Sun's Vision For Secure Solutions For The Government

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We make the net work.

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Outline

- Security @ Sun
- Thin clients and security
- DARPA HPCS Program at Sun
- Some Sun HPCS technical highlights
- Security in Sun's HPCS Research

Sun Desktop Core Values

1) Reduce Complexity

2) Improve Security

3) Promote Mobility

Core Value #1
Reduce Complexity

- Allow a few system administrators to manage thousands of desktops
- Manage services not desktops
- Reduce desktop productivity licensing by a factor of 10
- Optimize the user environment for the task

Core Value #2
Improve Security

- Centralize data and applications where they can be:
  - Easily backed up,
  - Made redundant,
  - Secured against theft and attack
- Eliminate data theft from insecure PC storage

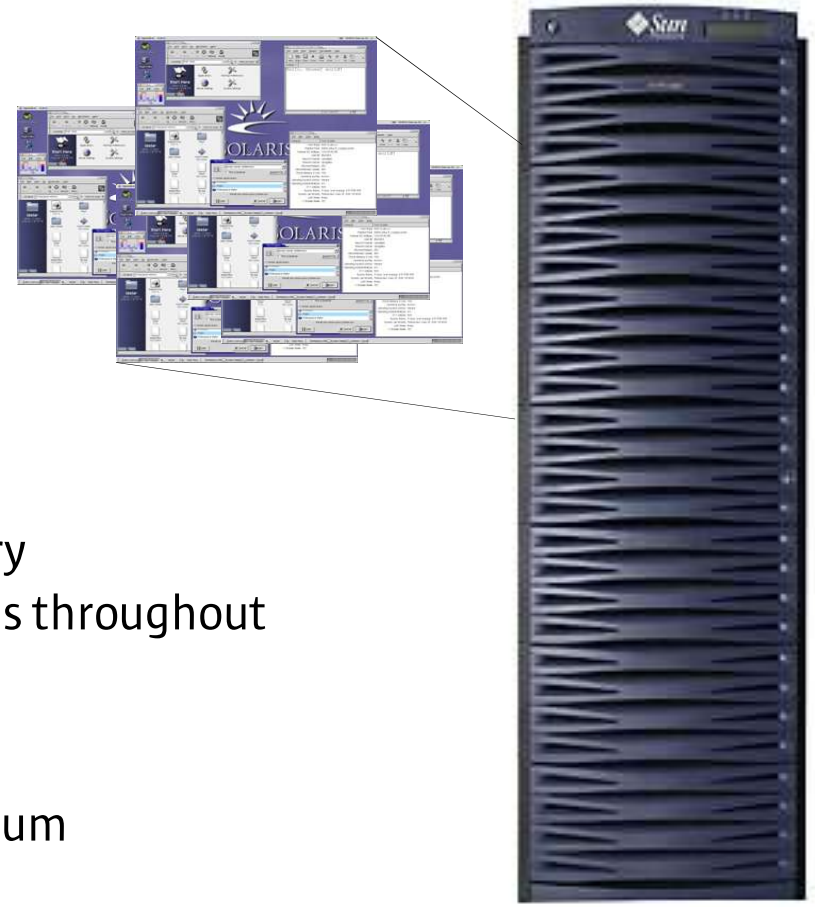
Core Value #3
Promote Mobility

- Work any time from any desktop
- Enable user access of individual computing sessions
  - Exactly where they left off
  - Any desktop via login or Java Card™

- Centralization permits a work from anywhere environment

Sun Ray Mobility

- User's Session
  - Restricted by bandwidth and latency
  - Adaptive Protocol allows for acceptable performance over lower bandwidth/high latency connections
- User's Environment
  - Global LDAP Authentication
  - Dynamically Mount Home Directory
  - “Build” Session w/user preferences throughout Global Enterprise
- User's Tools
  - Deploy Employee Portal for maximum remote connectivity flexibility



Sun Ray™ Equipment Options

Sun Ray 1

1280x1024

"High Resolution" Model Available Fall 2003

1920x1200

Sun Ray 100

1280x1024

17" CRT Integrated

Sun Ray 150

1024x768

15" LCD Integrated

XGA Out for Projector

17" LCD 1280x1024 Coming Soon

- 10/100 Mb Ethernet
- CD-Quality Audio I/O
- Built-In Smart Card Reader
- 4 USB Ports & Energy Star

Sun Ray Software Roadmap

Campus
- SRSS 2.0 (LAN, Encryption)
- LIB USB API
- Solaris Card Framework Middleware API

