Datacenter Naming Scheme

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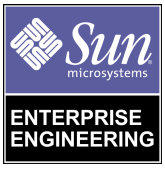

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Datacenter Naming Scheme

This article recommends a labeling and naming scheme for a Data Center. A basic naming convention is proposed for:

- Servers
- Storages
- Networks
- Cabling

The article is not intended to be prescriptive, as there are many naming solutions. The solution presented can be implemented "as is," or used as a starting point for a tailored solution. The target audience are those responsible for datacenter planning and implementation, systems or infrastructure design and implementation, and systems administration.

The need for a naming convention is not necessarily obvious--after all, it requires extra effort and time at installation. When all components are working properly, it is irrelevant where a disk is located, which service runs on which server, or where the end of a cable terminates. Realizing that failures have a tendency to strike when the new or most junior staff are on duty, naming conventions are for troubleshooting and emergencies. They will enable quicker problem determination and resolution. They convey information to new staff, and remind old hands of component functions. Consider a hypothetical case in which a consultant engineer is engaged to solve a problem; if it takes a day to understand the topology of the service infrastructure, that is not only a day longer to fix the problem, but several thousand dollars additional cost.

Obviously if a computer room has only three servers located next to each other, a naming mechanism to identify equipment location may be redundant. However there may still be a need to identify storage function and layout. Cables should practically always be labelled. Successful ventures have a propensity to scale; what is 4 servers now may become 40 in 8 months time. Plan for success and develop a suitable naming scheme from the beginning.

Some datacenters may resemble a rat's nest of cables of unclear origins and destinations. This can present a serious problem if, for example, tracing a cable involves the hazardous and time consuming job of lifting floor tiles. The author was once doing just that, and the dropped floor tile resulted in a severed AUI cable.

Clearly this becomes an availability issue; problems may take longer to rectify. It is potentially a reliability issue, because mistakes may arise out of the chaos. The irony is the small amount of additional installation time required to label components and cables when compared to the enormous task of rectification at a later date.

Naming conventions vary among corporations, sites, and even departments. This variance is not a problem, as long as the naming convention achieves its purpose and is documented. For any naming convention to succeed, it must be rigorously applied.

Unfortunately, naming conventions often evolve without planning or understanding. One naming convention can seldom address all circumstances; for example, an established datacenter may be relatively stable and static when compared to an e-commerce startup, and the two will have different naming requirements.

An established datacenter may choose to be absolute in its naming, knowing that equipment will move infrequently. A startup may wish to use some variety of relative naming, realizing that equipment may be moved often or expanded or upgraded frequently. A startup may also plan for a number of "standard cells" with prepared names to preempt expansion, sub-dividing a large computer room into a series of squares that could contain identical configurations sharing much commonality within the naming. This standardization would allow for rapid deployment and ease maintenance and operation.

All equipment names and naming conventions used in a datacenter should be documented, and a recommended method is use of HTML. Using HTML to table information has the added advantage of being searchable to identify all interrelated components.

Server Naming Conventions

A naming convention must embrace the requirements of each support group. These requirements may be contradictory; simplicity and unambiguity on one hand, and precision on the other. A single name may not address both needs--the naming convention may have to allow for multiple names for a single server. Consider the following basic requirements:

- The operations group requires a name to identify the location of a piece of equipment in the machine room.

- The help desk team requires a name that reflects the service being provided, because customers generally refer to problems by function or service. Different service levels and problem escalation priorities may exist for each service. It is essential that support staff can identify the criticality of a server, alerting them to associated change control and testing requirements.
- The systems administration group needs a reference name that is easy to communicate and is not likely to be confused when working under pressure, for example, simple names such as *Alfred, Diego, or Pegasus*.

These requirements are not mutually exclusive; therefore, a mapping process must exist from one to another.

