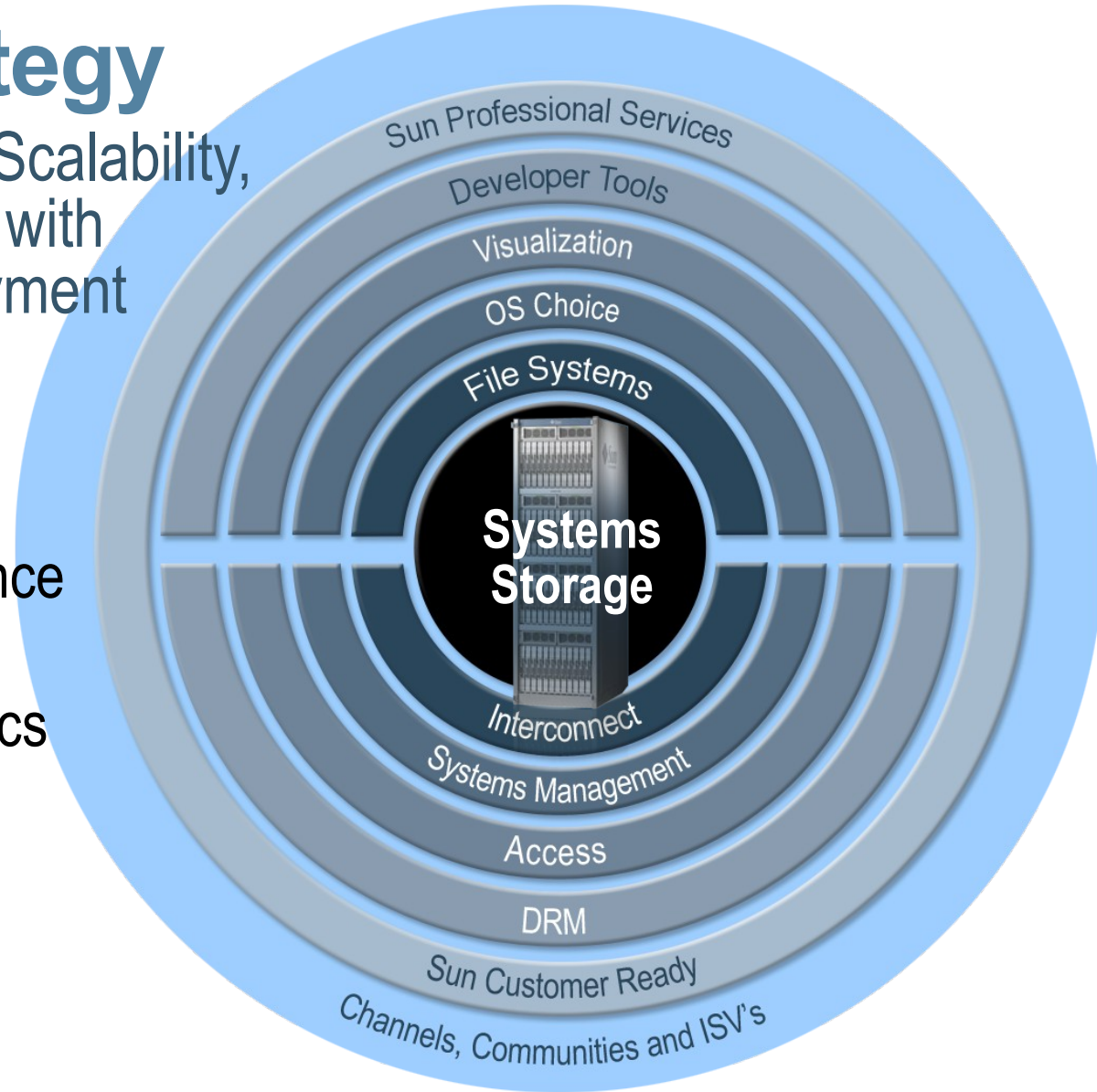# HIGH PERFORMANCE COMPUTING FROM SUN

Paulo Vilela

Sun Microsystems Portugal

Our HPC Strategy

Offering: Performance, Scalability, Capacity and Efficiency with Rapid, Low Risk Deployment

- Easy to deploy

- Un-matched performance and scalability

- New levels of economics

- Offers unprecedented choice and flexibility

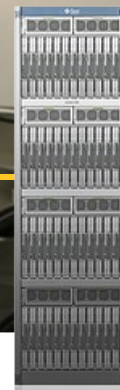Sun Professional Services

Developer Tools

Visualization

OS Choice

File Systems

Systems Storage

Interconnect

Systems Management

Access

DRM

Sun Customer Ready

Channels, Communities and ISV's

TACC

Sun Fire X4500
- 72 Systems
- 1.7 petabytes
- 64.8 GB/sec total bandwidth

Sun Fire X4600
- 25 systems
- 800 cores

SunBlade 6048
- 3,936 blades
- 15,744K CPUs
- 62,976 cores
- 125 TB/RAM

Sun Data Center Switch 3456
- Dual redundant
- 110 TB/sec bisectional bandwidth

- The world's 4th largest compute cluster. Based on Sun Constellation System
- 326 Tflops peak performance
- Sun is the sole hardware supplier

Sun is Leading the Way with the Sun Constellation System
The World's Largest & Most Scalable General Purpose Computer

- New levels of performance and scalability
  - Up to 2 PetaFLOPs
  - Up to 1.8 PetaBytes RAM
  - Up to 0.7 ExaBytes disk

- Open industry standards
  - Linux, Solaris, OpenMPI, open InfiniBand interfaces and management
  - X64 computing architecture
  - InfiniBand DDR interconnect

- New levels of efficiency
  - Provides a 6:1 reduction in physical ports and cables
  - 20% smaller footprint than competition
  - Eliminates 100s of discrete switching elements

- New levels of reliability
  - Dramatically reduced complexity: 6x fewer cables, up to 50% fewer racks
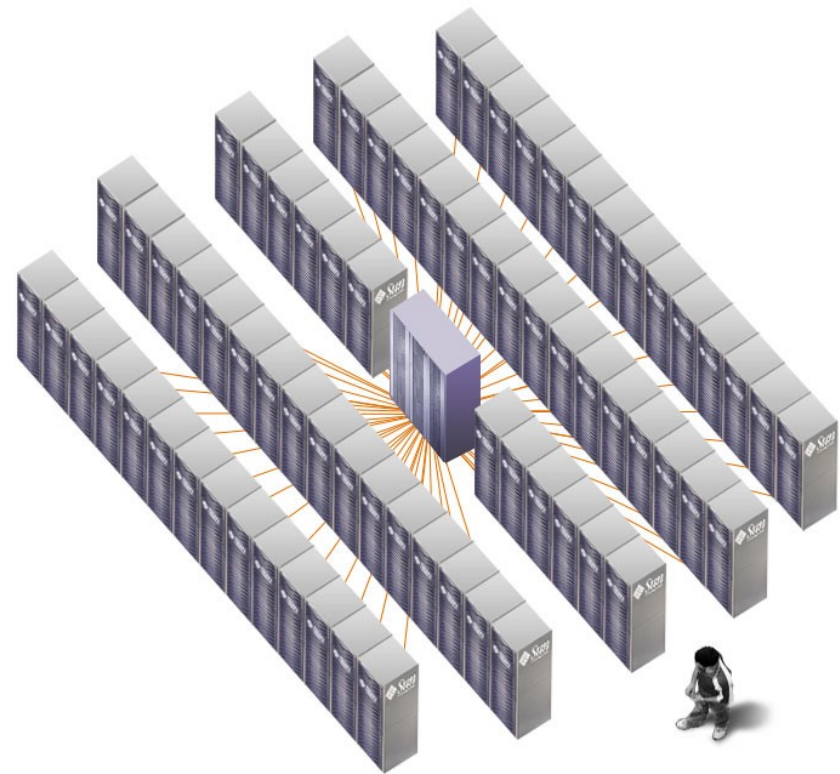
Massive Scaling, Performance and Reduced Complexity

