problems.

This message is generated by the NIS+ error code constant: `NIS_NOTEMPTY`. See the `nis_tables` man page for additional information.

`authdes_marshal: DES encryption failure`
DES encryption for some authentication data failed. Possible causes:

- Corruption of a library function or argument.
- A problem with a DES encryption chip, if you are using one.

Call the Sun Solutions Center for assistance.

`authdes_refresh: keyserv is unable to encrypt session key`
The `keyserv` process was unable to encrypt the session key with the public key that it was given. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information.

`authdes_refresh: unable to encrypt conversation key`
The `keyserv` process could not encrypt the session key with the public key that was given. This usually requires some action on your part. Possible causes are:

- The `keyserv` process is dead or not responding. Use `ps -ef` to check whether the `keyserv` process is running on the `keyserv` host. If it is not, then start it, and then run `keylogin`.
- The client has not performed a `keylogin`. Do a `keylogin` for the client and see if that corrects the problem.
- The client host does not have credentials. Run `nismatch` on the client's home domain cred table to see if the client host has the proper credentials. If it does not, create them.
- A DES encryption failure. See the authdes_marshal: DES encryption failure error message).

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information regarding security key problems.

`authdes_refresh: unable to synchronize clock`
This indicates a synchronization failure between client and server clocks. This will usually correct itself. However, if this message is followed by any time stamp related error, you should manually resynchronize the clocks. If the problem reoccurs, check that remote `rpcbind` is functioning correctly.

`authdes_refresh: unable to synch up w/server`
The client-server clock synchronization has failed. This could be caused by the `rpcbind` process on the server not responding. Use `ps -ef` on the server to see if `rpcbind` is running. If it is not, restart it. If this error message is followed by any time stamp-related message, then you need to use `rdate` *servername* to manually resync the client clock to the server clock.

`authdes_seccreate: keyserv is unable to generate session key`
This indicates that `keyserv` was unable to generate a random DES key for this session. This requires some action on your part:

- Check to make sure that `keyserv` is running properly. If it is not, restart it along with all other long-running processes that use Secure RPC or make NIS+ calls such as `automountd`, `rpc.nisd` and `sendmail`. Then do a `keylogin`.
- If `keyserv` is up and running properly, restart the process that logged this error.

`authdes_seccreate: no public key found for` *servername*
The client side cannot get a DES credential for the server named *servername*. This requires some action on your part:

- Check to make sure that *servername* has DES credentials. If it does not, create them.
- Check the switch configuration file to see which naming service is specified and then make sure that service is responding. If it is not responding, restart it.

`authdes_seccreate: out of memory`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on insufficient memory problems.

`authdes_seccreate: unable to gen conversation key`
The `keyserv` process was unable to generate a random DES key. The most likely cause is that the `keyserv` process is down or otherwise not responding. Use `ps -ef` to check whether the `keyserv` process is running on the `keyserv` host. If it is not, then start it and run `keylogin`.

If restarting `keyserv` fails to correct the problem, it might be that other processes that use Secure RPC or make NIS+ calls are not running (for example, `automountd`, `rpc.nisd`, or `sendmail`). Check to see whether these processes are running; if they are not, restart them.

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information regarding security key problems.

`authdes_validate: DES decryption failure`
See authdes_marshal: DES decryption failure for authentication data failure.

`authdes_validate: verifier mismatch`
The time stamp that the client sent to the server does not match the one received from the server. (This is not recoverable within a Secure RPC session.) Possible causes:

- Corruption of the session key or time stamp data in the client or server cache
- Server deleted from this cache a session key for a still active session.
- Network data corruption.

Try re-executing the command.

`CacheBind: xdr_directory_obj failed.`
The most likely causes for this message are:

- Bad or incorrect parameters being passed to the xdr_directory_obj routine. Check the syntax and accuracy of whatever command you most recently entered.

- An attempt to allocate system memory failed. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for a discussion of memory problems.
- If your command syntax is correct, and your system does not seem to be short of memory, contact the Sun Solutions Center.

`Cache expired`
The entry returned came from an object cache that has expired. This means that the time-to-live value has gone to zero and the entry might have changed. If the flag `-NO_CACHE` was passed to the lookup function, then the lookup function will retry the operation to get an unexpired copy of the object.

This message is generated by the NIS+ error code constant: `NIS_CACHEEXPIRED`. See the `nis_tables` and `nis_names` man pages for additional information.

`Callback: - select failed` *message nnnn*
An internal system call failed. In most cases this problem will correct itself. If it does not correct itself, make sure that `rpc.nisd` has not been aborted. If it has, restart it. If the problem reoccurs frequently, contact the Sun Solutions Center.

`CALLBACK_SVC: bad argument`
An internal system call failed. In most cases this problem will correct itself. If it does not correct itself, make sure that `rpc.nisd` has not been aborted. If it has, restart it. If the problem reoccurs frequently, contact the Sun Solutions Center.

`Cannot grow transaction log error` *string*
The system cannot add to the log file. The reason is indicated by the *string*. The most common cause of this message is lack of disk space. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*.

`Cannot truncate transaction log file`
An attempt has been made to checkpoint the log, and the `rpc.nisd` daemon is trying to shrink the log file after deleting the checkpointed entries from the log. See the `ftruncate` man pages for a description of various factors that might cause this routine to fail. See also "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*.

`Cannot write one character to transaction log, error`*message*
An attempt has been made by the `rpc.nisd` daemon to add an update from the current transaction into the transaction log, and the attempt has failed for the reason given in the *message* that has been returned by the function. Additional information can be obtained from the `write` routine's man page.

`Can't compile regular expression` *variable*
Returned by the `nisgrep` command when the expression in `keypat` was malformed.

`Can't get any map parameter information.`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

`Can't find name service for passwd`
Either there is no `nsswitch.conf` file or there is no `passwd` entry in the file, or the `passwd` entry does not make sense or is not one of the allowed formats.

`Can't find` *name* `'s secret key`
Possible causes:

- You might have incorrectly typed the password.
- There might not be an entry for *name* in the `cred` table.
- NIS+ could not decrypt the key (possibly because the entry might be corrupt).
- The `nsswitch.conf` file might be directing the query to a local password in an `/etc/passwd` file that is different than the NIS+ password recorded in the cred table.

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on diagnosing and solving these type of problem.

`checkpoint_log: Called from read only child ignored.`
This is a status message indicating that a read-only process attempted to perform an operation restricted to the parent process, and the attempt was aborted. No action need be taken.

`checkpoint_log: Unable to checkpoint, log unstable.`
An attempt was made to checkpoint a log that was not in a stable state. (That is, the log was in a resync, update, or checkpoint state.) Wait until the log is stable, and then rerun the `nisping` command.

`check_updaters: Starting resync.`
This is a system status message. No action need be taken.

`Child process requested to checkpoint!`
This message indicates a minor software problem that the system is capable of correcting. If these messages appear often, you can change the threshold level in your `/etc/syslog.conf` file. See the `syslog.conf` man page for details.

`Column not found:` *columnname*
The specified column does not exist in the specified table.

`Could not find` *string* `'s secret key`

Possible causes:

- You might have incorrectly typed the password.
- There might not be an entry for `name` in the `cred` table.
- NIS+ could not decrypt the key (possibly because the entry might be corrupt)
- The `nsswitch.conf` file might have the wrong publickey policy. It might be directing the query to a local public key in an `/etc/publickey` file that is different from the NIS+ password recorded in the cred table.

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on diagnosing and solving these types of problem.

`Could not generate netname`

The Secure RPC software could not generate the Secure RPC netname for your UID when performing a `keylogin`. This could be due to the following causes:

- You do not have LOCAL credentials in the NIS+ cred table of the machine's home domain.
- You have a local entry in `/etc/passwd` with a UID that is different from the UID you have in the NIS+ passwd table.

string`: could not get secret key for '`*string*

Possible causes:

- You might have incorrectly typed the password.
- There might not be an entry for `name` in the cred table.
- NIS+ could not decrypt the key (possibly because the entry might be corrupt)
- The `nsswitch.conf` file might have the wrong publickey policy. It might be directing the query to a local publickey in an `/etc/publickey` file that is different from the NIS+ password recorded in the cred table.

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on diagnosing and solving these type of problem.

`Couldn't fork a process!`

The server could not fork a child process to satisfy a callback request. This is probably caused by your system reaching its maximum number of processes. You can kill some unneeded processes, or increase the number of processes your system can handle. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information.

`Couldn't parse access rights for column` *string*
This message is usually returned by the `nistbladm -u` command when something other than a `+` (plus sign), a `-` (minus sign), or an `=` (equal sign) is entered as the operator. Other possible causes are failure to separate different column rights with a comma, or the entry of something other than `r`, `d`, `c`, or `m` for the type of permission. Check the syntax for this type of entry error. If everything is entered correctly and you still get this error, the table might have been corrupted.

`Database for table does not exist`
At attempt to look up a table has failed. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*for possible causes.

This message is generated by the NIS+ error code constant: `NIS_NOSUCHTABLE`. See the `nis_tables` and `nis_names` man pages for additional information.

`_db_add: child process attempting to add/modify _db_addib: non-parent process attempting an add`
These messages indicate that a read-only or nonparent process attempted to add or modify an object in the database. In most cases, these messages do not require any action on your part. If these messages are repeated frequently, call the Sun Solutions Center.

`db_checkpoint: Unable to checkpoint` *string*
This message indicates that for some reason NIS+ was unable to complete checkpointing of a directory. The most likely cause is that the disk is full See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information).

