Meet the HP Integrity Superdome

A white paper from HP

In the HP server product family, it is the high-end HP Integrity Superdome that supports Intel® Itanium® 2 processors with up to 9 MB of L3 cache and HP mx2 Dual-Processor Modules consisting of two Intel Itanium 2 processors. While HP 9000 Superdome servers with PA-RISC processors will continue to support HP-UX, HP Integrity Superdome servers with Intel Itanium 2 processors will run HP-UX, Windows®, and Linux® operating environments. OpenVMS is planned for qualification on the Superdome platform in 1H 2006. This flexibility allows customers to address a variety of needs with the same system, thus reducing support and management costs. The HP Integrity Superdome is designed to deliver the performance, availability, capacity, security, and manageability needed for a variety of applications, from mission-critical to compute-intensive. In this white paper, you'll learn about the architecture, system software, and management tools of the new HP Integrity Superdome based on the HP Super-Scalable Processor Chipset sx1000.

The sx1000 Chipset supports the Intel Itanium 2 processor, the HP mx2 Dual-Processor Module, and the PA-RISC PA-8800 and future PA-8900 processors. It provides higher CPU and memory bandwidth as well as greater memory capacity than the PA-8700+ based HP 9000 Superdome. Fast, low-level error correction further enhances the overall availability of systems that implement it.

With the introduction of the mx2 Dual-Processor Module, the sx1000 Chipset can support two Intel Itanium 2 processors with a large 32 MB of shared L4 cache in the same cell board socket that is used for a single Itanium 2 9M or Itanium 2 6M processor. This HP innovation offers up to twice the performance density of the previous HP Integrity Superdome servers.

The HP enterprise servers product line

First, let's look at the overall HP server products lineup. These servers address the major computing challenges that customers face today. They are especially suited to the demands of a variety of applications across HP-UX, Windows, Linux, and OpenVMS.

HP-UX 11i version 2
Running HP-UX 11i v2 on the HP Integrity Superdome is ideal for enterprise resource planning (ERP), customer relationship management (CRM), technical computing, system consolidation, data warehousing, and billing/financial/order processing.

Windows Server 2003, Datacenter Edition for Itanium-based systems
Running Windows Server 2003, Datacenter Edition on the HP Integrity Superdome is ideal for large, scalable enterprise-class databases as well as database consolidation, such as Microsoft® SQL Server 2000 (64-bit) and Oracle® 10g. Using these large databases in conjunction with supply-chain management (SCM) and ERP is also a common customer usage.

Linux
Running Linux on the HP Integrity Superdome is ideal for large databases, application development, Java™ applications, secure Web serving, and ERP. On the HP Integrity Superdome, both Red Hat Enterprise Linux Advanced Server 3 and SUSE LINUX Enterprise Server 9 are supported. In the rest of this paper, these two Linux releases will be collectively referred to as Linux.

OpenVMS
Starting in 1H 2006, running OpenVMS on the HP Integrity Superdome will be an ideal upgrade path for existing OpenVMS environments that require additional performance, scalability, and flexibility and would benefit from an industry-standards-based platform. This is an excellent solution for financial services, telecommunications, manufacturing, healthcare, and government applications. In addition to employing this platform for new OpenVMS projects, integrating HP Integrity servers into an existing OpenVMS environment can be as straightforward as adding a new node to the cluster.

As shown in Figure 1, the HP server product line is extremely comprehensive, with products ranging from entry-level to high-end. And now, the HP 9000 Superdome continues its strong market presence by offering upgrades to HP Integrity Superdome with even more computing power, support for multiple operating systems, and other new capabilities.