Server Naming Requirements

Server naming requirements should identify the following:

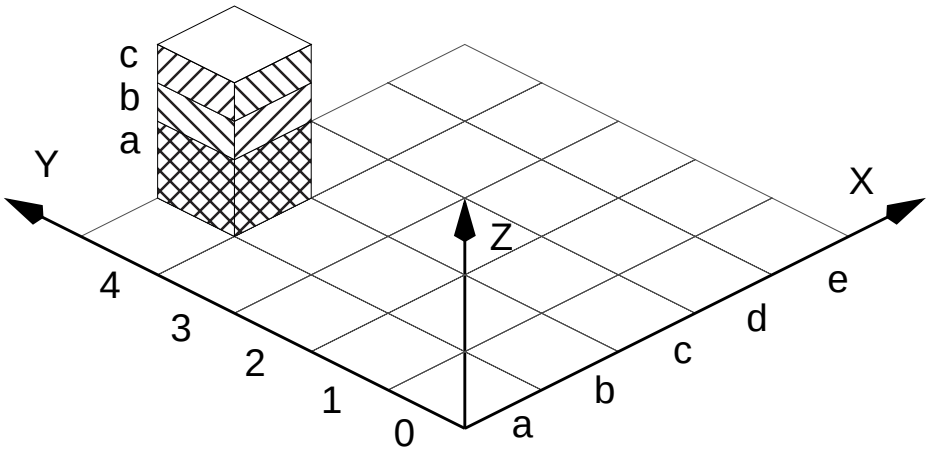
- Physical location
- Service or function name
- Hostname

Some companies assign three names to each server. The names are cross-referenced with either an HTML table or a simple written web application. Publishing with HTML is particularly useful because additional information such as hardware serial numbers, service contracts, and service level details can be included. HTML is easy to access, is flexible, and is straightforward to update and maintain.

Physical Location Name

The physical location of a piece of equipment should be mapped within a computer room using an X, Y, Z coordinate. A grid is formed using the computer room floor tiles as the units. X and Y denote the row and column of a floor tile, and Z denotes the position the equipment occupies in the rack.

FIGURE 1 Location Map



The preceding scheme, FIGURE 1, is based on a single computer room. The building and room location are documented but kept separate from the location within the computer room. This means labels can be kept shorter.

As a cabinet rarely occupies just one floor tile, a rack is deemed to be in the position occupied by its front left corner. The following nomenclature is suggested:

b4c

represents equipment located at row b, column 4 within the computer room, and position c within the rack.

Equipment is likely to be moved, so it should be accepted that keeping the order of equipment within a rack a, b, c ... from bottom to top may not always be possible. However, each item should be labelled and it should be accepted that there may be gaps or items out of sequence.

The letters "O" and "I" should be avoided, as they are easily confused with the numbers "0" and "1".

Service or Function Name

The service or function name should reflect the service that a server supports. Including this name makes it clear to the help desk or operations personnel what affect an outage will have on specific customers. The following is a suggested format.

Full descriptive name: The Accounting Database Server for the Enterprise Engineering Department.

Abbreviation: dbee

Service level

For each service or function the following should be documented:

- Owner or service delivery manager
- Maximum permissible length of an outage defined by the service level agreement
- Description of service function
- Abbreviated or short form name

Links or references from this information could be made to escalation procedures, problem determination procedures, orderly shutdown processes, and so on as required. If the service levels have been categorized, e.g. Gold, Silver, Bronze, it would be possible to instigate processes such as denying certain staff levels to change certain categories. Categorization of priorities allows triage; for example, knowing which services must be attended to first when power is restored.

Dependencies

For each server, document the following:

- Services required for correct operation, such as dependences or inputs. For example, a server may use DNS provided by service DNSwest and perhaps a remote filesystem via NFS from service File1
- The services or functions provided, or outputs. For example SMTP and IMAP mail server.

This information describes the impact of a specific server being unavailable. The information identifies dependencies and documents service architecture.

Hostname

The `hostname` of a server should be easy to remember and communicate. Names such as "a42z5p" should be avoided — "eagle" is much easier to remember and less easy to confuse when working under pressure.