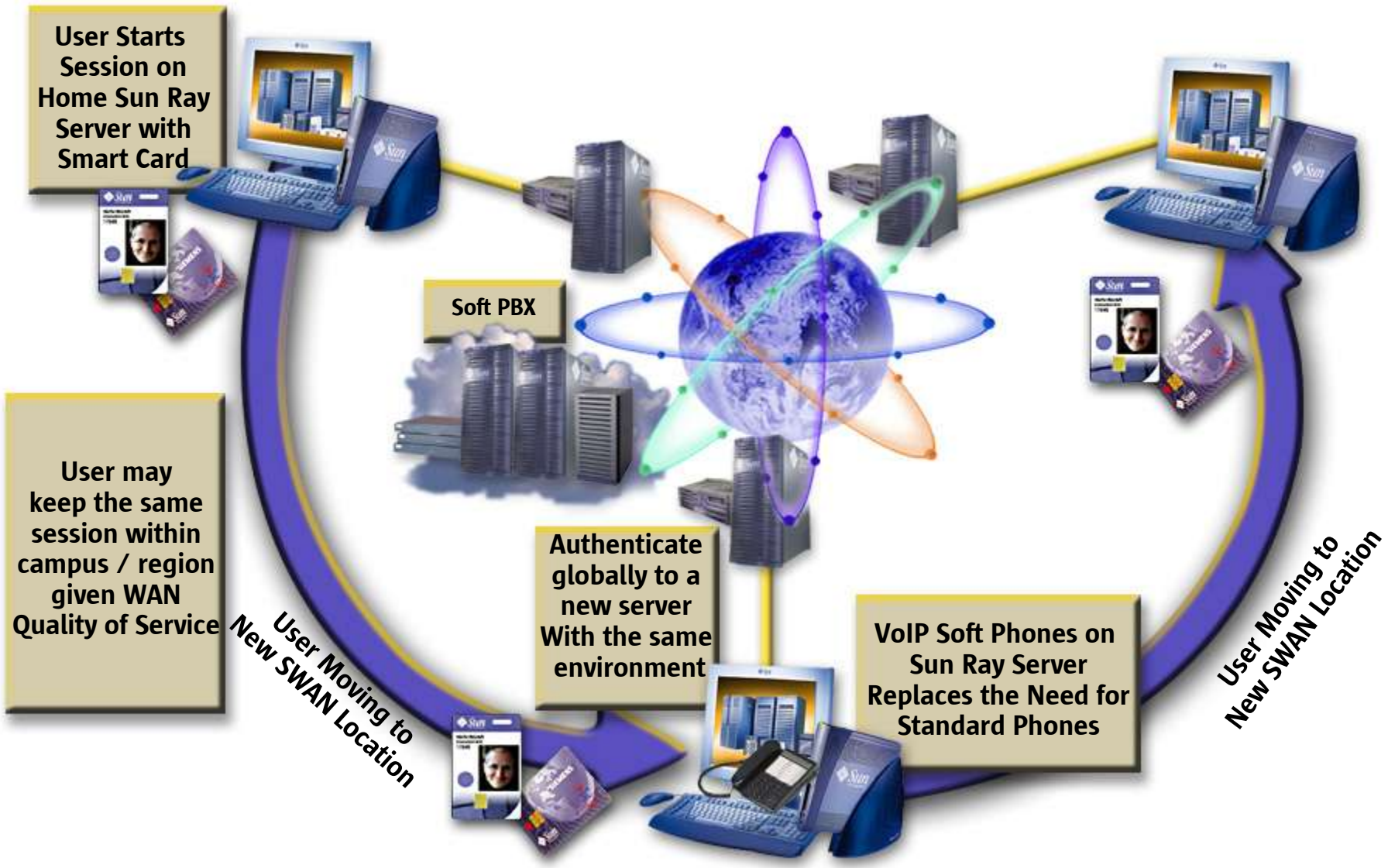
Regional
- Managed Roaming
- Global "Follow Me" Desktop
- Linux Support
- USB Storage

Remote
- Secure cross-platform remote access
- FIPS capable Encryption

SRSS on Linux 1.0

Q1 CY03 | Q3 CY03 | Q1 CY04 | Q3 CY04

Global Persistent Session/Thin Client



Sun Ray Deployment in Sun

Economical, Secure, Powerful

- 27,000 Sun Ray appliances deployed
- Realized $2.8 million in power savings
- 1 System Admins per 2,000 users
- $71 M Savings in Real Estate
- Secure: token authentication+password
  - no viruses