AMD, Intel or SPARC CPU's

Single Blade	Sun Blade 6000	Single Rack 768 Cores 7 TFLOPS Peak	4 Core Switches 13,824 Servers 2 PFLOPS Peak
10 x Scaling	**4.8 x Scaling**	**288 x Scaling**	

The Sun Cluster Portfolio

Open, Seamless and Comprehensive

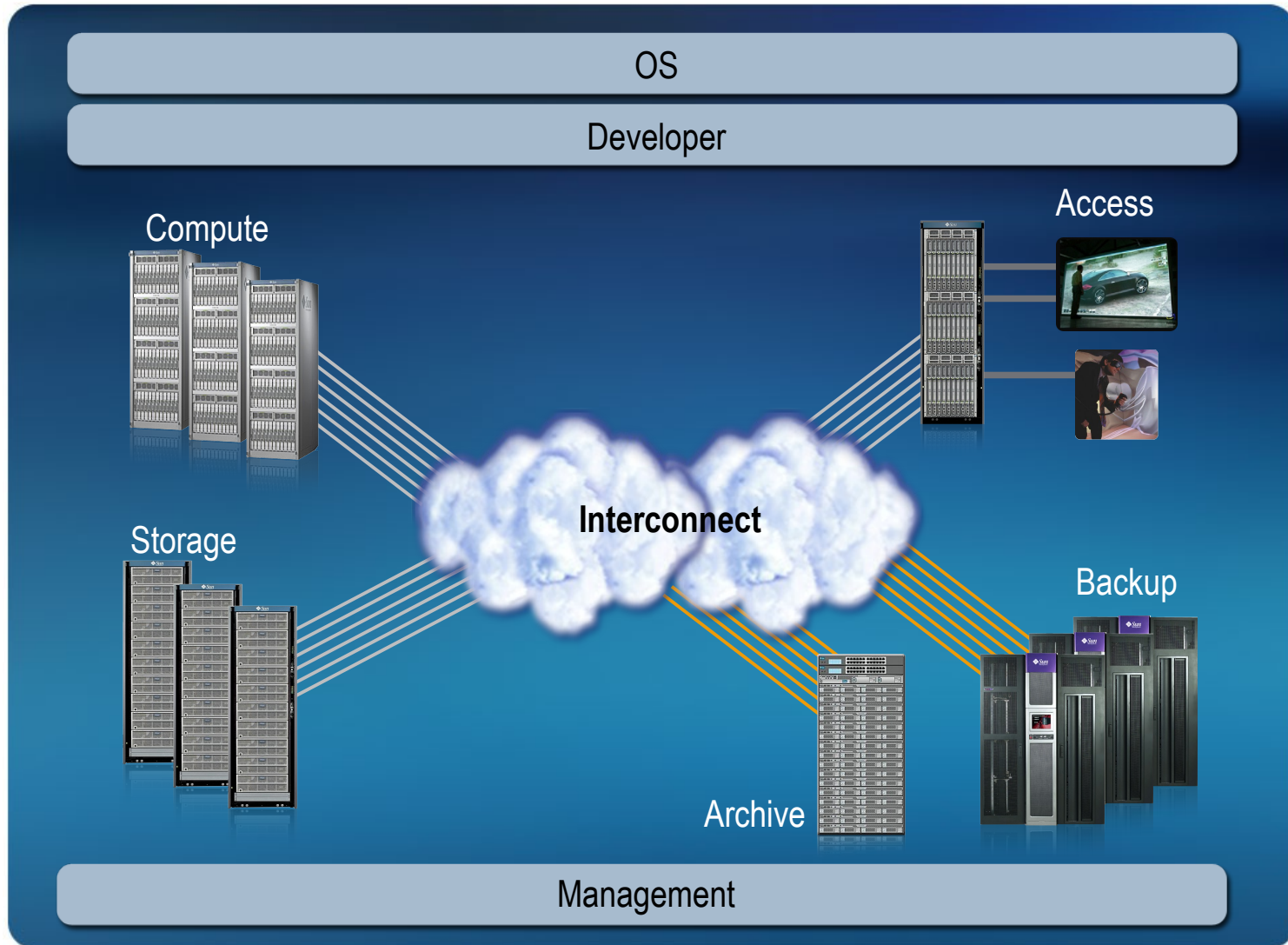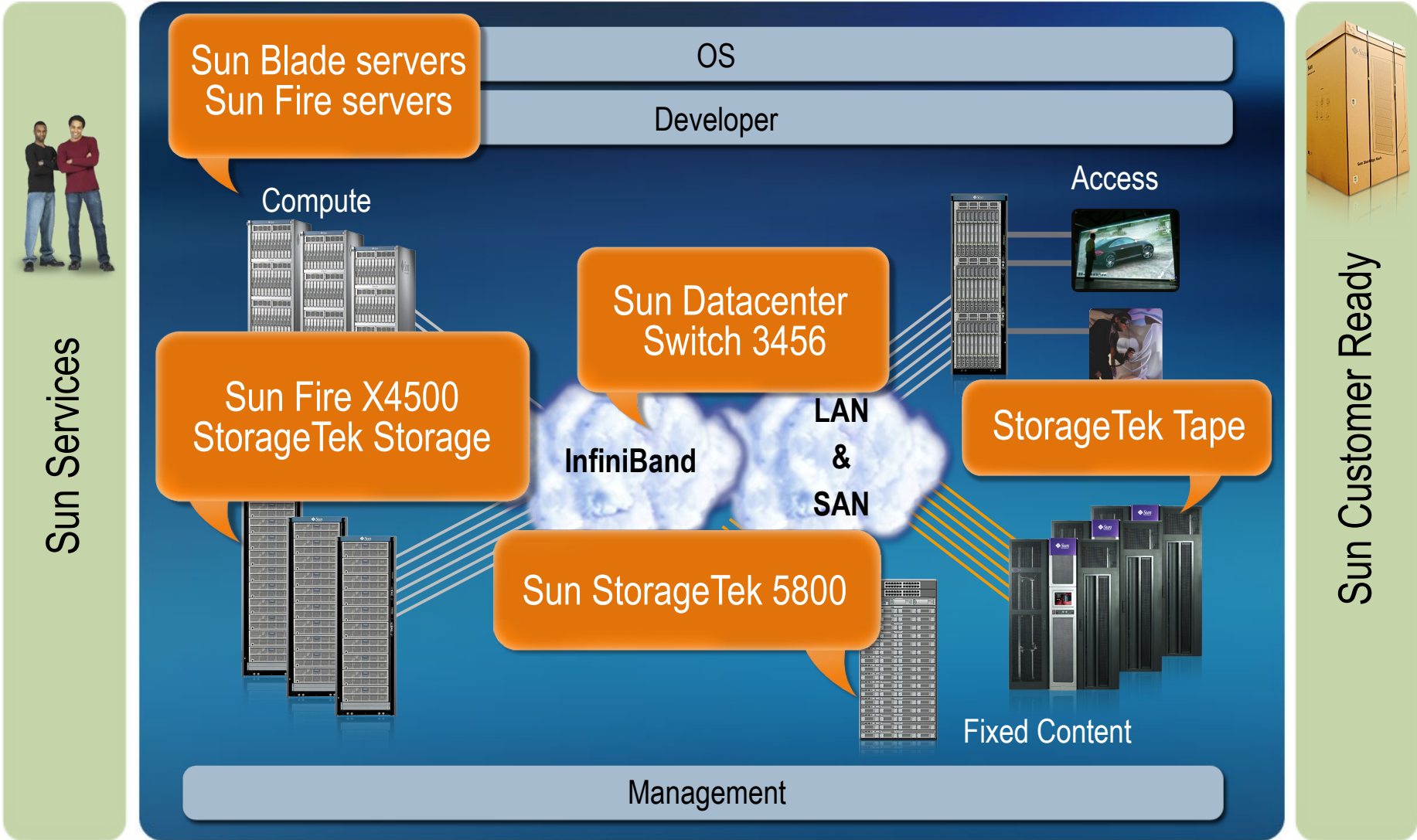| Access	Developer	Manage-ment	OS	Inter-connect	Storage/Archive	Systems
Visualization, Workstation, Thin Clients, Remote Access	Compilers, Debuggers, Optimization Tools, Libraries	Workload, Systems and Cluster Management	Linux, Solaris	InfiniBand or Ethernet	Cluster Storage, Backup, Archive, File Systems, HSM	Racks or Blades Variety of CPU Architectures