Figure 1. The HP server family
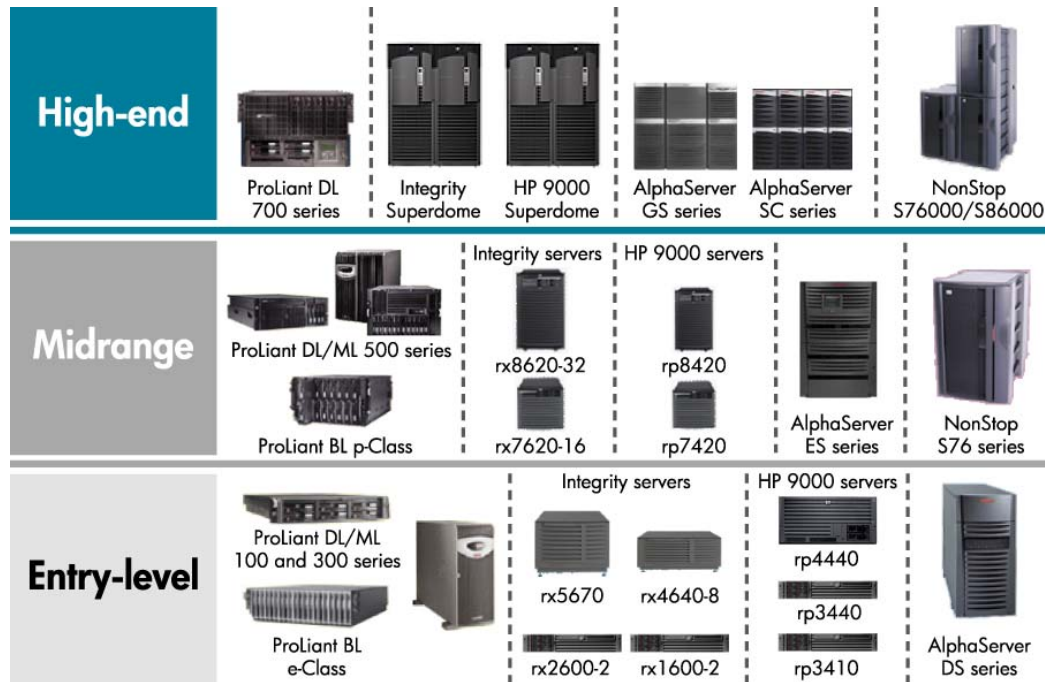
The HP server product line available today represents a robust, scalable range of computing. These systems feature the following:

- **Application compatibility and portability** across the product line, permitting users to select the best platform at the appropriate price point without worrying about whether applications will run on it
- **Fast uniprocessor performance**, providing reduced time to solution through parallelism and increased throughput through multiprocessing in all supported environments
- **Outstanding scalability** by providing the best price/performance over the entire range of products and protecting customers' investments in hardware and software
- **A consistent programming model**, presenting the same application programming environment regardless of the systems' performance levels; this greatly increases the number of available "off-the-shelf" third-party applications and reduces porting and development costs
- **Leading-edge utility pricing models** (Pay per use, Instant Capacity, and Pay per forecast), allowing customers who run HP-UX to better align their IT costs with revenues as their technology usage fluctuates over time
- **Broader application support** due to the Intel Itanium Processor Family and multi-OS capabilities

The need for "big iron"

Some applications demand maximum levels of performance, scalability, and availability. For instance, in the data center, where transaction processing is handled and the backbone of mission-critical applications runs, you'll want the best servers available to keep those applications running and meeting quality-of-service goals, 24 x 7. Workloads such as online transaction processing (OLTP) with database engines, data mining, high-performance technical computing, and CRM are best handled by "big iron," top-of-the-line computers that also combine security, scalability, flexibility,

capacity, and manageability. The HP Integrity Superdome meets and exceeds these demanding requirements.

Introducing the HP Integrity Superdome

The HP Integrity Superdome with Intel Itanium 2 processors and mx2 Dual-Processor Modules is the high-end addition to the HP family of enterprise servers. HP's innovations extend the capabilities of the HP Integrity Superdome family in the following areas:

- Scalability
- Performance
- Capacity
- Availability
- Flexibility
- Investment protection
- Manageability
- Multi-OS support (HP-UX, Windows, Linux; OpenVMS in 1H 2006)

As a high-end platform, HP Integrity Superdome servers are uniquely able to address your requirements, even as those requirements change over time. This capability is based on service-level agreement (SLA) features, partitions, scalability up to 128 industry-leading processors, and support for multiple operating environments (OEs). *Existing HP 9000 Superdome customers can upgrade to HP Integrity Superdome with Intel Itanium 2 processors by simply swapping out the cell boards, thus retaining their investment in the cabinet, I/O chassis, backplane, power supplies, and memory DIMMs.*