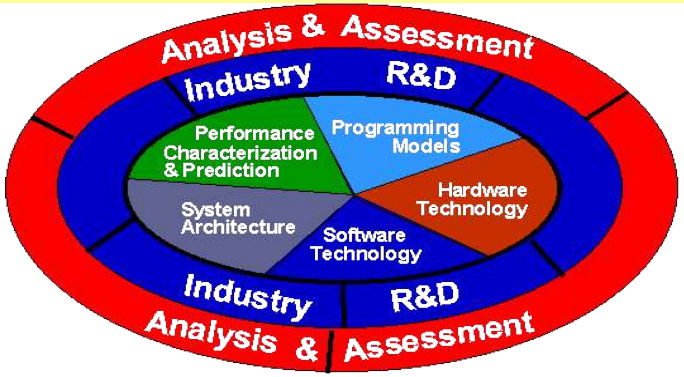
High Productivity Computing Systems

Goal:

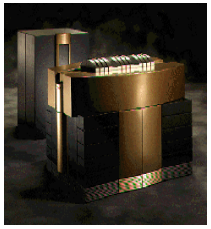
- **Provide a new generation of economically viable high productivity computing systems for the national security and industrial user community (2009 – 2010)**

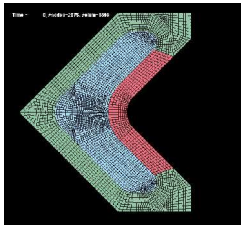
Impact:

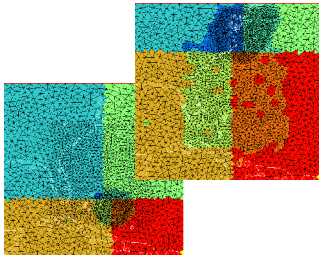
- **Performance** (time-to-solution): speedup critical national security applications by a factor of 10X to 40X
- **Programmability** (idea-to-first-solution): reduce cost and time of developing application solutions
- **Portability** (transparency): insulate research and operational application software from system
- **Robustness** (reliability): apply all known techniques to **protect against outside attacks**, hardware faults, & programming errors



HPCS Program Focus Areas







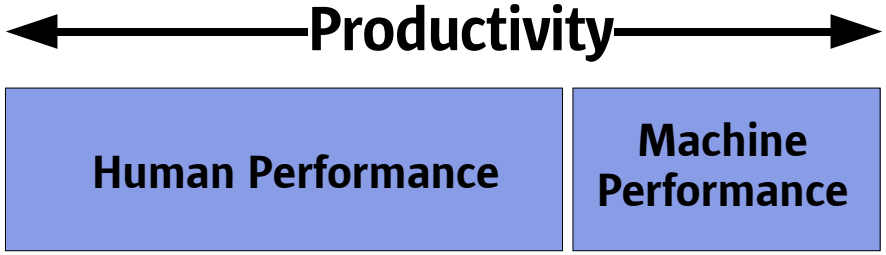
Applications:

- Intelligence/surveillance, reconnaissance, cryptanalysis, weapons analysis, airborne contaminant modeling and biotechnology

Fill the Critical Technology and Capability Gap
Today (late 80's HPC technology).....*to*.....Future (Quantum/Bio Computing)

DARPA HPCS Program at a Glance

- Goals
  - 10x productivity
  - 10x-40x performance
  - Commercial viability



- Phases
  - Phase 1 (2002-2003): Concept formation
  - **Phase 2 (2003-2006): Research risk reduction**
  - Phase 3 (2006-2010): Full scale development