`_db_remib: non-parent process attempting an remove _db_remove: non-parent process attempting a remove`
These messages indicate that a read-only or non-parent process attempted to remove a table entry. In most cases, these messages do not require any action on your part. If these messages are repeated frequently, call the Sun Solutions Center.

`Do you want to see more information on this command?`
This indicates that there is a syntax or spelling error on your script command line.

`Entry/Table type mismatch`
This occurs when an attempt is made to add or modify an entry in a table, and the entry passed is of a different type from the table. For example, if the number of columns is not the same. Check that your update correctly matches the table type.

This message is generated by the NIS+ error code constant: `NIS_TYPEMISMATCH`. See the `nis_tables` man page for additional information.

**ERROR: chkey failed again. Please contact your network administrator to verify your network password.

This message indicates that you typed the wrong network password.

- If this is the first time you are initializing this machine, contact your network administrator to verify the network password.
- If this machine has been initialized before as an NIS+ client of the same domain, try typing the root login password at the Secure RPC password prompt.
- If this machine is currently an NIS+ client and you are trying to change it to a client of a different domain, remove the `/etc/.rootkey` file, and rerun the `nisclient` script, using the network password given to you by your network administrator (or the network password generated by the `nispopulate` script).

Error: Could not create a valid NIS+ coldstart file

This message is from `nisinit`, the NIS+ initialization routine. It is followed by another message preceded by a string that begins: "`lookup:..`". This second message will explain why a valid NIS+ cold-start file could not be created.

**ERROR: could not restore file *filename*

This message indicates that NIS+ was unable to rename *filename*`.no_nisplus` to *filename*.

Check your system console for system error messages.

- If there is a system error message, fix the problem described in the error message and rerun `nisclient -i`.
- If there aren't any system error messages, try renaming this file manually, and then rerun `nisclient -i`.

**ERROR: Couldn't get the server NIS+_server's address.

The script was unable to retrieve the server's IP address for the specified domain. Manually add the IP address for *NIS+_server* into the `/etc/hosts` or `/etc/inet/ipnodes` file, then rerun `nisclient -i`.

**ERROR: directory *directory-path* does not exist.

This message indicates that you typed an incorrect directory path. Type the correct directory path.

**ERROR: *domainname* does not exist.

This message indicates that you are trying to replicate a domain that does not exist.

- If *domainname* is spelled incorrectly, rerun the script with the correct domain name.
- If the *domainname* domain does not exist, create it. Then you can replicate it.

**ERROR: *parent-domain* does not exist.

This message indicates that the parent domain of the domain you typed on the command line does not exist. This message should only appear when you are setting up a nonroot master server.

- If the domain name is spelled incorrectly, rerun the script with the correct domain name.
- If the domain's parent domain does not exist, you have to create the parent domain first, and then you can create this domain.

**ERROR: Don't know about the domain "*domainname*". Please check your *domainname*.

This message indicates that you typed an unrecognized domain name. Rerun the script with the correct domain name.

**ERROR: failed dumping *tablename* table.

The script was unable to populate the cred table because the script did not succeed in dumping the named table.

- If `niscat` *tablename* `.org_dir` fails, make sure that all the servers are operating, then rerun the script to populate the *tablename* table.
- If `niscat` *tablename*`.org_dir` is working, the error might have been caused by the NIS+ server being temporarily busy. Rerun the script to populate the *tablename* table.

**ERROR: host *hostname* is not a valid NIS+ principal in domain *domainname*. This host name must be defined in the credential table in domain *domainname*. Use nisclient -c to create the host credential

A machine has to be a valid NIS+ client with proper credentials before it can become an NIS+ server. To convert a machine to an NIS+ root replica server, the machine first must be an NIS+ client in the root domain. Follow the instructions on how to add a new client to a domain, then rerun `nisserver -R`.

Before you can convert a machine to an NIS+ nonroot master or a replica server, the machine must be an NIS+ client in the parent domain of the domain that it plans to serve. Follow the instructions on how to add a new client to a domain, then rerun `nisserver -M` or `nisserver -R`.

This problem should not occur when you are setting up a root master server.

Error in accessing NIS+ cold start file is NIS+ installed?

This message is returned if NIS+ is not installed on a machine or if for some reason the file `/var/nis/NIS_COLD_START` could not be found or accessed. Check to see if there is a `/var/nis/NIS_COLD_START` file. If the file exists, make sure your path is set correctly and that `NIS_COLD_START` has the proper permissions.

Then rename or remove the old cold-start file and rerun the `nisclient` script to install NIS+ on the machine.

This message is generated by the cache manager that sends the NIS+ error code constant: `NIS_COLDSTART_ERR`. See the `write` and `open` man pages for additional information on why a file might not be accessible.

`Error in RPC subsystem`
This fatal error indicates the RPC subsystem failed in some way. Generally, there will be a `syslog` message on either the client or server side indicating why the RPC request failed.

This message is generated by the NIS+ error code constant: `NIS_RPCERROR`. See the `nis_tables` and `nis_names` man pages for additional information.

`**ERROR: it failed to add the credential for root.`
The NIS+ command `nisaddcred` failed to create the root credential when trying to set up a root master server. Check your system console for system error messages:

- If there is a system error message, fix the problem described in the error message and then rerun `nisserver`.
- If there aren't any system error messages, check to see whether the `rpc.nisd` process is running. If it is not running, restart it and then rerun `nisserver`.

`**ERROR: it failed to create the tables.`
The NIS+ command `nissetup` failed to create the directories and tables. Check your system console for system error messages:

- If there is a system error message, fix the problem described in the error message and rerun `nisserver`.
- If there aren't any system error messages, check to see whether the `rpc.nisd` process is running. If it is not running, restart it and rerun `nisserver`.

`**ERROR: it failed to initialize the root server.`
The NIS+ command `nisinit -r` failed to initialize the root master server. Check your system console for system error messages. If there is a system error message, fix the problem described in the error message and rerun `nisserver`.

`**ERROR: it failed to make the` *domainname* `directory`
The NIS+ command `nismkdir` failed to make the new directory *domainname* when running `nisserver` to create a nonroot master. The parent domain does not have create permission to create this new domain.

- If you are not the owner of the domain or a group member of the parent domain, rerun the script as the owner or as a group member of the parent domain.

- If `rpc.nisd` is not running on the new master server of the domain that you are trying to create, restart `rpc.nisd`.

`**ERROR: it failed to promote new master for the` *domainname* `directory`

The NIS+ command `nismkdir` failed to promote the new master for the directory *domainname* when creating a nonroot master with the `nisserver` script.

- If you do not have modify permission in the parent domain of this domain, rerun the script as the owner or as a group member of the parent domain.
- If `rpc.nisd` is not running on the servers of the domain that you are trying to promote, restart `rpc.nisd` on these servers and rerun `nisserver`.

`**ERROR: it failed to replicate the` *directory-name* `directory`

The NIS+ command `nismkdir` failed to create the new replica for the directory *directory-name*.

- If `rpc.nisd` is not running on the master server of the domain that you are trying to replicate, restart `rpc.nisd` on the master server, rerun `nisserver`.
- If `rpc.nisd` is not running on the new replica server, restart it on the new replica and rerun `nisserver`.

`**ERROR: invalid group name. It must be a group in the` *root-domain* `domain.`

This message indicates that you used an invalid group name while trying to configure a root master server. Rerun `nisserver -r` with a valid group name for *root-domain*.

`**ERROR: invalid name "`*client-name*`" It is neither an host nor an user name.`

This message indicates that you typed an invalid *client-name*.

- If *client-name* was spelled incorrectly, rerun `nisclient -c` with the correct *client-name*.
- If *client-name* was spelled correctly, but it does not exist in the proper table, put *client-name* into the proper table and rerun `nisclient -c`. For example, a user client belongs in the passwd table, and a host client belongs in the hosts table.

`**ERROR:` *hostname* `is a master server for this domain. You cannot demote a master server to replica. If you really want to demote this master, you should promote a replica server to master using nisserver with the M option.`

You cannot directly convert a master server to a replica server of the same domain. You can, however, change a replica to be the new master server of a domain by running `nisserver -M` with the replica host name as the new master. This automatically makes the *old* master a replica.

**ERROR: missing hostnames or usernames.
This message indicates that you did not type the client names on the command line. Rerun `nisclient -c` with the client names.

**ERROR: NIS+ group name must end with a "."
This message indicates that you did not specify a fully qualified group name ending with a period. Rerun the script with a fully qualified group name.

**ERROR: NIS+ server is not running on *remote-host*. You must do the following before becoming an NIS+ server: 1. become an NIS+ client of the parent domain or any domain above the domain which you plan to serve. (nisclient) 2. start the NIS+ server. (rpc.nisd)
This message indicates that `rpc.nisd` is not running on the remote machine that you are trying to convert to an NIS+ server. Use the `nisclient` script to become an NIS+ client of the parent domain or any domain above the domain you plan to serve; start `rpc.nisd` on *remote-host*.

**ERROR: nisinit failed.
`nisinit` was unable to create the `NIS_COLD_START` file.

Check the following:

- That the NIS+ server you specified with the `-H` option is running—use `ping`
- That you typed the correct domain name
- That `rpc.nisd` is running on the server
- That the nobody class has read permission for this domain

**ERROR: NIS map transfer failed. *tablename* table will not be loaded.
NIS+ was unable to transfer the NIS map for this table to the NIS+ database.

- If the NIS server host is running, try running the script again. The error might have been due to a temporary failure.
- If all tables have this problem, try running the script again using a different NIS server.

**ERROR: no permission to create directory *domainname*
The parent domain does not have create permission to create this new domain. If you are not the owner of the domain or as a group member of the parent domain, rerun the script as the owner, or as a group member of the parent domain.