Hostnames should:

- Not look or sound alike (main, maine, c1c, c1d etc.)
- Not reveal security information (firewall, personnel etc.)
- Be easy to pronounce (Sam, not f2g6s7)
- Employ mnemonics to aid clarity (for example, Apple, Banana, A, B)
- Not be politically sensitive
- Not be longer than 8 characters

Using a theme for hostnames is a valuable technique. For example, all the servers for one service could be named after birds, for another service fish, and so on. This method highlights the server-service relationships. Categorization may be by service, service level, or location — whatever is most relevant to the architecture or function supported. Interested readers can refer to RFC 1178 by Don Libes for more information on this topic.

Server Naming Example

The following table is an example of how the server naming scheme works in the Enterprise Engineering Lab. The small amount of documentation required for each server provides the server type (item) and serial number (S/N) for placing a fault call, the server location, its importance (SLA), and supporting service (dependences). The PDU information is extremely helpful--it quickly identifies all the components affected by a power down. The hostnames in this example all refer to types of birds.

TABLE 1 Server List

Hostname	Item	Location	Service Name	SLA	PDU	Dependences	S/N	Asset Tag
albatross	E220R	F5A	Lopez	C	1	Lab	005H97B	4216A
martin	E250	C3C	Vargas	C	2	None	42178	4217G
owl	E4500	M12E	HPC	C	1	Lab	929H20F	4216G
robin	T1	F8J	Vargas	B	1	None	008A0A2	4217M
wagtail	E420R	F12C	Lab	A	1, 2	None	020H12A	4216B

The next table provides details of the service functions and responsible parties. Once again, documenting this information is a small task, but is invaluable for the impact and escalation of problems. Additional information, such as a senior system administrator, may also be pertinent.

TABLE 2 Service List

Service Name	Service Delivery Manager	Function
HPC	F Virgil	High Performance Computing (Project ends 8/20/01)
Lab	A Scott	NIS, JumpStart
Lopez	B Alan	Lab Guides
Vargas	A R Go	Cluster Project

The operations and systems administration web site should document how to place fault calls to the various suppliers, and contacts should be listed for all hours. This information is simple to publish in HTML.

Naming Conventions for Storage

Basic requirements of a naming convention for storage:

- The operations and systems administration teams must be able to easily locate a disk for replacement.
- The systems administration and operations teams should be able to map a file system or volume to the physical disks it occupies.
- The application support team needs a reference that can be communicated simply and without confusion, and be relevant in the context of the OS.
- The operations and systems administration teams should be able to identify the server or servers to which the disks are attached; for example, an alarm on the systems management console may merely identify that a disk has failed.

As was true for server naming, these requirements are not mutually exclusive. A mapping mechanism should exist from one to another. Remember too that the purpose is to encourage quicker installation time by discouraging the use of confusing names; to expedite maintenance and troubleshooting activities; to provide information such as which filesystems reside on which disks; and to highlight the effects of overfull filesystems or disks with long I/O service times.

The Storage Naming System

To summarize the previous section, the naming system for storage must identify the following: physical location; service or function name; filesystem name; and server hostname. Three names are assigned to the storage, together with a mapping back to the server hostname.

Physical Location

The physical location of a piece of equipment should be mapped by an X, Y, Z coordinate. After all, when there is a disk failure the disk must be located in order to be replaced.

The convention described for servers in the previous section is applicable, however, in this instance each disk within the array should also be identified. This scheme yields a general convention for naming the physical location of equipment:

Physical location + additional device information.

Disk arrays can have drives accessible from the front or the rear of the unit (or both with drives such as the Sun StorEdge A5200 array). It is suggested that an "f" be used to denote the front and an "r" for the rear and should include the slot number of the drive.

In the example "c2ef4," the naming scheme indicates row c, column 2 within the computer room, position e within the rack, and the disk is in slot 4 in the front of the array. If VERITAS volume manager, VxVM, is being used, this should be the disk name. If VxVM is not being used, this name will appear in a table against the device name or target within the operating system, i.e. c2ef4 = c1t0d0s2.