Top-of-the-line performance and capacity—scalability to 128 processors

Integrity Superdome servers greatly extend the capabilities of HP servers at the high end. These servers offer the following:

- High-performance Intel Itanium 2 processor
  - 0.13 micron copper silicon-on-insulator CMOS process
  - Parallel instruction execution
  - Data prefetching and branch prediction capabilities
  - Machine check architecture high-availability features
  - 1.6 or 1.5 GHz core frequency
  - Large on-chip cache (9 MB or 6 MB)
- Enhanced performance density with HP mx2 Dual-Processor Module
  - Two Intel Itanium 2 processors within the same cell board socket
  - 1.1 GHz core frequency per CPU
  - 32 MB of shared L4 cache per mx2 Dual-Processor Module
  - Scalability up to 128 processors
- Increased memory subsystem performance and capacity
  - Increased peak memory bandwidth to 256 GB/s per 64-way system
  - Doubled memory capacity (1024 GB overall, with a maximum of 512 GB in any hard partition)
  - Higher-density DIMM support (512 MB, 1 GB, and 2 GB DIMMs)
  - Configurations available from 2 to 128 CPUs (64 mx2 Dual-Processor Modules)

- Support of both PCI-X and PCI (legacy HP 9000 Superdome servers only) I/O
  - 64-bit 33 MHz (2X) industry-standard PCI
  - 64-bit 66 MHz (4X) industry-standard PCI
  - 64-bit 133 MHz industry-standard PCI-X
  - 16 2.0 GB/s I/O channels (32 GB/s per 64-processor or 64–mx2 Dual-Processor Module [128-CPU] system)
  - 192 PCI slots

Availability features for increased uptime

The HP Integrity Superdome servers are an ideal fit for today's mission-critical environments. This family of servers has the increased system reliability and availability necessary to provide the right level of uptime for the mission-critical environment, based on the organization's requirements. It is designed with system quality, resiliency, and fault management in mind, and it provides support for cluster failover (such as HP Serviceguard on HP-UX 11i version 2, Linux and Microsoft Cluster Service [MCSC] for Windows Server 2003, and, in 1H 2006, OpenVMS Clusters).

Flexibility with partitions

Integrity Superdome servers support only hard partitions at first release. Support of virtual partitions will be available in a follow-on update to HP-UX 11i v2 in 2005.

Partitions allow the Integrity Superdome to reach new heights in availability and scalability. These servers can be configured as one large symmetric multiprocessor or as several independent hard partitions, known as nPartitions. These nPartitions can provide hardware isolation as well as complete software isolation.

Investment protection, with support for PA-RISC or Intel Itanium processors

Quick and simple in-the-box upgrades from an HP 9000 Superdome with PA-RISC processors (e.g., PA-8700 750 MHz, PA-8700 875 MHz, and PA-8800 processors) to Integrity Superdome servers are available. In-the-box upgrades from an Integrity Superdome with Intel Itanium 2 processors to the new HP mx2 Dual-Processor Modules are also supported. These servers are the logical choice not only for your present and future high-end computing needs but also for helping to provide investment protection in the years to come.

Consistent manageability

HP is committed to making the management of the Integrity Superdome as simple and cost-effective as possible. Customers will be able to use the same great management capabilities to manage the new Integrity Superdome as those they have used with their current HP-UX, Linux, and Windows servers from HP—but with more advanced capabilities, particularly in the area of partition management. In addition, HP provides the Support Management Station, which provides additional diagnosis and test capabilities specifically for the Integrity Superdome.

HP Integrity Superdome configuration overview

You can choose HP Integrity Superdome servers in several different configurations—with capabilities from 2-way multiprocessing all the way to 128 processors. Depending on the model, Integrity Superdome servers come in one or two cabinets. Below is a summary of Integrity Superdome configurations.