**ERROR: no permission to replicate directory *domainname*.
This message indicates that you do not have permission to replicate the domain. Rerun the script as the owner or as a group member of the domain.

`error receiving zone transfer`
DNS error message. This usually indicates a syntax error in one of the primary server's DNS files. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*.

`**ERROR: table` *tablename* `.org_dir.`*domainname* `does not exist."` *tablename* `table will not be loaded."`
The script did not find the NIS+ table *tablename*.

- If *tablename* is spelled incorrectly, rerun the script with the correct table name.
- If the *tablename* table does not exist, use `nissetup` to create the table if *tablename* is one of the standard NIS+ tables. Or use `nistbladm` to create the private table *tablename*. Then rerun the script to populate this table.
- If the *tablename* table exists, the error might have been caused by the NIS+ server being temporarily busy. Rerun the script to populate this *tablename* table.

`**ERROR: this name "`*clientname*`" is in both the passwd and hosts tables. You cannot have an username same as the host name.`
client-name appears in both the passwd and hosts tables. One name is not allowed to be in both of these tables. Manually remove the entry from either the passwd or hosts table. Then, rerun `nisclient -c`.

`**ERROR: You cannot use the -u option as a root user.`
This message indicates that the superuser tried to run `nisclient -u`. The `-u` option is for initializing ordinary users only. Superusers do not need be initialized as NIS+ clients.

`**ERROR: You have specified the` *Z* `option after having selected the` *X* `option. Please select only one of these options [`*list*`]. Do you want to see more information on this command?`
The script you are running allows you to choose only one of the listed options.

- Type `y` to view additional information.
- Type `n` to stop the script and exit.

After exiting the script, rerun it with just one of the options.

`**ERROR: you must specify a fully qualified groupname.`
This message indicates that you did not specify a fully qualified group name ending with a period. Rerun the script with a fully qualified group name.

`**ERROR: you must specify both the NIS domainname (-y) and the NIS server host name (-h).`
This message indicates that you did not type either the NIS domain name and/or the NIS server host name. Type the NIS domain name and the NIS server host name at the prompt or on the command line.

**ERROR: you must specify one of these options: -c, -i, -u, -r.
This message indicates that one of these options, -c, -i , -u , -r was missing from the command line. Rerun the script with the correct option.

**ERROR: you must specify one of these options: -r, -M or -R"
This message indicates that you did not type any of the -r or the -M or the -R options. Rerun the script with the correct option.

**ERROR: you must specify one of these options: -C, -F, or -Y
This message indicates that you did not type either the -Y or the -F option. Rerun the script with the correct option.

**ERROR: You must be root to use -i option.
This message indicates that an ordinary user tried to run nisclient -i. Only the superuser has permission to run nisclient -i.

Error while talking to callback proc
An RPC error occurred on the server while it was calling back to the client. The transaction was aborted at that time and any unsent data was discarded. Check the syslog on the server for more information.

This message is generated by the NIS+ error code constant: NIS_CBERROR. See the nis_tables man page for additional information.

First/Next chain broken
This message indicates that the connection between the client and server broke while a callback routine was posting results. This could happen if the server died in the middle of the process.

This message is generated by the NIS+ error code constant: NIS_CHAINBROKEN.

Generic system error
Some form of generic system error occurred while attempting the request. Check the syslog record on your system for error messages from the server.

This message usually indicates that the server has crashed or the database has become corrupted. This message might also be generated if you incorrectly specify the name of a server or replica as if it belonged to the domain it was servicing rather than the domain above. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information.

This message is generated by the NIS+ error code constant: NIS_SYSTEMERROR. See the nis_tables and nis_names man pages for additional information.

`Illegal object type for operation`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for a description of these type of problems.

This message is generated by the NIS+ error code constant: `DB_BADOBJECT`.

`insufficient permission to update credentials.`
This message is generated by the `nisaddcred` command when you have insufficient permission to execute an operation. This could be insufficient permission at the table, column, or entry level. Use `niscat -o cred.org_dir` to determine what permissions you have for that cred table. If you need additional permission, you or the system administrator can change the permission requirements of the object or add you to a group that does have the required permissions.

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information about permission problems.

`Invalid Object for operation`

- *Name context*. The name passed to the function is not a legal NIS+ name.
- *Table context.* The object pointed to is not a valid NIS+ entry object for the given table. This could occur if it had a mismatched number of columns, or a different data type (for example, binary or text) than the associated column in the table.

This message is generated by the NIS+ error code constant: `NIS_INVALIDOBJ`. See the `nis_tables` and `nis_names` man pages for additional information.

`invalid usecs` *Routine_name*`: invalid usecs`
This message is generated when the value in the `tv_usecs` field of a variable of type `struct time stamp` is larger than the number of microseconds in a second. This is usually due to some type of software error.

tablename `is not a table`
The object with the name *tablename* is not a table object. For example, the `nisgrep` and `nismatch` commands will return this error if the object you specify on the command line is not a table.

`Link Points to illegal name`
The passed name resolved to a LINK type object and the contents of the object pointed to an invalid name.

You cannot link table entries. A link at the entry level can produce this error message.

This message is generated by the NIS+ error code constant: `NIS_LINKNAMEERROR`. See the `nis_tables` and `nis_names` man pages for additional information.

`Load limit of` *number* `reached!`
An attempt has been made to create a child process when the maximum number of child processes have already been created on this server. This message is seen on the server's system log, but only if the threshold for logging messages has been set to include `LOG_WARNING` level messages.

`login and keylogin passwords differ.`
This message is displayed when you are changing your password with `nispasswd` and the system has changed your password, but has been unable to update your credential entry in the cred table with the new password and also unable to restore your original password in the passwd table. This message is followed by the instructions:

```
Use NEW password for login and OLD password for
keylogin. Use "chkey -p" to reencrypt the credentials with
the new login password. You must keylogin explicitly after
your next login.
```

These instructions are then followed by a status message explaining why it was not possible to revert back to the old password. If you see these messages, be sure to follow the instructions as given.

`Login incorrect`
The most common cause of a "login incorrect" message is mistyping the password. Try it again. Make sure you know the correct password. Remember that passwords are case-sensitive (uppercase letters are considered different than lowercase letters) and that the letter "o" is not interchangeable with the numeral "0," nor is the letter "l" the same as the numeral "1".

For other possible causes of this message, see "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*.

`log_resync: Cannot truncate transaction log file`
An attempt has been made to checkpoint the log, and the `rpc.nisd` daemon is trying to shrink the log file after deleting the checkpointed entries from the log. See the `ftruncate` man pages for a description of various factors that might cause this routine to fail. See also "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*.

`Malformed Name or illegal name`
The name passed to the function is not a legal or valid NIS+ name.

One possible cause for this message is that someone changed an existing domain name. Existing domain names should not be changed. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*.

This message is generated by the NIS+ error code constant: `NIS_BADNAME`. See the `nis_tables` man page for additional information.

`_map_addr: RPC timed out.`
A process or application could not contact NIS+ within its default time limit to get necessary data or resolve host names from NIS+. In most cases, this problem will solve itself after a short wait. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*for additional information about slow performance problems.

`Master server busy full dump rescheduled`
This message indicates that a replica server has been unable to update itself with a full dump from the master server because the master is busy. See"NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information.

String `Missing or malformed attribute`
The name of an attribute did not match with a named column in the table, or the attribute did not have an associated value.

This could indicate an error in the syntax of a command. The *string* should give an indication of what is wrong. Common causes are spelling errors, failure to correctly place the equals sign (=), an incorrect column or table name, and so forth.

This message is generated by the NIS+ error code constant: `NIS_BADATTRIBUTE`. See the `nis_tables` man page for additional information.

`Modification failed`
Returned by the `nisgrpadm` command when someone else modified the group during the execution of your command. Check to see who else is working with this group. Reissue the command.

This message is generated by the NIS+ error code constant: `NIS_IBMODERROR`.

`Modify operation failed`
The attempted modification failed for some reason.

This message is generated by the NIS+ error code constant: `NIS_MODFAIL`. See the `nis_tables` and `nis_names` man pages for additional information.

`Name not served by this server`
A request was made to a server that does not serve the specified name. Normally this will not occur; however, if you are not using the built-in location mechanism for servers, you might see this if your mechanism is broken.

Other possible causes are:

- Cold-start file corruption. Delete the `/var/nis/NIS_COLD_START` file and then reboot.
- Cache problem such as the local cache being out of date. Kill the `nis_cachemgr` and `/var/nis/NIS_SHARED_DIRCACHE`, and then reboot. (If the problem is not in the root directory, you might be able to kill the domain cache manager and try the command again.)
- Someone removed the directory from a replica.

This message is generated by the NIS+ error code constant: `NIS_NOT_ME`. See the `nis_tables` and `nis_names` man pages for additional information.

`Named object is not searchable`
The table name resolved to an NIS+ object that was not searchable.

This message is generated by the NIS+ error code constant: `NIS_NOTSEARCHABLE`. See the `nis_tables` man page for additional information.

`Name/entry isn't unique`
An operation has been requested based on a specific search criteria that returns more than one entry. For example, you use `nistbladm -r`to delete a user from the passwd table, and there are two entries in that table for that user name as shown as follows:

```
mymachine# nistbladm -r [name=arnold],passwd.org_dir
Can't remove entry: Name/entry isn't unique
```

You can apply your command to multiple entries by using the `-R` option rather than `-r` . For example, to remove all entries for `arnold`:

```
mymachine# nistbladm -R name=arnold],passwd.org_dir
```

`NIS+ error`
The NIS+ server has returned an error, but the `passwd` command determines exactly what the error is.