Service or Function Name

The service or function name should indicate what the storage supports. It will be the name given to the volume if VxVM is being used. The following format is suggested:

- eedata
- eelogs

Where “ee” indicates the service (Enterprise Engineering), and “data” or “logs” represent the functions supported. Note that a name such as "vol1" conveys no information.

A fully descriptive name should support the short names; for example, Enterprise Engineering database--index files.

Filesystem Name

The filesystem name should also reflect the service or function that the storage supports. The directory path which forms the mount point for the file system should reflect this information. It will be the only indication from the command line as to the service or function the storage is supporting. In the majority of cases it will be the same name or represent the same information as the service or function name however, a longer directory path can be used to identify the application, customer, and function. Therefore, the VxVM volume names assigned previously may have mount points as follows:

- /database/ee/data
- /database/ee/logs

Where “database” represents the application; “ee” represents the service (Enterprise Engineering), and “data” or “logs” indicates the functions supported by the file systems. A fully descriptive name will also assist support staff performing maintenance operations.

Server Hostname

The server hostnames refer to the servers that are using the storage.

Example of the storage naming system

The following table is an example of how the storage naming scheme works in Sun’s Enterprise Engineering lab. Most of the table is self explanatory, but as VxVM is being used, the devices (c1t5d0s2 and c1t4d1s2 in this example) can be ascertained from the `vxprint` command.

Also in this example, the location column warrants further description. "s05" is the position of the rack in the computer room. A Sun StorEdge™ A3500 array resides here comprising two hardware RAID controller units and 5 Sun StorEdge D1000 disk arrays. The arrays are labelled a, b, c, d, & e within the rack. To maximize resilience, the LUNs have been created on the Sun StorEdge A3500 array as 5 disks in a RAID

5 configuration striped as one disk in each Sun StorEdge D1000 array i.e. vertically (down each array) as opposed to horizontally (within an array). The "a--e" represents the 5 D1000 arrays and the "00" represents the disk in position "00" in each array.

TABLE 3 Storage List

Filesystem (Mount Point)	Function (Volume Name)	Location (Disk Name)	Host	Item	PDU	S/N	Asset Tag
/bparchive	bp	s05a-e00	wagtail	A3500	1,2	906H38	4217N
/jumpstart	js	s05a-e01	"	"	"	"	"
/labhome	labhome	s05a-e01	"	"	"	"	"

Naming Conventions for Networks

There are two functions to be addressed by a network naming convention:

- A name that identifies the network address within the server operating system and will be used to configure the network interface on the server is the name that appears in the `/etc/hosts` and `/etc/hostname.<interface>` files. Correctly chosen names will make it clear, for example, that the network attached to hme0 is for system administration activities and the network attached to qfe0 is for data. This allows application supporters and systems administrators to make correct choices when performing installation and maintenance tasks.
- A name that will be registered within the name service and used to connect to the server or service. The name should indicate the importance of each server, alerting those involved of whether ad-hoc equipment changes are acceptable or not.

Interface Name

The interface name is used when configuring a network interface on a server. This name will appear in the `/etc/hosts` file with its associated IP address, and also in the `/etc/hostname.<interface>` file. The name should identify the function of the network. Therefore, "backup" would be a good name to choose for the backup network. It is advisable to create the name in the form <*hostname*> <*suffix indicating network function*> e.g. alfred–backup, which may also have a shortened alias “alfredb” assigned—where the “b” indicates the network used to perform backups. In this instance, the `/etc/hosts` file may appear as:

- 10.1.1.5 alfred-data alfredd

- 10.1.2.5 alfred-backup alfredb

It is recommended that network names also be included in the file `/etc/network`. In this instance, `/etc/network` would appear as:

- data 10.1.1
- backup 10.1.2

Running the `netstat -i` command will then display the function of each network in addition to the associated interface and address.

With the above scheme, it is clear to all which interface serves which function.