	HP Integrity Superdome— 16 Intel Itanium 2 processors or mx2 Dual-Processor Modules (32 CPUs)	HP Integrity Superdome— 32 Intel Itanium 2 processors or mx2 Dual-Processor Modules (64 CPUs)	HP Integrity Superdome— 64 Intel Itanium 2 processors or mx2 Dual-Processor Modules (128 CPUs)	HP Integrity Superdome— I/O expansion (see note)
1.6 GHz (9 MB or 6 MB of L3 cache) Intel Itanium 2 9M processors or 1.5 GHz Intel Itanium 2 6M processors				
Number of processors	2–16	2–32	6–64	
Number of 2-CPU or 4-CPU cell boards (hot-swap capability offered with HP-UX releases after 11i v2)	1–4	1–8	3–16	
Max. processors per partition	16	32	64	
mx2 Dual-Processor Module				
Number of Intel Itanium 2 processors	4–32	4–64	12–128	
Shared L4 cache per mx2 Dual-Processor Module	32 MB	32 MB	32 MB	
Number of 4-CPU or 8-CPU cell boards (hot-swap capability offered with HP-UX releases after 11i v2)	1–4	1–8	3–16	
Max. processors per partition	32	64	128 (only with HP-UX 11i)	
Memory (with 512 MB, 1 GB, or 2 GB DIMMs)	2 GB–256 GB	2 GB–512 GB	6 GB–1 TB	
Max. memory per partition	256 GB	512 GB	1 TB (requires HP-UX 11i v2; Windows Server 2003 Datacenter Edition support with SP1)	
Physical (hard) partitions	4	8	16	
12-slot I/O card cages	1–4	1–4 (1–8 with I/O expander [iOX])	1–8 (1–16 with I/O expander [IOX])	6
Hot-swap PCI-X I/O slots	48 slots (32 slots @ 533 MB/s, 16 slots @ 1066 MB/s)	48 slots (12–96 with IOX— 64 slots @ 533 MB/s, 32 slots @ 1066 MB/s)	96 slots (12–192 with IOX— (128 slots @ 533 MB/s, 64 slots @ 1066 MB/s)	72 slots
Hot-swap redundant power supplies (N+1 included)	4	6	12	2
I/O fans	6	6	12	4 per I/O chassis enclosure (max. 12)
Hot-swap redundant fans (N+1 included)	4	4	8	
Standard PCI-X bus bandwidth	533 MB/s	533 MB/s	533 MB/s	533 MB/s

	HP Integrity Superdome—16 Intel Itanium 2 processors or mx2 Dual-Processor Modules (32 CPUs)	HP Integrity Superdome—32 Intel Itanium 2 processors or mx2 Dual-Processor Modules (64 CPUs)	HP Integrity Superdome—64 Intel Itanium 2 processors or mx2 Dual-Processor Modules (128 CPUs)	HP Integrity Superdome—I/O expansion (see note)
High PCI-X bus bandwidth	1066 MB/s	1066 MB/s	1066 MB/s	1066 MB/s
2X PCI I/O bus bandwidth	266 MB/s	266 MB/s	266 MB/s	266 MB/s
4X PCI I/O bus bandwidth	533 MB/s	533 MB/s	533 MB/s	533 MB/s
Cell controller to I/O subsystem bandwidth (peak)	2.0 GB/s	2.0 GB/s	2.0 GB/s	2.0 GB/s
I/O bandwidth (peak)	8 GB/s	16 GB/s	32 GB/s	
Crossbar (peak)	16 GB/s	16 GB/s	32 GB/s	
Memory (peak)	16 GB/s	32 GB/s	64 GB/s	
Cell controller to memory subsystem bandwidth (peak)	16 GB/s	32 GB/s	64 GB/s	
Average memory load-to-use latency				
4 CPUs or mx2 Dual-Processor Modules (8 CPUs)	246 ns	246 ns	246 ns	
8 CPUs or mx2 Dual-Processor Modules (16 CPUs)	330 ns	330 ns	330 ns	
16 CPUs or mx2 Dual-Processor Modules (32 CPUs)	371 ns	371 ns	371 ns	
32 CPUs or mx2 Dual-Processor Modules (64 CPUs)	N/A	417 ns	417 ns	
64 CPUs or mx2 Dual-Processor Modules (128 CPUs)	N/A	N/A	440 ns	
Operating system availability	Today: HP-UX 11i v2; Windows Server 2003, Datacenter Edition for Itanium-based systems Linux (Red Hat Enterprise Linux Advanced Server 3, SUSE LINUX Enterprise Server 9) By 1H 2006: OpenVMS			
Number of cabinets	1 (left)	1 (left)	2 (1 left, 1 right)	1 Rack System/E expansion
Dimensions				
Height	1.96 m (77.2 in.)	1.96 m (77.2 in.)	1.96 m (77.2 in.)	1.96 m (77.2 in.) or 1.60 m (63.0 in.)
Width	762 mm (30 in.)	762 mm (30 in.)	1524 mm (60 in.)	610 mm (24 in.)
Depth	1220 mm (48 in.)	1220 mm (48 in.)	1220 mm (48 in.)	1220 mm (48 in.)