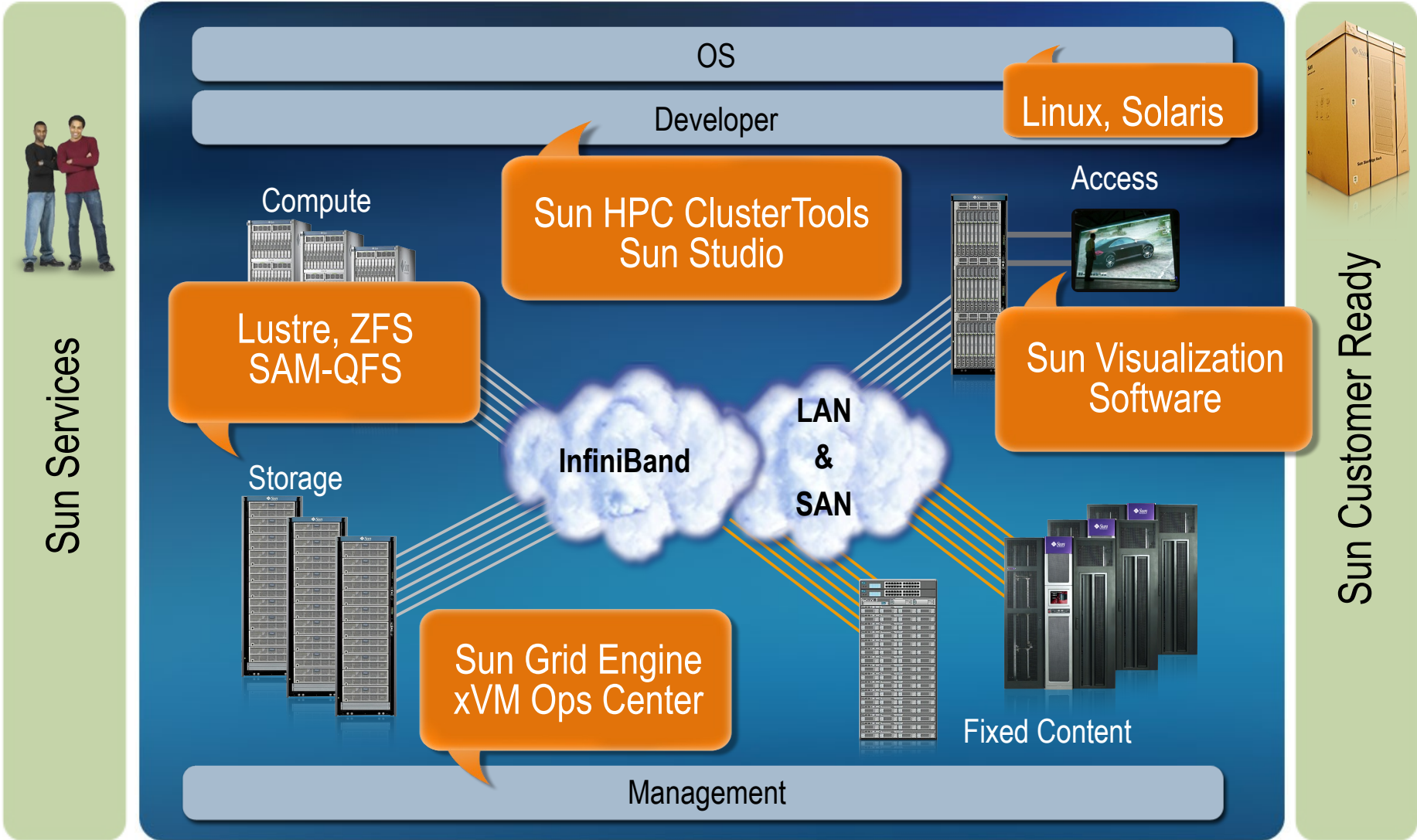**Sun Services**   **Storage**   **Compute**   **Sun Customer Ready**