Network Address Name

The network address name is the name used when the server or service is contacted via the network. It is the name registered with the naming service. It is suggested that this name reflect the service or function performed by the network. This would yield addresses of the forms shown in the following table:

TABLE 4 Network Address Naming Conventions

Network Naming Convention	Examples
<hostname or service>.<location>. company.com	wagtail.sandiego file.sandiego
<hostname or service>.<department>. company.com	wagtail.ee file.ee
<hostname or service>.<environment>. <department-location>. company.com	wagtail.test.sandiego postoffice.production.sandiego file.qa.ee
<(hostname or service)-networkfunction>. <environment>.<location or department>. company.com	wagtail-backup.test.sandiego postoffice-data.production.ee

To clarify the nomenclature used in the preceding table:

- <hostname> represents the common reference (`hostname`) of a system; <service> represents the service that the system performs, for example, postoffice, fileserver, or database.
- <network function> represents the data function the network supports, for example, backup, data (application data), admin (administration), client (client data) etc.
- <environment> represents the environment, for example, development (dev), quality assurance (qa), or production (prod).
- <department> represents the department or division that the network supports.

- <location> represents the location, country, or combination thereof.
- “company.com” represents the company name and Top Level Domain—these can be excluded in the internal name service.

Two points to note: the company.com portion of the address can be omitted in the context of the internal network address name space, and for ease of use it is suggested that there be no more than three levels below company.com.

Remember to include aliases, that is both the hostname and the service name for each service. The abstraction provided by using duplicate entries; the service name plus a hostname, for example, virgil.west and postoffice.west, enable the functions to be migrated to new servers without the need to change client application configurations. These would continue to reference the service name rather than the hostname. This maybe required as a result of service expansion or service consolidation activities. A host can support multiple services and thus multiple name service entries may be applicable, one for each service. The common reference name should always be included.

It can be deduced that there are more variations that given based on this scheme. The general rule that has been used is service function through location information (left to right). Some of this information may not be required initially in a small organization but plans should be made on how the naming scheme will scale over time. Looking at the scheme, if a basic address (<hostname or service>.<location>.company.com) is introduced initially it should be possible to expand this (<(hostname or service)-networkfunction>.<environment>.<location>.company.com) as the company matures.

Naming Conventions for Cables

Imagine that the Sun StorEdge D1000 boot arrays for a Sun Enterprise™ 10,000 server reside two rows away from the server itself in a computer room. This is as result of equipment upgrades and retirements over time where it has not been possible to take services down to move racks around. The setup has a complete absence of labels, meaning guess work and cable tracing are involved for the engineer making changes to the domain configuration. Once the rack containing the Sun StorEdge D1000 boot disks has been identified, it is still necessary to identify which array supports which domain on the server.

Clearly the preceding is a hypothetical situation, but it identifies the basic requirements for a labeling scheme for cables:

- Identify the exact location of the opposite end of the cable
- Identify the port on the equipment to attach the cable
- Identify the data function i.e. SCSI, Serial, Ethernet, FC-AL, Data, or Backup

- Indicate the service criticality i.e. production data (critical), backup (critical), or administration (non-critical)
- Label both ends of each cable

Physical Location

As previously defined, the physical location of a piece of equipment is mapped by an X, Y, Z coordinate. Therefore, the label will have the structure:

c3d - h9e

This scheme indicates the cable; from row c, column 3 in the computer room, and position d within the rack, to row h, column 9 and position e. This information must be labelled at both ends of the cable. This is one of the two labels that will appear at each end of a cable, the second label is described in the next section.

Port Information

When a problem arises it may be necessary to verify all interface connections. The presence or absence of a label on each port (or a list containing this information) will allow a quick verification as to whether the port should or should not have a cable attached to it and which cable that should be. For instance, identical looking network or SCSI cables could become transposed during equipment reconfiguration or hardware replacement.