Note: For I/O expansion up to 168 slots, one expansion cabinet (holds up to 6 I/O card cages) is required. For I/O expansion up to 192 slots, two expansion cabinets are required. Any remaining space in the I/O expansion cabinets can be used to store peripherals. Both the 1.96 m and 1.6 m heights are available for the I/O expansion cabinet.

HP Integrity Superdome configuration overview by OS

Hardware configuration	HP-UX 11i v2	Windows Server 2003, Datacenter Edition	Linux
Maximum processors in one partition	64 Intel Itanium 2 processors or mx2 Dual-Processor Modules (128 processors)	64 Intel Itanium 2 processors or 32 mx2 Dual-Processor Modules (64 processors)	16 Intel Itanium 2 processors
Maximum memory in one partition	1 TB (requires HP-UX 11i v2)	512 GB	64 GB
Maximum I/O in one partition	192 PCI-X	192 PCI-X	12 PCI-X
Maximum cells in one partition	16	16	4
Maximum number of single-cell partitions	16	16	16

HP Integrity Superdome hardware

For increased flexibility in configuring the data center, an HP Integrity Superdome has up to four different types of cabinet assemblies:

- HP Integrity Superdome 16-processor or 16–mx2 Dual-Processor Module (32-CPU) and 32-processor or 32–mx2 Dual-Processor Module (64-CPU) systems are single-cabinet configurations with one left cabinet. The cabinet contains all of the processors, memory, and core devices of the system. It also houses up to 48 I/O cards or 4 I/O chassis.
- The HP Integrity Superdome 64-processor or 64–mx2 Dual-Processor Module (128-CPU) system is a dual-cabinet configuration with one left cabinet and one right cabinet. Together, the two cabinets contain all of the processors, memory, and core devices of the system. The dual-cabinet configuration houses up to 96 I/O cards or 8 I/O chassis.
- Up to two optional I/O expansion cabinets may be added if the required number of I/O cards exceeds the number of I/O cards that can be accommodated in a 32-processor or 32–mx2 Dual-Processor Module (64-CPU) configuration or a 64-processor or 64–mx2 Dual-Processor Module (128-CPU) configuration.

The HP Integrity Superdome cabinet

Figure 2 shows the physical layout of an Integrity Superdome 32-processor or 32–mx2 Dual-Processor Module (64-CPU) server cabinet. At the top of the cabinet, hot-swappable main fans are installed after the cabinet arrives at the customer site. Below these fans is a cage for the eight cell boards on which processors and memory DIMMs reside. In a future release of HP-UX 11i, these cell boards will support hot-swap capability, so you can change them without bringing down the system.