Networking

The Sun HPC Cluster Platform

The Sun HPC Cluster Platform

The Sun HPC Cluster Platform

Sun Services

Sun Customer Ready

OS

Developer

Linux, Solaris

Compute

Access

Sun HPC ClusterTools
Sun Studio

Lustre, ZFS
SAM-QFS

Sun Visualization
Software

Storage

InfiniBand

LAN
&
SAN

Sun Grid Engine
xVM Ops Center

Fixed Content

Management

Sun Constellation System Open Petascale Architecture

Radical Simplicity, Faster time to Deployment

Competitors Compute Clusters

Racks

Competitors Cabling Infrastructure

Leaf Switches

Core Switches
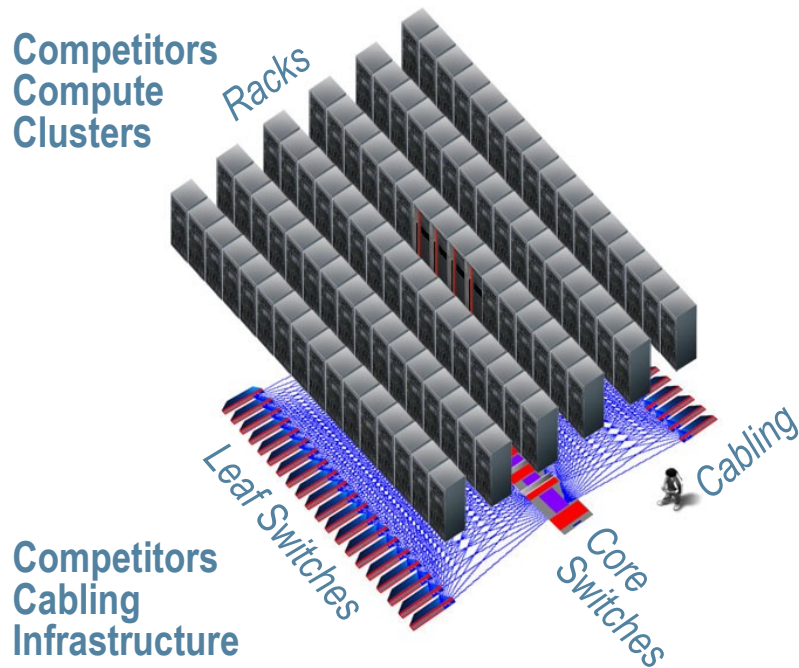
Cabling

Alternative Open Standards Fabric

- 300 switching elements
- 6912 cables
- 92 racks

Sun Constellation System Cluster
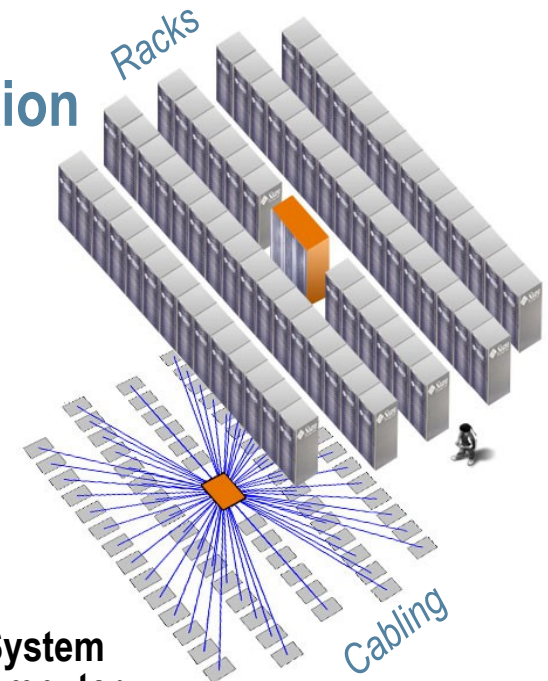
Racks

Reduced Cabling

Cabling

Constellation System Open Super Computer

- 1 switching element **300:1 reduction**
- 1152 cables **6:1 reduction**
- 74 racks **20% smaller footprint**

HPC Clusters Arrive Ready to Run

Your Choice of Sun and 3rd Party Hardware and Software

Hardware Racked and Cabled

Software Installed and Configured

Sun Customer Ready Program
Deliver "Ready-to-Deploy" HPC Systems
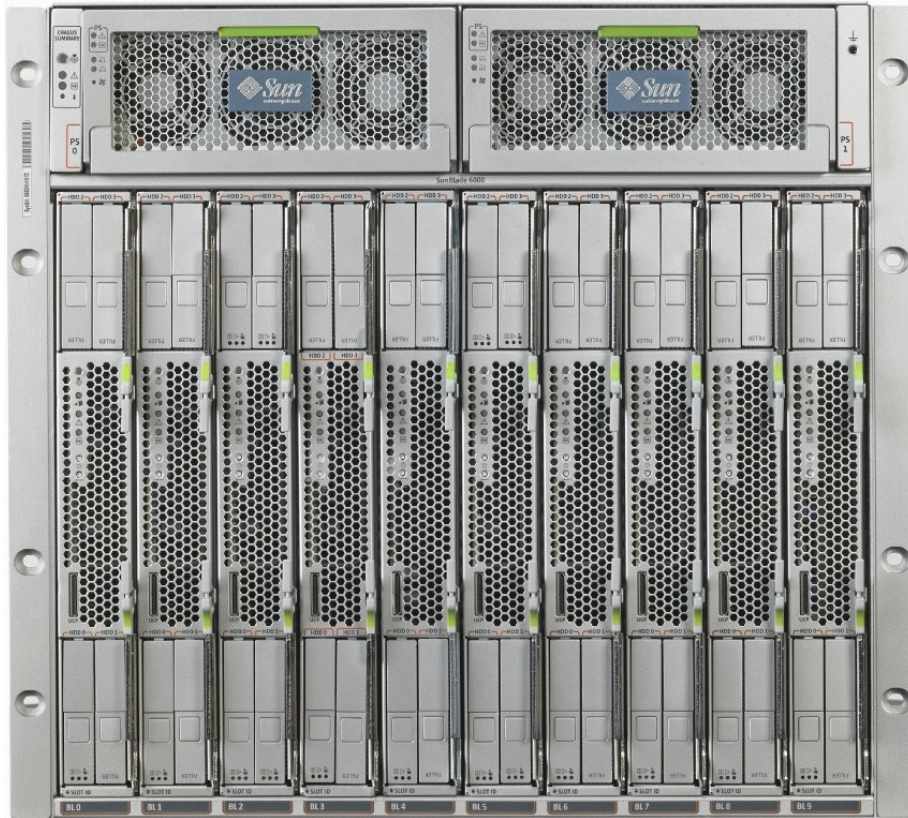
Agile Development

- Up to 90% faster
- Tools to tailor to specific needs
- You concentrate on your core business

Higher Quality, Lower Risk

- Up to 80% less installation issues
- Integration and testing in the factory
- Uses Sun's ISO9000 certified manufacturing processes

Sun Blade 6000 Modular System

10 Server Module Capacity

Compute
- 10 Server Modules

I/O
- 1.42Tb/s I/O per Chassis
- 20 Ho1t-Plug PCIe ExpressModules$^{(TM)}$ for granular blade I/O configuration
- 2 PCIe Network Express Modules$^{(TM)}$ for multi blade I/O configuration