Sun HPCS Technology Goals

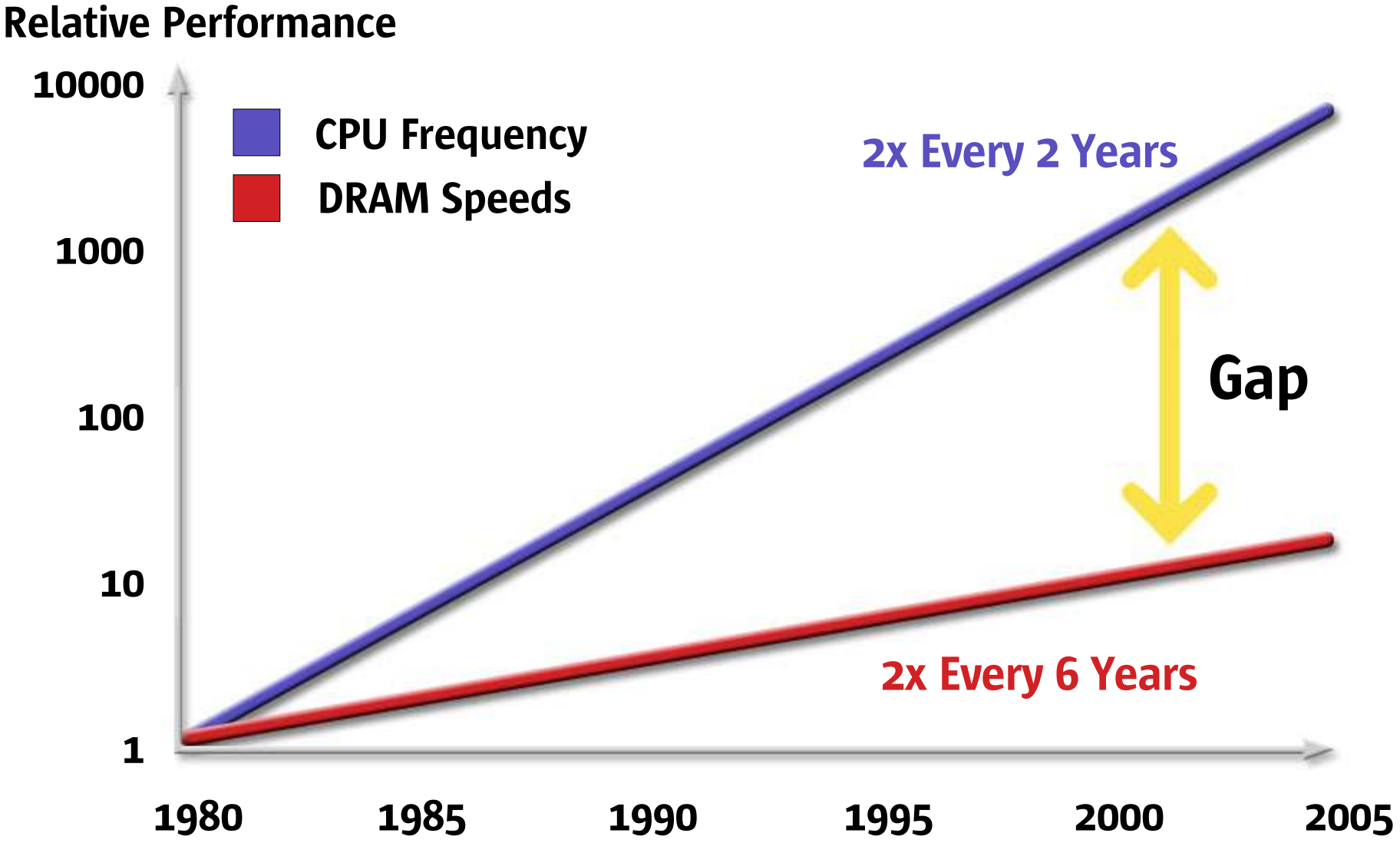
Powerful productivity at an affordable cost

- Peta-scale computing (10x performance) accessible to the individual research scientist
- Breakaway productivity enhancements (10x) for programmer, administrator, and owner
- System-wide optimization
- Portability with Security
- Commercial viability to meet needs of technical and commercial markets