Figure 2. Front and rear views of HP Integrity Superdome 32-processor or 32–mx2 Dual-Processor Module server cabinet
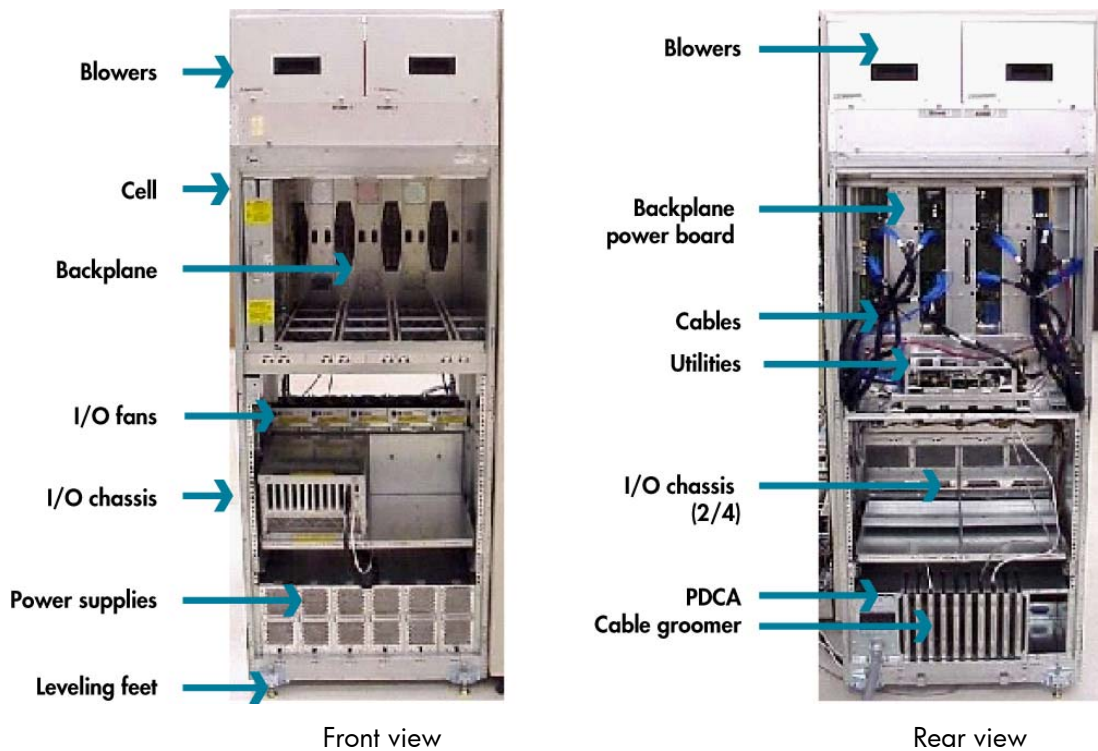
Directly below the cell boards is the main air intake, and below that are two I/O chassis. Each I/O chassis holds 12 PCI-X I/O cards. Redundant power supplies are at the bottom of the cabinet. The HP Integrity Superdome family does not use electric plugs; instead, 48 Vdc power is hard-wired to each cabinet. There are two redundant power inputs so the system can be powered up via two different power grids. An opening in the side of the cabinet allows two HP Integrity Superdome 32-processor or 32–mx2 Dual-Processor Module server cabinets to be cabled together to constitute an HP Integrity Superdome with 64 processors or 64 mx2 Dual-Processor Modules.

In order to differentiate between the existing HP 9000 Superdome servers and new Integrity Superdome servers based on the sx1000 Chipset, the cabinet skin color will no longer be an off-white quartz; it will be a dark gray graphite. The I/O expansion cabinet associated with the HP Integrity Superdome will also be graphite in color.

Features of the Integrity Superdome cabinets include:

- **Front and rear servicing**—This lets you arrange the cabinets of your HP Integrity Superdome in the traditional row fashion found in most computer rooms.
- **Sized for easy installation**—The width of the cabinet allows entry through most doorways without disassembly.
- **Hot-swappable filters**—The intake air to the cell boards is filtered, helping to keep the boards clean and operational. You can remove the filter for cleaning or replacement while the system is operating.
- **External status display**—A status display on the outside of the front and rear doors of each cabinet allows maintenance personnel and HP field engineers to determine the basic status of each cabinet without opening any cabinet doors.

HP Integrity Superdome architecture

HP Integrity Superdome servers are cache-coherent, non-uniform memory access (ccNUMA) systems. And Integrity Superdome servers present a symmetric multiprocessing (SMP) programming model to the operating system by allowing any processor to have access to any byte of memory anywhere in the system. In fact, it is the first mission-critical UNIX® system to exploit distributed processors and memory. Here's why.