Availability
- Hot Swap fans
- Hot Swap power supplies
- Redundant power grid connection capability

Management
- SNMP, SSH, CLI

Form Factor
- **10 Rack Units**
  - **40 Opteron Cores**
  - **80 Intel Cores**
  - **80 SPARC cores**

Chassis – Rear View

- 20 x PCI Express ExpressModules
  - > Two per Server Module
- 2 x PCI Express Network Express Modules (NEM)
- 1 x Chassis Monitoring Module
- Cooling Fans
  - > 6 x Rear Fan Modules
  - > Hot-Swap
  - > Redundant (N+1)
- 4 x power inlets with cable holders
  - > Two inlets per power supply
  - > Cable holders prevent accidental loss of power
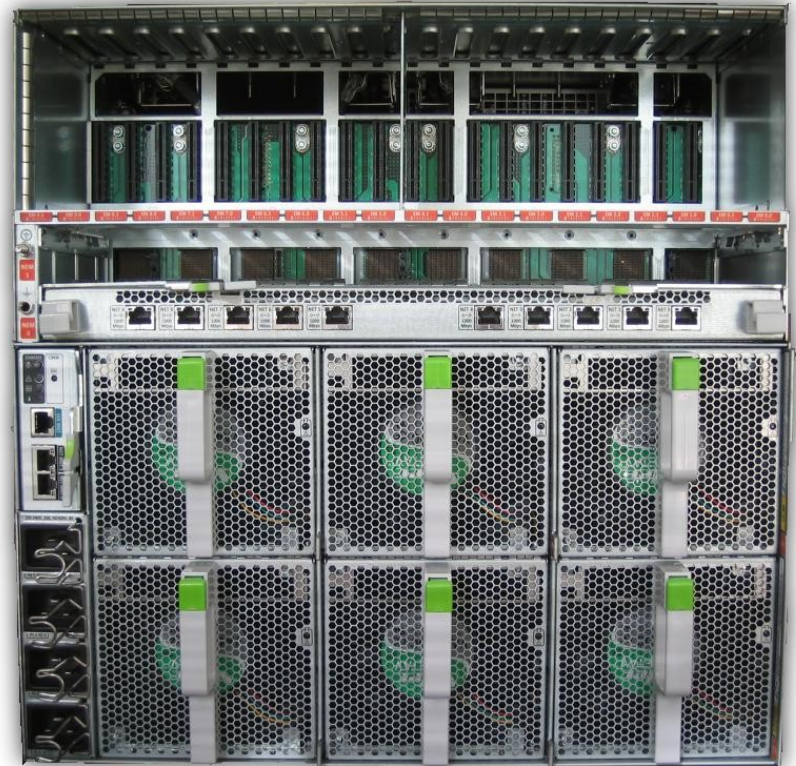
Chassis – Air Flow

- Air flow in the chassis is front to rear

- Two separate air flows
    - > One is powered by the Front Fan Modules within the Power Supplies
    - > Second is powered by the Rear Fan Modules which cools the Server Modules
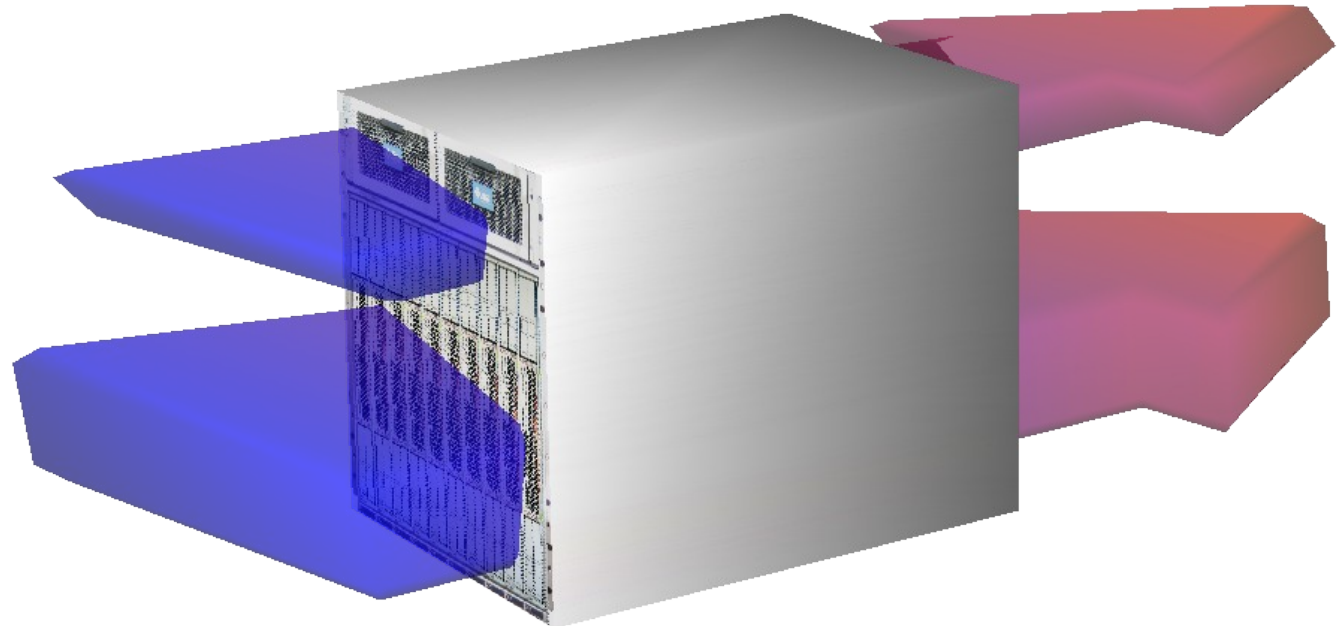
Sun Blade 6048 Modular System

- The first blade platform designed for extreme density and performance
  - > 7 TFLOPS, 768 cores per chassis/42U
    - — 50% more compute power than HP C-Class
    - — 71% more compute power than IBM BladeCenterH
  - > 4 InfiniBand Leaf Switch Network Express Modules
    - — Lowest cost per port with ultra-dense switch solution
- Pay as you grow platform ideal for fast growing businesses
  - > Choose among SPARC, AMD Opteron and Intel Xeon CPU technologies
- Runs general purpose software
  - > Custom compiles and tuning are not required
- Realize economies of scale savings in power and cooling

Massive Horizontal Scale

Sun Blade 6048 Chassis

Compute

- 4 x Shelves per chassis
- 48 x Sun Blade 6000 series server modules
  - Sun UltraSPARC
  - Intel Xeon
  - AMD Opteron

I/O

- 96x Hot-Plug PCIe ExpressModules
- 8x Hot-Plug PCIe Network Express Modules
  - 12 1xGbit Ethernet connections per NEM