Defining a general convention to identify a port is inadvisable. The variety of equipment means that no one convention will be ideal. Some of the challenges are:

- Servers have multiple I/O boards, therefore, both the board and interface card should be identified.
- Some interface cards have multiple ports, therefore, the interface card and the port must be identified.
- Network equipment may have a large number of ports in a small space making the physical process of labelling more difficult.
- Machines such as the Sun Enterprise 10000 server can be domained in to several servers (the devices qfe1 or c0 can exist in more than one location on the same server).
- Machines that are to be dynamically reconfigured (where a system board can be moved from one server domain to another). After a dynamic reconfiguration, an interface that was c5 on one domain becomes c3 when moved to another.

A number of device specific conventions should be used that best fit the device being labelled. The following recommendations are made:

- For a server that is not to be domained or dynamically reconfigured label the ports on the machine and the cables with the device as seen from the OS. This method is particularly useful because there is a direct correlation between the physical port and the device name within the OS, for example, c0, qfe, etc. A *link down* message from qfe1 can immediately be traced to the interface card or cable. This will yield port identification labels of the following form:

  C0 {{Where C0 is port / device C0 on the server}}

  SCSIA {{Where SCSIA is the SCSI A port of a Sun StorEdge D1000 array}}

  Labels bearing C0 will be attached to the server end of the cable and the port on the server. Similarly labels bearing SCSIA will be attached to the Sun StorEdge D1000 array end of the cable and the Sun StorEdge D1000 array itself.
- For a server that is being domained but is not using dynamic reconfiguration, label the ports and cables with a unique number and also with the device name as seen from the OS. There may be some difficulty doing both due to the space available on the server. In this case, a data sheet should be kept with the server—mapping the port numbers to device names (and also published via HTML). This is performed because the data center and systems administration functions may be in separate locations; therefore, both must be able to identify the physical port from the OS messages. This scheme will yield labels of the form:

  12 (qfe0)

  7-5

  The labels should be attached to both device and cable. At the server the cable and port are labelled 12, in this instance device qfe0. At the patch panel the cable and port are labelled 7-5, in this instance the patch panel port was already pre-labelled with 7-5 so its scheme was adopted.
- For a server using domains and dynamic reconfiguration label the ports and cables with a unique number as described previously but omit the device information as this may change. A data sheet should be kept with the server and also published via HTML.
- For a switch or patch panel where space to attach labels is limited label the cables with the port number as inscribed on the equipment as described in the previous example.

Cable Function

Colors can be used to identify cable function. The objective of identifying cable function is to highlight vital connections or reinforce server importance. This is practical for category 5 network cables, which can be ordered in a variety of colors, but not as practical for SCSI and FC-AL cables, which are generally only available in one or two colors.

The following color coding suggestions are made for the network cables:

- Red = Service Critical Production network
- Blue = Service Non-Critical Production network
- Yellow = Serial connections
- Black = Point to Point (null) Ethernet
- Grey = Everything else, including all other networks

Conclusion

This article outlines an example naming scheme. It is the naming scheme used in the Enterprise Engineering Lab by the Sun BluePrints™ team. It should be possible to use the conventions with little or no modification, however, it is recommended that specific requirements are examined before adopting the scheme discussed in this article.

The naming scheme covered servers, storage, networks, and cables.

The scheme has shown how the service function should be cross referenced to the network, server, and file systems. It has shown how a common reference to a server can be defined, how the exact physical location and service function may be identified, and how the location of storage can be represented and its purpose married to a service and server. It has shown that this task is relatively small when compared to infrastructure installation and configuration activities.

A system has been described to identify the source and destination ports and physical locations of cable connection, and general advice given for a network naming scheme. All information should be documented in HTML and posted on the system administration web server.

In summary, if a name must be provided make it convey meaningful information. This article has demonstrated this concept and also shown that the work involved is not arduous.

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Mark Garner is a Systems Engineer for Enterprise Engineering at Sun Microsystems. Prior to joining Sun, Mark spent three years as a Systems Architect specializing in Email and Office Automation architectures and before this over eight years in systems administration. While at Sun Mark has focused on the design and implementation of mission critical business and Internet application's infrastructure principally to provide for high availability and scalability.