- Usable bandwidth scales with system size, thanks to two important design features:
  - **HP Integrity Superdome coherency scheme**—Unlike some UNIX systems, which rely on snoop-based coherency that results in bottlenecks (large, flat latencies and bandwidth starvation) in high-end configurations, Integrity Superdome servers use a highly customized directory coherency scheme that scales to 16 cells with very low coherency bandwidth overhead.
  - **HP Integrity Superdome topology**—Integrity Superdome servers implement a point-to-point global packet switch for a communication fabric that is very well balanced across processor, memory, and I/O traffic.
- **Large physical memory with extremely low latency**—Integrity Superdome servers support 512 MB, 1 GB, and 2 GB DIMMs, yielding a maximum memory of 1 TB. Even with these high amounts of memory, the latency growth from 2 to 128 processors is only 1.8X (80% growth), which is extremely flat.
- **High I/O bandwidth and connectivity**—Integrity Superdome servers provide a high degree of I/O connectivity while preserving bandwidth. There are 192 I/O cards in the system, each with its own dedicated I/O bus; at the adapter level, this aggregates to 64 GB/s of raw bandwidth for PCI and 128 GB/s for PCI-X. The I/O bandwidth available between the system core (processors and memory) and the I/O controllers is roughly 30 GB/s for PCI and 32 GB/s for PCI-X.
- **Large number of high-performance processors**—Integrity Superdome servers provide up to 128 Intel Itanium 2 processors—and these are the highest-performance processors in the industry. The system can consist of up to 64 Intel Itanium 2 processors or 64 mx2 Dual-Processor Modules (128 CPUs). The new mx2 Dual-Processor Module enables two Intel Itanium 2 processors sharing a large 32 MB L4 cache to be supported in the same socket that a single Intel Itanium 2 processor would occupy, thus doubling the capacity of the system.
- **True hardware isolation of system resources**—Processors, memory, and I/O resources are truly isolated from each other in order to provide flexibility in system usage. This means:
  - The system has great SMP performance to attack large single workloads.
  - Hardware-enforced isolation of resources coupled with great single-system high-availability and manageability features provides a strong consolidation platform.

Modular architecture

The HP Integrity Superdome architecture is modular, with components that can be used to construct several different server-class computer products based on Intel Itanium 2 and future PA-RISC processors. The same cell board can support Intel Itanium 2 processors (1.5 GHz with 6 MB L3 cache), mx2 Dual-Processor Modules (two Intel Itanium 2 processors sharing a large, 32 MB L4 cache), PA-8800 processors, future Intel Itanium processors, or future PA-RISC processors (PA-8900). PA-RISC and Intel Itanium 2 processors cannot be mixed in the same system. Intel Itanium 2 processors and mx2 Dual-Processor Modules are supported in the same system, but only in different hard partitions. Such modularity helps provide investment protection—you can simply add or change cell boards as system requirements change.

With the new mx2 Dual-Processor Module, the HP Integrity Superdome platform supports a variety of system configurations, from 2 to 128 processors. (There are three models to choose from—the largest is a 64-processor or 64–mx2 Dual-Processor Module system [4 to 128 processors] with a scalable memory and I/O system.) The system is extremely flexible and has a cell-based hierarchical crossbar architecture that can be configured as one large symmetric multiprocessor or as several independent nPartitions. In an Integrity Superdome system, any processor on any nPartition can directly address any byte of memory on any nPartition, through processor-issued load or store instructions.

There are three basic components in the Integrity Superdome architecture: the cell or cell board, the crossbar backplane, and the PCI-X-based I/O subsystem (the PCI-based I/O subsystem is supported when an existing HP 9000 Superdome is upgraded to an Integrity Superdome). Figure 3 is an illustration of this architecture.

Figure 3. The HP Integrity Superdome's hierarchical crossbar architecture

The crossbar mesh: interconnect fabric

- Fully connected crossbar mesh
  - Four crossbars
  - Four cells per crossbar
- Equal bandwidth and latency for all links
  - Lower latency
  - More usable bandwidth
- Point-to-point packet filtering and routing network implementation
  - Allows hardware isolation of all faults
- 16 cells interconnected with 3 latency domains
  - Cell local
  - Crossbar local
  - Remote crossbar
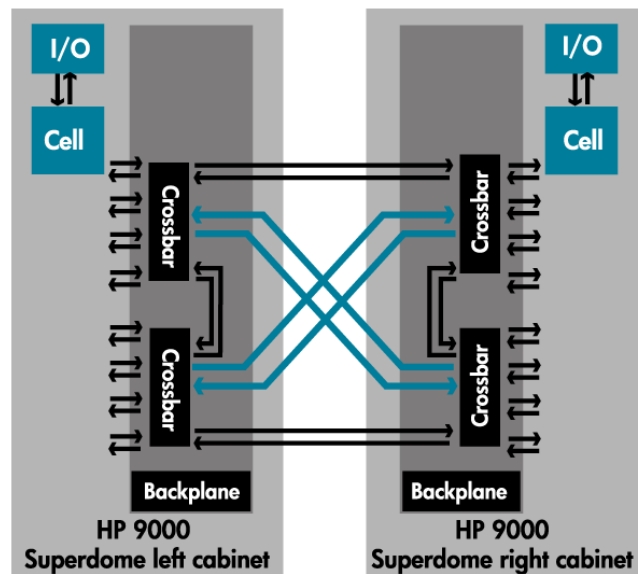
Industry-leading, flexible elegance in a high-end server