`NIS+ operation failed`
This generic error message should be rarely seen. Usually it indicates a minor software problem that the system can correct on it own. If it appears frequently, or appears to be indicating a problem that the system is not successfully dealing with, contact the Sun Solutions Center.

This message is generated by the NIS+ error code constant: `NIS_FAIL`.

string`: NIS+ server busy try again later.`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for possible causes.

`NIS+ server busy try again later.`
Self explanatory. Try the command later.

See also "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for possible causes.

`NIS+ server for` *string* `not responding still trying`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for possible causes.

`NIS+ server not responding`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for possible causes.

`NIS+ server needs to be checkpointed. Use nisping -C`*domainname*

Caution – Checkpoint immediately! Do not wait!

This message is generated at the `LOG_CRIT` level on the server's system log. It indicates that the log is becoming too large. Use `nisping -C` *domainname* to truncate the log by checkpointing.

See also "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information on log size.

`NIS+ servers unreachable`
This soft error indicates that a server for the desired directory of the named table object could not be reached. This can occur when there is a network failure or the server has crashed. A new attempt might succeed. See the description of the `-HARD_LOOKUP` flag in the `nis_tables` and `nis_names` man pages.

This message is generated by the NIS+ error code constant: `NIS_NaMEUNREACHABLE`.

`NIS+ service is unavailable or not installed`
Self-explanatory. This message is generated by the NIS+ error code constant: `NIS_UNAVAIL`.

`NIS+: write ColdStart File: xdr_directory_obj failed`
The most likely causes for this message are:

- Bad or incorrect parameters. Check the syntax and accuracy of whatever command you most recently entered.
- An attempt to allocate system memory failed. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and*

LDAP) for a discussion of memory problems.

- If your command syntax is correct, and your system does not seem to be short of memory, contact the Sun Solutions Center.

`nis_checkpoint_svc: readonly child instructed to checkpoint ignored.`
This is a status message indicating that a read-only process attempted to perform an operation restricted to the parent process, and the attempt was aborted. No action need be taken.

`nis_dumplog_svc: readonly child called to dump log, ignore`
This is a status message indicating that a read-only process attempted to perform an operation restricted to the parent process, and the attempt was aborted. No action need be taken.

`nis_dump_svc: load limit reached.`
The maximum number of child processes permitted on your system has been reached.

`nis_dump_svc: one replica is already resyncing.`
Only one replica can resync from a master at a time. Try the command later.

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on these three error messages.

`nis_dump_svc: Unable to fork a process.`
The fork system call has failed. See the `fork` man page for possible causes.

`nis_mkdir_svc: readonly child called to mkdir, ignored`
This is a status message indicating that a read-only process attempted to perform an operation restricted to the parent process, and the attempt was aborted. No action need be taken.

`nis_ping_svc: readonly child was pung ignored.`
This is a status message indicating that a read-only process attempted to perform an operation restricted to the parent process, and the attempt was aborted. No action need be taken.

`nis_rmdir_svc: readonly child called to rmdir, ignored`
This is a status message indicating that a read-only process attempted to perform an operation restricted to the parent process, and the attempt was aborted. No action need be taken.

`nisaddcred: no password entry for uid` *userid* `nisaddcred: unable to create credential.`

These two messages are generated during execution of the `nispopulate` script. The NIS+ command `nisaddcred` failed to add a LOCAL credential for the user ID *userid* on a remote domain. (This only happens when you are trying to populate the `passwd table` in a remote domain.)

To correct the problem, add a table path in the local passwd table:

```
# nistbladm -u -p passwd.org_dir.remote-domain passwd.org_dir
```

The *remote-domain* must be the same domain that you specified with the `-d` option when you ran `nispopulate`. Rerun the script to populate the passwd table.

`No file space on server`

Self-explanatory.

This message is generated by the NIS+ error code constant: `NIS_NOFILESPACE`.

`No match`

This is most likely an error message from the shell, caused by failure to escape the brackets when specifying an indexed name. For example, failing to set off a bracketed indexed name with quote marks would generate this message because the shell would fail to interpret the brackets as shown as follows:

```
# nistbladm -m shell=/bin/csh [name=miyoko],passwd.org_dir No match
```

The correct syntax is:

```
# nistbladm -m shell=/bin/csh `[name=miyoko],passwd.org_dir`
```

`No memory`

Your system does not have enough memory to perform the specified operation. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information on memory problems.

`Non NIS+ namespace encountered`

The name could not be completely resolved. This usually indicates that the name passed to the function resolves to a namespace that is outside the NIS+ name tree. In other words, the name is contained in an unknown directory. When this occurs, this error is returned with an NIS+ object of type `DIRECTORY`.

This message is generated by the NIS+ error code constant: `NIS_FOREIGNNS`. See the `nis_tables` or `nis_names` man pages for additional information.

`No password entry for uid` *userid* `No password entry found for uid` *userid*

Both of these two messages indicate that no entry for this user was found in the passwd table when trying to create or add a credential for that user. (Before you can create or add a credential, the user must be listed in the passwd table.)

- The most likely cause is misspelling the user's *userid* on the command line. Check your command line for correct syntax and spelling.
- Check that you are either in the correct domain, or specifying the correct domain on the command line.
- If the command line is correct, check the passwd table to make sure the user is listed under the *userid* you are entering. This can be done with `nismatch`:

```
mymachine# nismatch uid=userid passwd.org_dir.
```

If the user is not listed in the passwd table, use `nistbladm` or `nisaddent` to add the user to the passwd table before creating the credential.

`No shadow password information`

This means that password aging cannot be enforced because the information used to control aging is missing.

`Not found` *String* `Not found`

Names context. The named object does not exist in the namespace.

Table context. No entries in the table matched the search criteria. If the search criteria was null (return all entries), then this result means that the table is empty and can safely be removed.

If the `-FOLLOW_PATH` flag was set, this error indicates that none of the tables in the path contain entries that match the search criteria.

This message is generated by the NIS+ error code constant: `NIS_NOTFOUND`. See the `nis_tables` and `nis_names` man pages for additional information.

See also "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for general information on this type of problem.

`Not Found no such name`

This hard error indicates that the named directory of the table object does not exist. This could occur when the server that should be the parent of the server that serves the table, does not know about the directory in which the table resides.

This message is generated by the NIS+ error code constant: `NIS_NOSUCHNAME`. See the `nis_names` and `nis_names` man pages for additional information.

See also "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for general information on this type of problem.

`Not master server for this domain`
This message might mean that an attempt was made to directly update the database on a replica server.

This message might also mean that a change request was made to a server that serves the name, but it is not the master server. This can occur when a directory object changes and it specifies a new master server. Clients that have cached copies of that directory object in their `/var/nis/NIS_SHARED_DIRCACHE` file should run `ps` to obtain the process ID of the `nis_cachemgr`, kill the `nis_cachemgr` process, remove the `/var/nis/NIS_SHARED_DICACHE` file, and then restart `nis_cachemgr`.

This message is generated by the NIS+ error code constant: `NIS_NOTMASTER`. See the `nis_tables` and `nis_names` man pages for additional information.

`Not owner`
The operation you attempted can only be performed by the object's owner, and you are not the owner.

This message is generated by the NIS+ error code constant: `NIS_NOTOWNER`.

`Object with same name exists`
An attempt was made to add a name that already exists. To add the name, first remove the existing name and then add the new name or modify the existing named object.

This message is generated by the NIS+ error code constant: `NIS_NAMEEXISTS`. See the `nis_tables` and `nis_names` man pages for additional information.

`parse error:` *string* `(key` *variable*`)`
This message is displayed by the `nisaddent` command when it attempts to use database files from a `/etc` directory and there is an error in one of the file's entries. The first variable should describe the problem, and the variable after `key` should identify the particular entry at fault. If the problem is with the `/etc/passwd` file, you can use `/usr/sbin/pwck` to check it.

`Partial Success`
This result is similar to `NIS_NOTFOUND`, except that it means the request succeeded but resolved to zero entries.

When this occurs, the server returns a copy of the table object instead of an entry so that the client can then process the path or implement some other local policy.

This message is generated by the NIS+ error code constant: `NIS_PARTIAL`. See the `nis_tables` man page for additional information.

`Passed object is not the same object on server`
An attempt to remove an object from the namespace was aborted because the object that would have been removed was not the same object that was passed in the request.

This message is generated by the NIS+ error code constant: `NIS_NOTSAMEOBJ`. See the `nis_tables` and `nis_names` man pages for additional information.

`Password does not decrypt secret key for` *name*
Possible causes:

- You might have incorrectly typed the password.
- There might not be an entry for *name* in the cred table.
- NIS+ could not decrypt the key (possibly because the entry might be corrupt).
- The Secure RPC password does not match the login password.
- The `nsswitch.conf` file might be directing the query to a local password in an `/etc/passwd` file that is different from the NIS+ password recorded in the cred table. (Note that the actual encrypted passwords are stored locally in the `/etc/shadow` file.)

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on diagnosing and solving these types of problems.

`Password has not aged enough`
This message indicates that your password has not been in use long enough and that you cannot change it until it has been in use for *N* (a number of) days.

`Permission denied`
Returned when you do not have the permissions required to perform the operation you attempted. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information.

This message might be related to a login or password matter, or an NIS+ security problem. The most common cause of a Permission denied message is that the password of the user receiving it has been locked by an administrator or the user's account has been terminated.

`Permissions on the password database may be too restrictive`
You do not have authorization to read (or otherwise use) the contents of the passwd field in an NIS+ table. See Chapter 15, for information on NIS+ access rights.