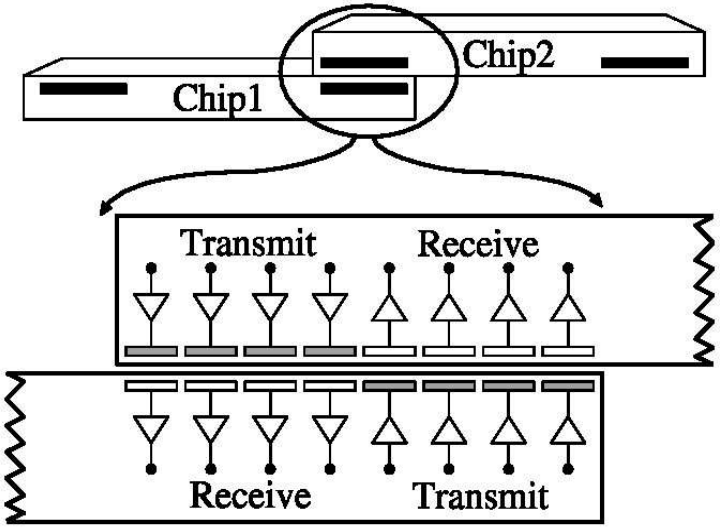
Hardware Philosophy

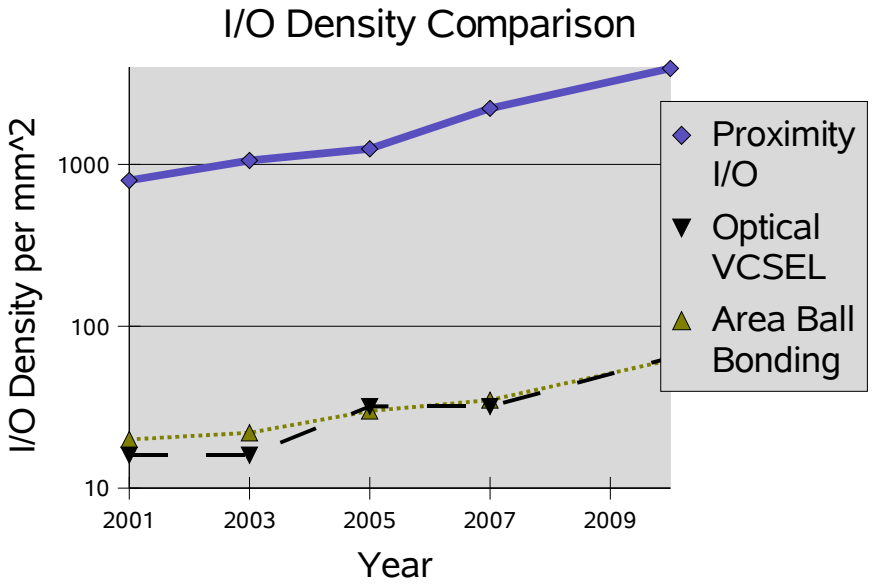
- First-order constraints: size, power/heat, cost.
- Reduce size to reduce latency.
  - Speeds: 0.6c in fiber, 0.04c on chip (2007)
- Modular design allows greatly reduced cost.
- Reducing size reduces cost of bandwidth, also.
- Make every watt count.

Memory Bottleneck



Proximity Communication





Bandwidth Burns Energy

Operation	Energy (130 nm, 1.2 V)
32-bit ALU operation	5 pJ
32-bit register read	10 pJ
Read 32 bits from 8K RAM	50 pJ
Move 32 bits across 10 mm chip	100 pJ
Move 32 bits off chip	1300 to 1900 pJ
Move 32 bits chip to chip with PI	48 pJ

[source: Bill Dally, Stanford; Sun]

Proximity Communication Implications

- Sun has demonstrated inter-chip communication based on capacitance
- Order-of-magnitude improvements in density, power, latency, bandwidth, cost
- Like wafer-scale integration, but with high yield and freedom to mix process types

Sun HPCS Hardware Characteristics (1 of 2)

- Sun's HPCS hardware design is called Hero
- A petaFlop-scale machine
  - Myriads of processor and memory elements
  - Proximity interconnect supports a directly addressable global memory address space
    - It will be reasonable to allocate shared arrays that each occupy many terabytes

Sun HPCS Hardware Characteristics

(2 of 2)

- Each processor element executes multiple hardware threads
  - Hero will have hundreds of thousands of hardware thread execution units
- The processors will have caches
  - Software plus hardware support will maintain a suitable level of coherence

Microkernel

- Microkernel
  - manage address mapping, thread dispatch, etc
  - minimize internal state (ideally zero)
  - intimate with hardware mechanisms
- Protection & Memory Mapping
- Threads and Inter-Process Communication
- Companion processors
  - I/O
  - hooks for extended OS & user-level services

Portable Intermediate Language

- Connect Static Compilers & Dynamic Runtime
- Express high-level computational model
- Relegate architecture-specific constructs to RTE
- Shift tuning burden to system instead of programmer
- Incorporate feedback from tuning and testing
- Support legacy software (languages, codes, and parallel models) fully

Run-Time Executive (RTE)

- Productivity enhancements
  - Dynamic compilation/optimization
  - Parallelization enhancements
- Program execution
  - Process/thread creation/mapping/scheduling
  - Drives microkernel mechanisms
  - Memory and other resource allocation
- Fault Tolerance/Insulation
  - Security
  - Fault Insulation
  - Failure Recovery

Security in Hero

- Application isolation via Virtual Machine and normal OS and HW mechanisms
- I/O Subsystem
  - Networking
  - Storage
- Real-time encryption/decryption
  - Keeps pace with network and storage
  - Nothing ever in the clear outside a Hero machine
- Visualization
  - Fat clients: easy for Hero
  - Thin clients: Hero is a tremendous graphics engine

For more information:

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We make the net work.