Availability

- Hot swap redundant fans
  - Eight Rear Fan modules per shelf
  - Two Front Fan Modules per shelf
- Hot swap power supply modules
  - Two 9000 W power supplies per shelf
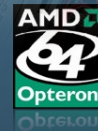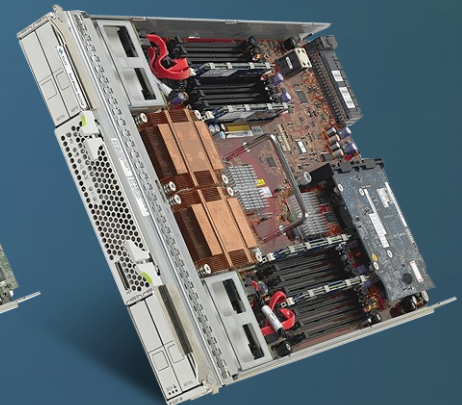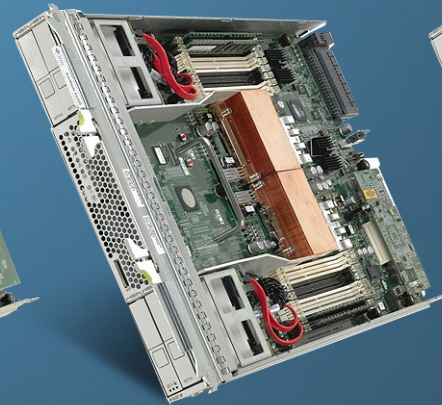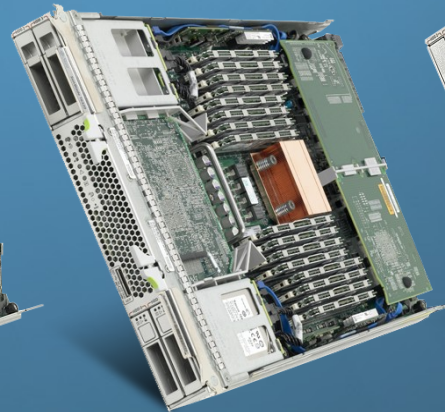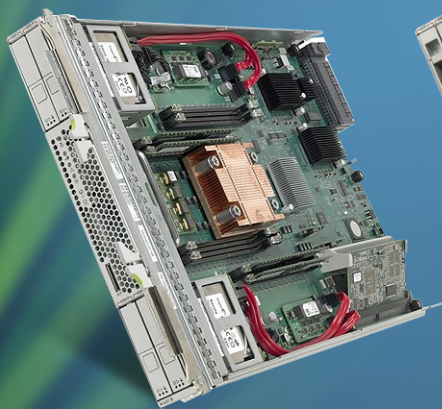- Total of 8 power supplies per chassis

Management

- 4 x Chassis Monitoring Modules
- Solaris, Linux, or Windows OS, VMware

Density

- **48 Servers**
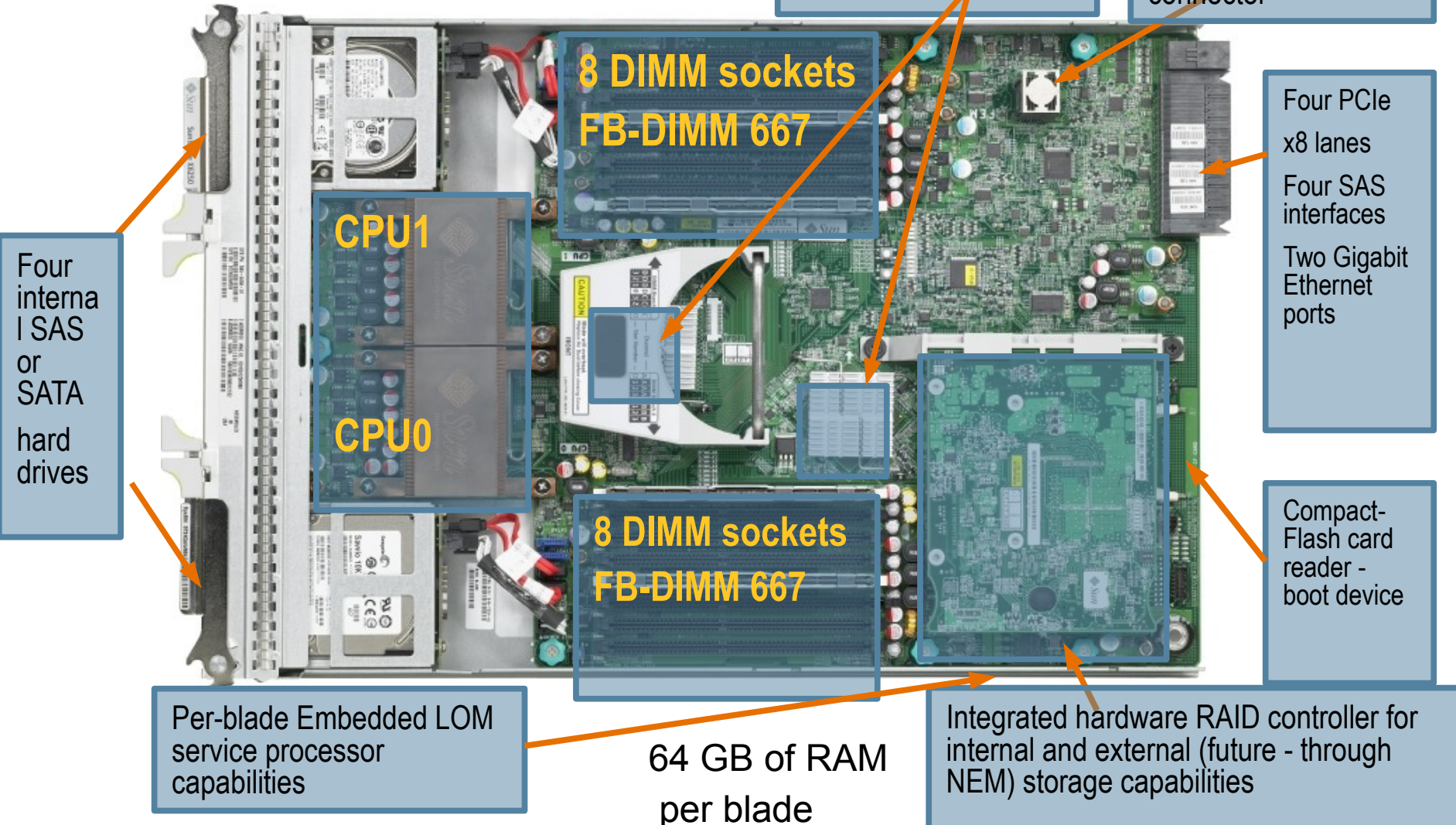- **192 Sockets / 768 cores**

Versatile Blade Portfolio

ULTRASPARC

AMD 64 Opteron

(intel)