`Please notify your System Administrator`
When displayed as a result of an attempt to update password information with the `passwd` command, this message indicates that the attempt failed for one of many reasons. For example, the service might not be available, a necessary server is down, there is a "permission denied" type problem, and so forth. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*for a discussion of various types of security problems.

`Please check your /etc/nsswitch.conf file`
The `nsswitch.conf` file specifies a configuration that is not supported for `passwd` update. See "`nsswitch.conf` File Requirements" on page 296 for supported configurations.

`Probable success`
Name context. The request was successful; however, the object returned came from an object cache and not directly from the server. (If you do not want to see objects from object caches, you must specify the flag `-NO_CACHE` when you call the lookup function.)

Table context. Even though the request was successful, a table in the search path was not able to be searched, so the result might not be the same as the one you would have received if that table had been accessible.

This message is generated by the NIS+ error code constant: `NIS_S_SUCCESS`. See the `nis_tables` and `nis_names` man pages for additional information.

`Probably not found`
The named entry does not exist in the table; however, not all tables in the path could be searched, so the entry might exist in one of those tables.

This message is generated by the NIS+ error code constant: `NIS_S_NOTFOUND`. See the `nis_tables` man page for additional information.

`Query illegal for named table`
A problem was detected in the request structure passed to the client library.

This message is generated by the NIS+ error code constant: `NIS_BADREQUEST`. See the `nis_tables` man page for additional information.

`Reason: can't communicate with ypbind.`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

`replica_update: Child process attempting update, aborted`
This is a status message indicating that a read-only process attempted an update and the attempt was aborted.

`replica_update: error result was string`
This message indicates a problem (identified by *string*) in carrying out a dump to a replica. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for further information.

`replica_update: error result was Master server busy, full dump rescheduled replica_update: master server busy rescheduling the resync. replica_update: master server is busy will try later. replica_update: nis dump result Master server busy, full dump rescheduled`
These messages all indicate that the server is busy and the dump will be done later.

`replica_update: nis dump result nis_perror` *errorstring*
This message indicates a problem (identified by the *error string*) in carrying out a dump to a replica. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for further information.

`replica_update:` *nnnn* `updates` *nnnn* `errors`
A status message indicating a successful update.

`replica_update: WARNING: last_update (`*directoryname*`) returned 0!`
An NIS+ process could not find the last update time stamp in the transaction log for that directory. This will cause the system to perform a full resync of the problem directory.

`Results Sent to callback proc`
This is a status message. No action need be taken.

This message is generated by the NIS+ error code constant: `NIS_CBRESULTS`. See the `nis_tables` man page for additional information.

`root_replica_update: update failed` *string*`: could not fetch object from master.`
This message indicates a problem in carrying out a dump to a replica. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for further information.

`RPC failure: "RPC failure on yp operation.`
This message is returned by `ypcat` when an NIS client's `nsswitch.conf` file is set to `files` rather than `nis`, and the server is not included in the `/etc/hosts` or `/etc/inet/ipnodes` file

`Security exception on local system. UNABLE TO MAKE REQUEST.`
This message might be displayed if a user has the same login ID as a machine name. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for additional information.

date: hostname: `sendmail (nnnn) : gethostbyaddr failed`
One common cause of this problem is entering IP addresses in NIS+, NIS, files, or DNS data sets with leading zeros. For example, you should never enter an IP address as `151.029.066.001`. The correct way to enter that address is: `151.29.66.1`.

`Server busy, try again`
The server was too busy to handle your request.

- For the add, remove, and modify operations, this message is returned when either the master server for a directory is unavailable or it is in the process of checkpointing its database.
- This message can also be returned when the server is updating its internal state.
- In the case of `nis_list`, if the client specifies a callback and the server does not have enough resources to handle the callback.

Retry the command at a later time when the server is available.

This message is generated by the NIS+ error code constant: `NIS_TRYAGAIN`. See the `nis_tables` and `nis_names` man pages for additional information.

`Server out of memory`
In most cases this message indicates a fatal result. It means that the server ran out of heap space.

This message is generated by the NIS+ error code constant: `NIS_NOMEMORY`. See the `nis_tables` and `nis_names` man pages for additional information.

`Sorry`
This message is displayed when a user is denied permission to login or change a password, and for security reasons the system does not display the reason for that denial because such information could be used by an unauthorized person to gain illegitimate access to the system.

`Sorry: less than` *nn* `days since the last change`
This message indicates that your password has not been in use long enough and that you cannot change it until it has been in use for *N* days. See "Changing Your Password" on page 293 for further information.

`_svcauth_des: bad nickname`
The nickname received from the client is invalid or corrupted, possibly due to network congestion. The severity of this message depends on what level of security you are running. At a low security level, this message is informational only; at a higher level, you might have to try the command again later.

`_svcauth_des: corrupted window from` *principalname*
The window that was sent does not match the one sent in the verifier.

The severity of this message depends on what level of security you are running. At a low security level, this message is primarily for your information; at a higher level you might have to try the command again at some later time or take corrective action as described below.

Possible causes:

- The server's key pair has been changed. The client used the server's old public key while the server has a new secret key cached with `keyserv`. Run `keylogin` on both client and server.
- The client's key pair has been changed and the client has not run `keylogin` on the client system, so system is still sending the client's old secret key to the server, which is now using the client's new public key. Naturally, the two do not match. Run `keylogin` again on both client and server.
- Network corruption of data. Try the command again. If that does not work, use the `snoop` command to investigate and correct any network problems. Then run `keylogin` again on both server and client.

`_svcauth_des: decryption failure`
DES decryption for some authentication data failed. Possible causes:

- Corruption to a library function or argument.
- A problem with a DES encryption chip, if you are using one.

The severity of this message depends on what level of security you are running. At a low security level, this message is primarily for your information; at a higher level, you might have to call the Sun Solutions Center for assistance. If the problem appears to be related to a DES encryption chip, call the Sun Solutions Center.

`_svcauth_des: corrupted window from` *principalname*
The window that was sent does not match the one sent in the verifier.

The severity of this message depends on what level of security you are running. At a low security level, this message is primarily for your information; at a higher level you might have to try the command again at some later time or take corrective action as described below.

Possible causes:

- The server's key pair has been changed. The client used the server's old public key while the server has a new secret key cached with `keyserv`. Run `keylogin` on both client and server.
- The client's key pair has been changed and the client has not run `keylogin` on the client system, so system is still sending the client's old secret key to the server, which is now using the client's new public key. Naturally, the two do not match. Run `keylogin` again on both client and server.
- Network corruption of data. Try the command again. If that does not work, use the `snoop` command to investigate and correct any network problems. Then

run `keylogin` again on both server and client.

`_svcauth_des: decryption failure for` *principalname*
DES decryption for some authentication data failed. Possible causes:

- Corruption to a library function or argument.
- A problem with a DES encryption chip, if you are using one.

The severity of this message depends on what level of security you are running. At a low security level, this message is primarily for your information; at a higher level, you might have to call the Sun Solutions Center for assistance. If the problem appears to be related to a DES encryption chip, call the Sun Solutions Center.

`_svcauth_des: invalid timestamp received from` *principalname*
The time stamp received from the client is corrupted, or the server is trying to decrypt it using the wrong key. Possible causes:

- Congested network. Retry the command.
- Server cached out the entry for this client. Check the network load.

`_svcauth_des: key_decryptsessionkey failed for` *principalname*
The `keyserv` process failed to decrypt the session key with the given public key. Possible causes are:

- The `keyserv` process is dead or not responding. Use `ps -ef` to check if the `keyserv` process is running on the `keyserv` host. If it is not, then restart it and run `keylogin`.
- The server principal has not keylogged in. Run `keylogin` for the server principal.
- The server principal (host) does not have credentials. Run `nismatch` *hostname*`.`*domainname*`. cred.org_dir` on the client's home domain cred table. Create new credentials if necessary.
- `keyserv` might have been restarted, in which case certain long-running applications, such as `rpc.nisd`, `sendmail`, and `automountd`, also need to be restarted.
- DES encryption failure. Call the Sun Solutions Center.

`_svcauth_des: no public key for` *principalname*
The server cannot get the client's public key. Possible causes are:

- The principal has no public key. Run `nismatch` on the cred table of the principal's home domain. If there is no DES credential in that table for the principal, use `nisaddcred` to create one, and then run `keylogin` for that principal.
- The naming service specified by a `nsswitch.conf` file is not responding.

`_svcauth_des: replayed credential from` *principalname*
The server has received a request and finds an entry in its cache for the same client name and conversation key with the time stamp of the incoming request *before* that of the one currently stored in the cache.

The severity of this message depends on what level of security you are running. At a low security level, this message is primarily for your information. At a higher level, you might have to take corrective action as described below.

Possible causes are:

- The client and server clocks are out of sync. Use `rdate` to resync the client clock to the server clock.
- The server is receiving requests in random order. This could occur if you are using multithreading applications. If your applications support TCP, then set `/etc/netconfig` (or your `NETPATH` environment variable) to `tcp`.

`_svcauth_des: timestamp is earlier than the one previously seen from` *principalname*
The time stamp received from the client on a subsequent call is earlier than one seen previously from that client. The severity of this message depends on what level of security you are running. At a low security level, this message is primarily for your information; at a higher level, you might have some corrective action as described below.

Possible causes are:

- The client and server clocks are out of sync. Use `rdate` to resynch the client clock to the server clock.
- The server cached out the entry for this client. The server maintains a cache of information regarding the current clients. This cache size equals 64 client handles.

`_svcauth_des: timestamp expired for` *principalname*
The time stamp received from the client is not within the default 35-second window in which it must be received. The severity of this message depends on what level of security you are running. At a low security level, this message is primarily for your information; at a higher level, you might have to take corrective action as described below.

Possible causes are:

- The 35-second window is too small to account for slow servers or a slow network.
- The client and server clocks are so far out of sync that the window cannot allow for the difference. Use `rdate` to resynchronize the client clock to the server clock.
- The server has cached out the client entry. Retry the operation.

`Too Many Attributes`
The search criteria passed to the server had more attributes than the table had searchable columns.

This message is generated by the NIS+ error code constant: `NIS_TOOMANYATTRS`. See the `nis_tables` man page for additional information.

`Too many failures - try later`

`Too many tries; try again later`
These messages indicate that you have had too many failed attempts (or taken too long) to either log in or change your password. See "The `Login incorrect` Message" on page 292 or "Password Change Failures" on page 294 for further information.

`Unable to authenticate NIS+ client`
This message is generated when a server attempts to execute the callback procedure of a client and gets a status of `RPC_AUTHERR` from the RPC `clnt_call()`. This is usually caused by out-of-date authentication information. Out-of-date authentication information can occur when the system is using data from a cache that has not been updated, or when there has been a recent change in the authentication information that has not yet been propagated to this server. In most cases, this problem should correct itself in a short period of time.

If this problem does not self-correct, it might indicate one of the following problems:

- Corrupted `/var/nis/NIS_SHARED_DIRCACHE` file. Kill the cache manager, remove this file, and restart the cache manager.
- Corrupted `/var/nis/NIS_COLD_START` file. Remove the file and then run `nisinit` to recreate it.
- Corrupted `/etc/.rootkey` file. Run `keylogin -r`.

This message is generated by the NIS+ error code constant: `NIS_CLNTAUTH`.

`Unable to authenticate NIS+ server`
In most cases, this is a minor software error from which your system should quickly recover without difficulty. It is generated when the server gets a status of `RPC_AUTHERR` from the `RPC clnt_call`.

If this problem does not quickly clear itself, it might indicate a corrupted `/var/nis/NIS_COLD_START`, `/var/nis/NIS_SHARED_DIRCACHE`, or `/etc/.rootkey` file.

This message is generated by the NIS+ error code constant: `NIS_SRVAUTH`.

`Unable to bind to master server for name '`*string*`'`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*for information on this type of problem. This particular message might be caused by adding a trailing dot to the server's domain name in the `/etc/defaultdomain` file.

`Unable to create callback.`
The server was unable to contact the callback service on your machine. This results in no data being returned.

See the `nis_tables` man page for additional information.

`Unable to create process on server`
This error is generated if the NIS+ service routine receives a request for a procedure number which it does not support.

This message is generated by the NIS+ error code constant: `NIS_NOPROC`.

string`: Unable to decrypt secret key for` *string*`.`
Possible causes:

- You might have incorrectly typed the password.
- There might not be an entry for *name* in the cred table.
- NIS+ could not decrypt the key because the entry might be corrupt.
- The `nsswitch.conf` file might be directing the query to a local password in an `/etc/passwd` file that is different than the NIS+ password recorded in the cred table.

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for information on diagnosing and solving these type of problem.

`Unknown error`
This is displayed when the NIS+ error handling routine receives an error of an unknown type.

`Unknown object`
The object returned is of an unknown type.

This message is generated by the NIS+ error code constant: `NIS_UNKNOWNOBJ`. See the `nis_names` man page for additional information.

`update_directory:` *nnnn* `objects still running.`
This is a status message displayed on the server during the update of a directory during a replica update. You do not need to take any action.

`User` *principalname* `needs Secure RPC credentials to login but has none.`

The user has failed to perform a keylogin. This problem usually arises when the user has different passwords in `/etc/shadow` and a remote NIS+ passwd table.

`Warning: couldn't reencrypt secret key for` *principalname*

The most likely cause of this problem is that your Secure RPC password is different from your login password (or you have one password on file in a local `/etc/shadow` file and a different one in a remote NIS+ table) and you have not yet done an explicit `keylogin`. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)* for more information on these types of problems.

`WARNING: db::checkpoint: could not dump database: No such file or directory`

This message indicates that the system was unable to open a database file during a checkpoint. Possible causes:

- The database file was deleted.
- The server is out of file descriptors.
- There is a disk problem
- You or the host do not have correct permissions.

`WARNING: db_dictionary::add_table: could not initialize database from scheme`

The database table could not be initialized. Possible causes:

- There was a system resource problem See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*).
- You incorrectly specified the new table in the command syntax.
- The database is corrupted.

`WARNING: db_query::db_query:bad index`

In most cases this message indicates incorrect specification of an indexed name. Make sure that the indexed name is found in the specified table. Check the command for spelling and syntax errors.

`**WARNING: domain` *domainname* `already exists.`

This message indicates that the domain you tried to create already exists.

- If you are trying to promote a new nonroot master server or are recovering from a previous `nisserver` problem, continue running the script.
- If *domainname* was spelled incorrectly, rerun the script with the correct domain name.

**WARNING: failed to add new member *NIS+_principle* into the *groupname* group. You will need to add this member manually: 1. /usr/sbin/nisgrpadm -a groupname NIS+_principal

The NIS+ command `nisgrpadm` failed to add a new member into the NIS+ group *groupname*. Manually add this NIS+ principal by typing:

```
# /usr/sbin/nisgrpadm -a groupname NIS+_principal
```

**WARNING: failed to populate *tablename* table.

The `nisaddent` command was unable to load the NIS+ *tablename* table. A more detailed error message usually appears before this warning message.

**WARNING: hostname specified will not be used. It will use the local hostname instead.

This message indicates that you typed a remote host name with the `-H` option. The `nisserver -r`script does not configure remote machines as root master servers.

- If the local machine is the one that you want to convert to an NIS+ root master server, no other action is needed. The `nisserver -r`script will ignore the host name you typed.
- If you actually want to convert the remote host (instead of the local machine) to an NIS+ root master server, exit the script. Rerun the `nisserver -r`script on the remote host.

**WARNING: *hostname* is already a server for this domain. If you choose to continue with the script, it will try to replicate the groups_dir and org_dir directories for this domain.

This is a message warning you that *hostname* is already a replica server for the domain that you are trying to replicate.

- If you are running the script to fix an earlier `nisserver` problem, continue running the script.
- If *hostname* was mistakenly entered, rerun the script with the correct host name.

**WARNING: *alias-hostname* is an alias name for host *canonical_hostname*. You cannot create credential for host alias.

This message indicates that you have typed a host alias in the name list for `nisclient -c`. The script asks you if you want to create the credential for the canonical host name, since you should not create credentials for host alias names.

**WARNING: file *directory-path/tablename* does not exist! *tablename* table will not be loaded.

The script was unable to find the input file for *tablename*.

- If *directory-path*/*tablename* is spelled incorrectly, rerun the script with the correct table name.
- If the *directory-path*/*tablename* file does not exist, create and update this file with the proper data. Then rerun the script to populate this table.

**WARNING: NIS auto.master map conversion failed. auto.master table will not be loaded.

The auto.master map conversion failed while trying to convert all the dots to underscores in the auto_master table. Rerun the script with a different NIS server.

**WARNING: NIS netgroup map conversion failed. netgroup table will not be loaded.

The netgroup map conversion failed while trying to convert the NIS domain name to the NIS+ domain name in the netgroup map. Rerun the script with a different NIS server.

**WARNING: nisupdkeys failed on directory *domainname*. This script will not be able to continue. Please remove the *domainname* directory using 'nisrmdir'.

The NIS+ command nisupdkeys failed to update the keys in the listed directory object. If rpc.nisd is not running on the new master server that is supposed to serve this new domain, restart rpc.nisd. Then use nisrmdir to remove the *domainname* directory. Finally, rerun nisserver.

WARNING: nisupdkeys failed on directory *directory-name* You will need to run nisupdkeys manually: 1. /usr/lib/nis/nisupdkeys *directory-name*

The NIS+ command nisupdkeys failed to update the keys in the listed directory object. Manually update the keys in the directory object by typing:

```
# /usr/lib/nis/nisupdkeys directory-name
```

**WARNING: once this script is executed, you will not be able to restore the existing NIS+ server environment. However, you can restore your NIS+ client environment using "nisclient -r" with the proper domainname and server information. Use "nisclient -r" to restore your NIS+ client environment.

These messages appear if you have already run the script at least once before to set up an NIS+ server and indicate that NIS+-related files will be removed and recreated as needed if you decide to continue running this script.

- If it is all right for these NIS+ files to be removed, continue running the script.
- If you want to save these NIS+ files, exit the script by typing "**n**" at the Do you want to continue? prompt. Then save the NIS+ files in a different directory and rerun the script.

**WARNING: this script removes directories and files related to NIS+ under /var/nis directory with the exception of the NIS_COLD_START and NIS_SHARED_DIRCACHE files which will be renamed to <file>.no_nisplus. If you want to save these files, you should abort from this script now to save these files first.

See "WARNING: once this script is executed,..." above.

**WARNING: you must specify the NIS domainname.
This message indicates that you did not type the NIS domain name at the prompt. Type the NIS server domain name at the prompt.

**WARNING: you must specify the NIS server *hostname*. Please try again.
This message indicates that you did not type the NIS server host name at the prompt. Type the NIS server host name at the prompt.

Window verifier mismatch
This is a debugging message generated by the _svcauth_des code. A verifier could be invalid because a key was flushed out of the cache. When this occurs, _svcauth_des returns the AUTH_BADCRED status.