Sun Blade T6300

Sun Blade T6320

Sun Blade X6220

Sun Blade X6250
Sun Blade X6450

Sun Blade X6250 Server Module Device Map

Northbridge and PCI-E expansion HUB

Fabric Expansion Module (FEM) connector

8 DIMM sockets FB-DIMM 667

Four PCIe x8 lanes

Four SAS interfaces

Two Gigabit Ethernet ports

CPU1

CPU0

Four internal SAS or SATA hard drives

8 DIMM sockets FB-DIMM 667

Compact-Flash card reader - boot device

Per-blade Embedded LOM service processor capabilities

64 GB of RAM per blade

Integrated hardware RAID controller for internal and external (future - through NEM) storage capabilities

Sun Blade X6450 Server Module

24 FB-DIMM slots. Up to 96 GB of RAM

FEM connector

Four PCIe interfaces, four SAS links and two 1GbEth ports
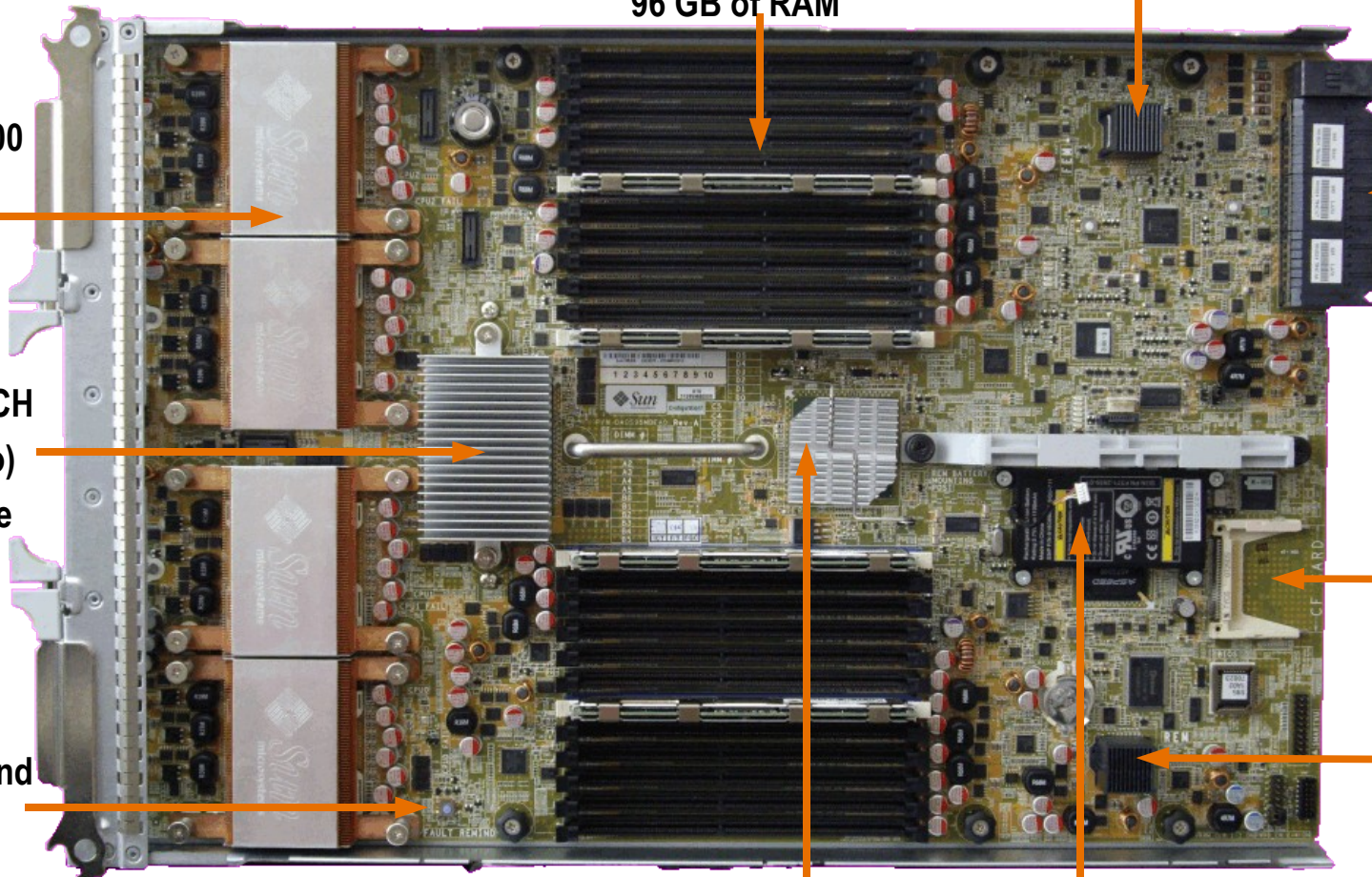
Four Intel 7000 processors. Dual or quad-core.

Intel 7000 MCH (Clarksboro) Northbridge
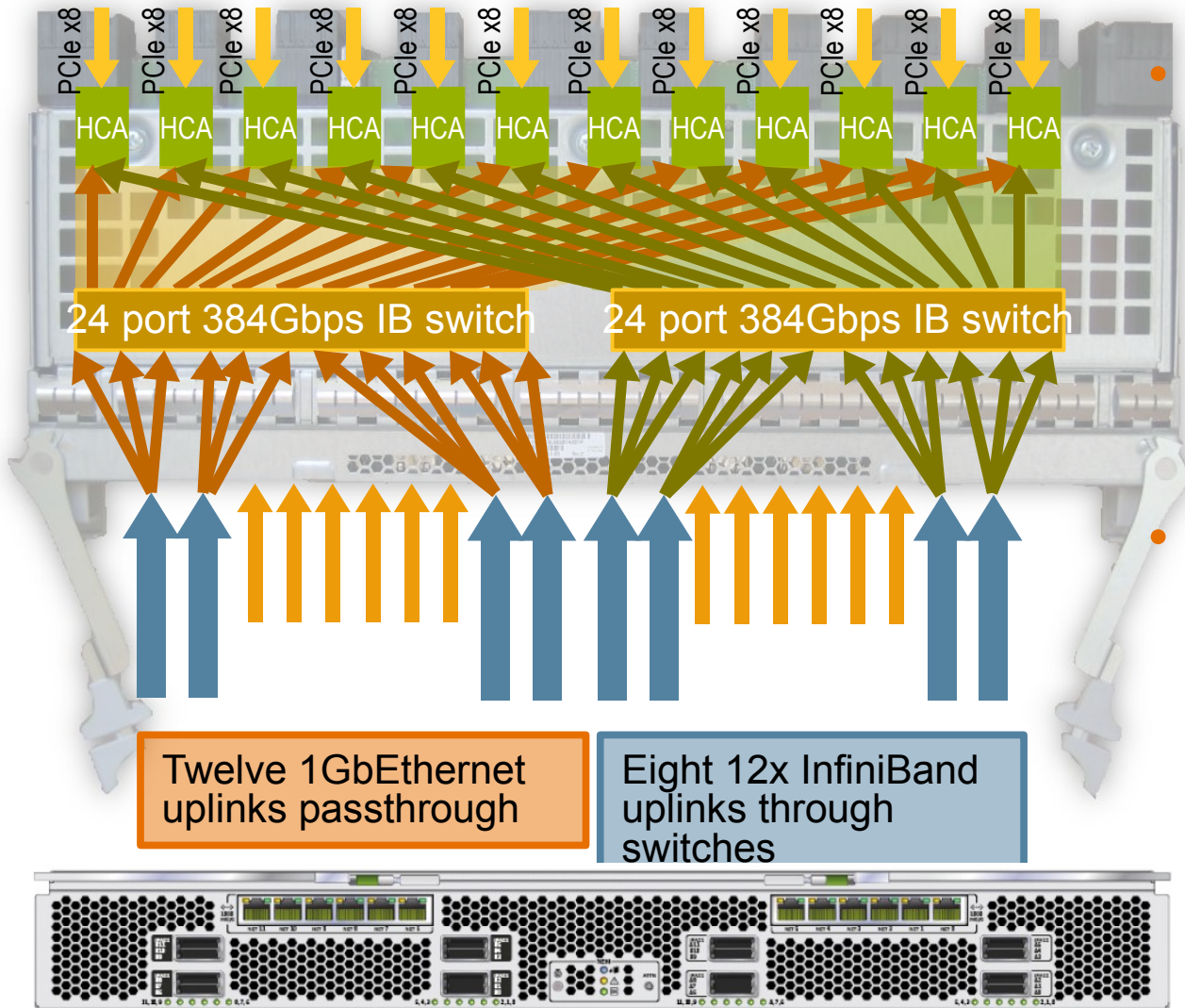
Compact Flash Storage

REM connector

Fault remind button

ESB2 I/O bridge

Battery location for the REM

Sun Blade 6048 InfiniBand switched NEM
Double width NEM – takes up both slots of a shelf

PCIe x8 (×12)

HCA (×12)

24 port 384Gbps IB switch   24 port 384Gbps IB switch

Twelve 1GbEthernet uplinks passthrough

Eight 12x InfiniBand uplinks through switches

- Twelve dual port Host Channel Adapters (HCA)
  > Two 4x InfiniBand uplinks per server module

- Two 24 port InfiniBand switches
  > 12 x4 ports used for the HCA connection
  > 4 x12 ports used for the uplink

Sun Customer Ready HPC Cluster

Clusters Made Simpler

- Sun™ Customer Ready HPC Cluster
  - > Designed specifically for science, engineering and compute intensive applications
  - > Choice of: Sun servers/blades based on AMD or Intel processors,Gigabit Ethernet or InfiniBand, the Solaris 10 OS, or Linux. Optional Sun xVM and Sun Grid Engine software
  - > Web-based configurator tool available

- Sun™ Customer Ready HPC Cluster for Crash Analysis
  - > Ideal for computer-aided engineering crash analysis applications
  - > Sun Fire rackmount servers, the Solaris 10 OS
  - > Reference configurations as starting points

Sun Datacenter Switch 3456
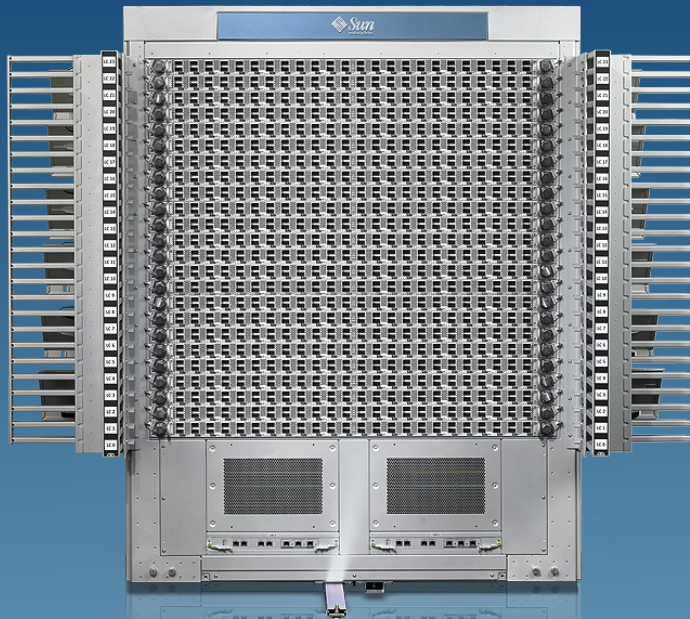
- Unique in the industry
- 12x Capacity of largest IB switch available today
- 6x Reduction in Cables, Space and Weight
- 300:1 Switch Reduction

The World's First Petascale Single Chassis Switch

Sun Visualization System
Scalable, Sharable and Secure

- Virtualizing graphics resources
- Massive scale in compute density and Display resolution
- Share across multiple users with different devices
- Data is secured on central server

Scalable Clustered Storage
Sun Fire X4500 Server

- Industry's first data server
- Best server data throughput and storage density
- Runs Lustre parallel file system
- Standard platform and common systems management capabilities

Sun Modular Data Center

The Virtualized Datacenter

High Capacity

- 820 CPU's, 3,280 Cores
  - > Sun Blade 6000 systems and Sun Fire X2200 servers

- 2,240 cores and 17,920 compute threads!
  - > UltraSPARC T2 servers

- 3 petabytes of disk
  - > Sun Fire X4500 servers

High Performance

- 31 Teraflops Peak
  - > 210 Sun Blade 6000 nodes

- ~170,000 web ops/sec
  - > 78 x Sun Fire T2000 servers

Current Deployments

Stanford Linear Accelerator Center (SLAC) High Performance Computing Node

Sun HPC Grid - Menlo Park, CA

Sun HPC Resources

On-Demand Computing

Visit: network.com access compute cycles and applications over the network

Developers

Visit:
http://opensolaris.org/os/community/mmunity/hpcdev
Join the opensolaris HPC community. Download the latest opensolaris HPC distro

Radio HPC

Subscribe via iTunes and get regular updates on HPC technology from Sun and our partners

Website

Visit: sun.com/hpc
Read the latest news, view the latest offers, download the latest white papers and more
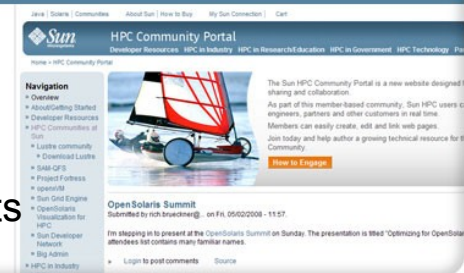
Watercooler

Visit the HPC Watercooler at: blogs.sun.com/hpc and get the latest HPC news from around the globe

HPC Community

Join the online HPC community at: hpc.sun.com and collaborate with Sun engineers and experts

HIGH PERFORMANCE COMPUTING FROM SUN.

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