You (*string*) do not have Secure RPC credentials in NIS+ domain *'string'*
This message could be caused by trying to run nispasswd on a server that does not have the credentials required by the command. (Keep in mind that servers running at security level 0 do not create or maintain credentials.)

See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*for additional information on credential, ownership, and permission problems.

You may not change this password
This message indicates that your administrator has forbidden you to change your password.

You may not use nisplus repository
You used -r nisplus in the command line of your command, but the appropriate entry in the NIS+ passwd table was not found. Check the passwd table in question to make sure it has the entry you want. Try adding nisplus to the nsswitch.conf file.

Your password has been expired for too long

Your password is expired
These messages refer to password aging and indicate that your password has been in use too long and needs to be changed now. See "The will expire Message" on page 292for further information.

Your password will expire in *nn* days

Your password will expire within 24 hours
These messages refer to password aging and indicate that your password is about to become invalid and should be changed now. See "The will expire Message" on page 292 for further information.

`Your specified repository is not defined in the nsswitch file!`
This warning indicates that you have specified a password information repository with the `-r` option, but that password repository is not included in the passwd entry of the `nsswitch.conf` file. The command you have just used will perform its job and make whatever change you intend to the password information repository you specified with the `-r` flag. However, the change will be made to information that the `nsswitch.conf` file does not point to, so no one will ever gain the benefit of it until the switch file is altered to point to that repository.

For example, suppose the passwd entry of the switch file reads: `files nis`, and you used

```
passwd -r nisplus
```

to establish a password age limit. That limit would be ignored, as the switch file remains set to `files nis`.

`verify_table_exists: cannot create table for` *string* `nis_perror` *message*`.`
To perform an operation on a table, NIS+ first verifies that the table exists. If the table does not exist, NIS+ attempts to create it. If it cannot create the table, it returns this error message. The *string* portion of the message identifies the table that could not be located or created; the nis_perror *message* portion provides information as to the cause of the problem (you can look up that portion of the message as if it were an independent message in this appendix). Possible causes for this type of problem:

- The server was just added as a replica of the directory and it might not have the directory object. Run `nisping -C` to checkpoint.
- You are out of disk space. See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*.
- Database corruption.
- Some other type of software error. Contact the Sun Solutions Center.

`ypcat: can't bind to NIS server for domain` *domainname*`. Reason: can't communicate with ypbind.`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

`yppoll: can't get any map parameter.`
See "NIS Troubleshooting" in *System Administration Guide: Naming and Directory Services (DNS, NIS, and LDAP)*

Glossary

access rights The permissions assigned to classes of NIS+ principals that determine what operations they can perform on NIS+ objects: read, modify, create, or destroy.

application-level name service Application-level name services are incorporated in applications offering services such as files, mail, and printing. Application-level name services are bound below enterprise-level name services. The enterprise-level name services provide contexts in which contexts of application-level name services can be bound.

atomic name An FNS (XFN) term referring to the smallest indivisible component of a name as defined by the naming convention.

attribute In FNS (XFN), each named object is associated with a set of zero or more attributes. Each attribute in the set has a unique attribute identifier, an attribute syntax, and a set of zero or more distinct attribute values.

authentication The determination of whether an NIS+ server can identify the sender of a request for access to the NIS+ namespace. Authenticated requests are divided into the authorization categories of owner, group, and world. Unauthenticated requests—the sender is unidentified, are placed in the Nobody category.

binding In FNS (XFN), the association of an atomic name with an object reference. For simplicity, an object reference and the object it refers to are used interchangeably in this guide.

BNF An FNS (XFN) acronym referring to a Backus-Naur Form.

cache manager The program that manages the local caches of NIS+ clients (`NIS_SHARED_DIRCACHE`), which are used to store location information about the NIS+ servers that support the directories most frequently used by those clients, including transport addresses, authentication information, and a time-to-live value.

child domain See *domain.*

checkpointing The process of writing changes to NIS+ data that are stored in server memory and recorded in the transaction log to the NIS+ tables stored on disk. In other words, updating the NIS+ tables with recent changes to the NIS+ data set.

client (1) In NIS+, the client is a principal (machine or user) requesting an NIS+ service from an NIS+ server.

(2) In the client-server model for file systems, the client is a machine that remotely accesses resources of a compute server, such as compute power and large memory capacity.

(3) In the client-server model, the client is an *application* that accesses services from a "server process." In this model, the client and the server can run on the same machine or on separate machines.

client-server model A common way to describe network services and the model user processes (programs) of those services. Examples include the name-server/name-resolver paradigm of the *Domain Name System (DNS)* and file-server/file-client relationships such as *NFS* and diskless hosts. See also *client*.

cold-start file The NIS+ file given to a client when it is initialized that contains sufficient information so that the client can begin to contact the master server in its home domain.

composite name In FNS (XFN), a name that spans multiple naming systems. It consists of an ordered list of zero or more components. Each component is a name from the namespace of a single naming system. Composite name resolution is the process of resolving a name that spans multiple naming systems.

compound name In FNS (XFN), a sequence of atomic names composed according to the naming convention of a naming system.

context In FNS (XFN), an object whose state is a set of bindings with distinct atomic names. Every context has an associated naming convention. A context provides a lookup (resolution) operation, which returns the reference, and may provide operations such as binding names, unbinding names, and listing bound names.

credentials The authentication information about an NIS+ principal that the client software sends along with each request to an NIS+ server. This information verifies the identity of a user or machine.

data encrypting key A key used to encipher and decipher data intended for programs that perform encryption. Contrast with *key encrypting key*.

data encryption standard (DES) A commonly used, highly sophisticated algorithm developed by the U.S. National Bureau of Standards for encrypting and decrypting data. See also SUN-DES-1.

decimal dotted notation The syntactic representation for a 32-bit integer that consists of four 8-bit numbers written in base 10 with periods (dots) separating them. Used to represent IP addresses in the Internet as in: 192.67.67.20.

DES See *data encryption standard (DES)*.

directory (1) An NIS+ directory is a container for NIS+ objects such as NIS+ tables, groups, or subdirectories

(2) In UNIX, a container for files and subdirectories.

directory cache A local file used to store data associated with directory objects.

distinguished name A distinguished name is an entry in an X.500 directory information base (DIB) composed of selected attributes from each entry in the tree along a path leading from the root down to the named entry.

DNS See *Domain Name System*.

DNS-forwarding An NIS server or an NIS+ server with NIS compatibility set forwards requests it cannot answer to DNS servers.

DNS zones Administrative boundaries within a network domain, often made up of one or more subdomains.

DNS zone files A set of files wherein the DNS software stores the names and IP addresses of all the workstations in a domain.

domain (1) In NIS+ a group of hierarchical objects managed by NIS+. There is one highest level domain (root domain) and zero or more subdomains. Domains and subdomains may be organized around geography, organizational or functional principles.

- *Parent domain*. Relative term for the domain immediately above the current domain in the hierarchy.
- *Child domain*. Relative term for the domain immediately below the current domain in the hierarchy.
- *Root domain*. Highest domain within the current NIS+ hierarchy.

(2) In the Internet, a part of a naming hierarchy usually corresponding to a Local Area Network (LAN) or Wide Area Network (WAN) or a portion of such a network. Syntactically, an Internet domain name consists of a sequence of names (labels) separated by periods (dots). For example, `sales.doc.com`.

(3) In International Organization for Standardization's open systems interconnection (OSI), "domain" is generally used as an administrative

	partition of a complex distributed system, as in MHS private management domain (PRMD), and directory management domain (DMD).
domain name	The name assigned to a group of systems on a local network that share DNS administrative files. The domain name is required for the network information service database to work properly. See also *domain*.
Domain Name Service (DNS)	A service that provides the naming policy and mechanisms for mapping domain and machine names to addresses outside of the enterprise, such as those on the Internet. DNS is the network information service used by the Internet.
encryption key	See *data encrypting key*.
enterprise-level name service	An enterprise-level naming service identifies (names) machines (hosts), users and files within an enterprise-level network. FNS also allows naming of organizational units, geographic sites, and application services.
enterprise-level network	An "enterprise-level" network can be a single Local Area Network (LAN) communicating over cables, infra-red beams, or radio broadcast; or a cluster of two or more LANs linked together by cable or direct phone connections. Within an enterprise-level network, every machine is able to communicate with every other machine without reference to a global naming service such as DNS or X.500/LDAP.
enterprise root	In FNS (XFN), the root context of an enterprise. A context for naming objects found at the root of the enterprise namespace.
entry	A single row of data in a database table.
federated naming service	The service offered by a federated naming system.
federated naming system	An aggregation of autonomous naming systems that cooperate to support name resolution of composite names through a standard interface. Each member of a federation has autonomy in its choice of operations other than name resolution.
federated namespace	An FNS (XFN) term referring to the set of all possible names generated according to the policies that govern the relationships among member naming systems and their respective namespaces.
FNS	See *Federated naming service*.
generic context	In FNS (XFN), a context for binding names used in applications.
GID	See *group ID*.
global context	In FNS (XFN), a context for naming objects that have global names (currently, DNS and X.500 are the only global naming systems specified by XFN).

global name service A global naming service identifies (names) those enterprise-level networks around the world that are linked together via phone, satellite, or other communication systems. This world-wide collection of linked networks is known as the "Internet." In addition to naming networks, a global naming service also identifies individual machines and users within a given network.

group (1) A collection of users who are referred to by a common name.

(2) In NIS+ a collection of users who are collectively given specified access rights to NIS+ objects. NIS+ group information is stored in the NIS+ group table.

(3) In UNIX, groups determine a user's access to files. There are two types of groups: default user group and standard user group.

group ID A number that identifies the default *group* for a user.

host context In FNS (XFN), a context for naming objects related to a computer.

implicit naming system pointer An FNS (XFN) term referring to an unnamed reference that points to a context in another naming system.

indexed name A naming format used to identify an entry in a table.

initial context In FNS (XFN), every XFN name is interpreted relative to some context, and every XFN naming operation is performed on a context object. The XFN interface provides a function that allows the client to obtain an initial context object that provides a starting point for resolution of composite names.

initial context function An FNS function, `fn_ctx_handle_from_initial()`, that obtains the initial context which allows a client to obtain an initial starting point for name resolution.

Internet The world-wide collection of networks interconnected by a set of routers that enable them to function and communicate with each other as a single virtual network.

Internet address A 32-bit address assigned to hosts using *TCP/IP*. See *decimal dotted notation*.

IP Internet Protocol. The *network layer* protocol for the Internet protocol suite.

IP address A unique number that identifies each host in a network.

junction An FNS (XFN) term referring to a name in one namespace bound to a context in the next naming system.

key (column) An NIS+ table entry's data can be accessed from any column, regardless of that table's key.

key (encrypting) A key used to encipher and decipher other keys, as part of a key management and distribution system. Contrast with *data encrypting key*.

key server A Solaris operating environment process that stores private keys.

local-area network (LAN) Multiple systems at a single geographical site connected together for the purpose of sharing and exchanging data and software.

mail exchange records Files that contain a list of DNS domain names and their corresponding mail hosts.

mail hosts A workstation that functions as an email router and receiver for a site.

master server The server that maintains the master copy of the network information service database for a particular domain. Namespace changes are always made to the name service database kept by the domain's master server. Each domain has only *one* master server.

MIS Management information systems (or services)

naming convention In FNS (XFN), every name is generated by a set of syntactic rules called a naming convention.

name resolution The process of translating workstation or user names to addresses.

name server Servers that run one or more network name services.

name service switch A configuration file (`/etc/nsswitch.conf`) that defines the sources from which an NIS+ client can obtain its network information.

name service A network service that handles machine, user, printer, domain, router, an other network names and addresses.

namespace (1) A namespace stores information that users, workstations, and applications must have to communicate across the network.

(2) The set of all names in a naming system.

(3) NIS+ namespace, A collection of hierarchical network information used by the NIS+ software.

(4) NIS namespace. A collection of *non*-hierarchical network information used by the NIS software.

(5) DNS namespace. A collection of networked workstations that use the DNS software.

namespace identifier An FNS (XFN) term referring to a special atomic name used to refer to the root of a namespace.

naming system In FNS (XFN), a connected set of contexts of the same type (having the same naming convention) and providing the same set of operations with identical semantics. In the UNIX operating environment, for

example, the set of directories in a given file system (and the naming operations on directories) constitutes a naming system.

network mask A number used by software to separate the local subnet address from the rest of a given Internet protocol address.

next naming system pointer (NNSP) In FNS (XFN), a reference to a context in which composite names from subordinate naming systems are resolved.

network password See Secure RPC password.

NIS A distributed network information service containing key information about the systems and the users on the network. The NIS database is stored on the *master server* and all the *replica* or *slave servers*.

NIS maps A file used by NIS that holds information of a particular type, for example, the password entries of all users on a network or the names of all host machines on a network. Programs that are part of the NIS service query these maps. See also *NIS*.

NIS+ A distributed network information service containing hierarchical information about the systems and the users on the network. The NIS+ database is stored on the *master server* and all the *replica server*s.

NIS-compatibility mode A configuration of NIS+ that allows NIS clients to have access to the data stored in NIS+ tables. When in this mode, NIS+ servers can answer requests for information from both NIS and NIS+ clients.

NIS+ environment For administrative purposes, an NIS+ environment refers to any situation in which the applicable `nsswitch.conf` file points to `nisplus`. Or any time a command is run with an option that forces it to operate on objects in an NIS+ namespace (for example, `passwd -r nisplus`).

NIS+ object An NIS+ domain, directory, table, or group. See *domain*, *directory*, *group*, and *table*.

NIS+ principal See *principal*.

NIS+ transaction log A file that contains data updates destined for the NIS+ tables about objects in the namespace. Changes in the namespace are stored in the transaction log until they are propagated to replicas. The transaction log is cleared only after all of a master server's replicas have been updated.

NNSP See *next naming system pointer*.

organizational units In FNS (XFN), an enterprise is organized into organizational units such as centers, laboratories, departments, divisions, and so on. An organizational unit is a subunit of an enterprise.

organizational unit context In FNS (XFN), a context for naming objects related to an organizational unit within an enterprise.

parent context In FNS (XFN), a context in which this context and its siblings are bound.

parent domain See *domain*.

pinging The process by which an NIS+ master server transfers a change a NIS+ data to the domain's replica servers.

preference rank number A number which a machine uses to rank the order in which it tries to obtain namespace information from NIS+ servers. A machine will first try all servers with a given rank number before trying any server with the next highest rank number. For example, a machine will query NIS+ servers with a rank number of 0 before it queries any server with a rank number of 1.

preferred server From the point of view of a client machine, a preferred NIS+ server is a server that the client should try to use for namespace information ahead of non-preferred servers. Servers that are listed in a client or domain's preferred server list are considered preferred servers for that client or domain.

preferred server list A `client_info` table or a `client_info` file. Preferred server lists specify the preferred servers for a client or domain.

principal Any user of NIS+ information whose credentials have been stored in the namespace. Any user or machine that can generate a request to a NIS+ server. There are two kinds of NIS+ principal: client users and client machines:

- *Root principal*. A machine root user (user ID = 0). Requires only a DES credential.
- *User principal*. Any nonroot user (user ID > 0). Requires local and DES credentials.

private key The private component of a pair of mathematically generated numbers, which, when combined with a private key, generates the DES key. The DES key in turn is used to encode and decode information. The private key of the sender is only available to the owner of the key. Every user or machine has its own public and private key pair.

public key The public component of a pair of mathematically generated numbers, which, when combined with a private key, generates the DES key. The DES key in turn is used to encode and decode information. The public key is available to all users and machines. Every user or machine has their own public and private key pair.

populate tables Entering data into NIS+ tables either from files or from NIS maps.

record See *entry*.

reference An FNS (XFN) term referring to the thing bound to a name. It contains addresses identifying the communication endpoints of the object.

remote procedure call (RPC) An easy and popular paradigm for implementing the client-server model of distributed computing. A request is sent to a remote system to execute a designated procedure, using arguments supplied, and the result is returned to the caller.

replica server NIS+ server that maintains a duplicate copy of the domain's master NIS+ server database. Replicas run NIS+ server software and maintain copies of NIS+ tables. A replica server increases the availability of NIS+ services. Each NIS+ domain should have at least one, and perhaps more, replicas. (In an NIS namespace, a replica server was known as a *slave* server.)

reverse resolution The process of converting workstation IP addresses to workstation names using the DNS software.

root context In FNS (XFN), a context for naming the objects found in the root of the namespace.

root domain See *domain*.

root master server The master server for a NIS+ root domain.

root replica server NIS+ server that maintains a duplicate copy of the root domain's master NIS+ server database.

RPC See remote procedure call (RPC).

Secure RPC password Password required by Secure RPC protocol. This password is used to encrypt the private key. This password should always be identical to the user's login password.

server (1) In NIS+, NIS, DNS, and FNS (XFN) a host machine providing naming services to a network.

(2) In the *client-server model* for file systems, the server is a machine with computing resources (and is sometimes called the compute server), and large memory capacity. Client machines can remotely access and make use of these resources. In the client-server model for window systems, the server is a process that provides windowing services to an application, or "client process." In this model, the client and the server can run on the same machine or on separate machines.

(3) A *daemon* that actually handles the providing of files.

server list *See* preferred server list.

service context In FNS (XFN), a context for naming objects that provide services.

site context In FNS (XFN), a context for naming objects related to a physical site.

slave server (1) A server system that maintains a copy of the NIS database. It has a disk and a complete copy of the operating environment.

(2) Slave servers are called *replica servers* in NIS+.

strong separation An FNS (XFN) term referring to cases where the XFN context treats the XFN component separator as the naming system boundary.

subcontext In FNS (XFN), a context bound within another context.

subnet A working scheme that divides a single logical network into smaller physical networks to simplify routing.

table In NIS+ a two-dimensional (nonrelational) database object containing NIS+ data in rows and columns. (In NIS an NIS map is analogous to a NIS+ table with two columns.) A table is the format in which NIS+ data is stored. NIS+ provides 16 predefined or system tables. Each table stores a different type of information.

TCP See *Transport Control Protocol (TCP)*.

TCP/IP Acronym for Transport Control Protocol/Interface Program. The protocol suite originally developed for the Internet. It is also called the *Internet* protocol suite. Solaris networks run on TCP/IP by default.

Transport Control Protocol (TCP) The major transport protocol in the Internet suite of protocols providing reliable, connection-oriented, full-duplex streams. Uses IP for delivery. See TCP/IP.

user context In FNS (XFN), a context for naming objects related to a human user.

weak separation An FNS (XFN) term referring to cases where the XFN context does not treat the XFN component separator as the naming system boundary.

wide-area network (WAN) A network that connects multiple local-area networks (LANs) or systems at different geographical sites via phone, fiber-optic, or satellite links.

XFN link In FNS (XFN), a special form of reference that has a composite name as an address. Like any other type of reference, an XFN link is bound to an atomic name in a context.

X.500 A global-level directory service defined by an Open Systems Interconnection (OSI) standard.

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