The cell board

A cell, or cell board, shown in Figure 4, is the basic building block of an HP Integrity Superdome. Each cabinet can contain up to eight cell boards, which are plugged into the backplane of the cabinet.

In the original Superdome release, the cell board frame contained both the cell board and associated cell power board. In the Integrity Superdome with Intel Itanium 2 processors or mx2 Dual-Processor Modules, the cell and cell power board are in separate assemblies to improve handling. The same cell power board is used with all varieties of cell boards, including those for Itanium 2–based and PA-8800–based systems.

When upgrading an existing HP 9000 Superdome to an Integrity Superdome, the existing cell boards are removed from the system. The DIMMs from these boards are removed and placed into the Integrity Superdome cell boards, which are then loaded into the system along with the cell power boards. Existing HP 9000 Superdome cell boards cannot coexist in the same complex with Integrity Superdome cell boards. In addition, Intel Itanium 2 processors and future PA-RISC processors must be in different complexes. Different Intel Itanium 2 processors can be in the same complex, but they must be in different hard partitions. (For example, the mx2 Dual-Processor Modules [two 1.1 GHz Intel Itanium 2 processors] can be used in one hard partition while another hard partition contains single 1.5 GHz Intel Itanium 2 processors.) This provides organizations with the ability to migrate individual partitions to the latest technology when the time is right for them. In addition, only the partition that is being upgraded needs to be taken down, which reduces the impact to the business. Any cell blockers in the original HP 9000 Superdome system must also be replaced with new cell blockers.

Figure 4. Cell board layout of HP Integrity Superdome with Intel Itanium 2 processors or mx2 Dual-Processor Modules
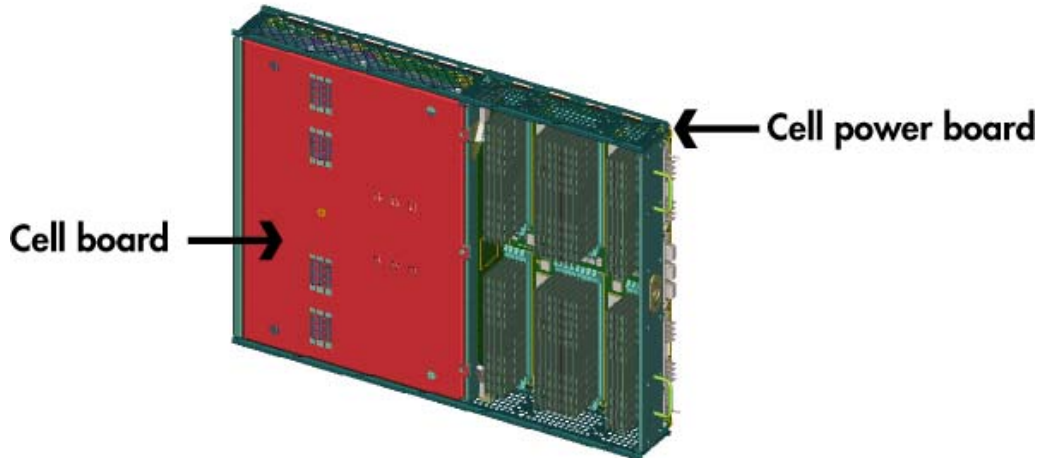
Each cell board is a self-contained unit, with a symmetric multiprocessor (SMP), main memory, and all necessary hardware:

- CPUs or mx2 Dual-Processor Modules (up to 4 processors or 4 mx2 Dual-Processor Modules [8 processors])
- Cell controller ASIC (application-specific integrated circuit)
- Main memory DIMMs (up to 32 DIMMs per board in 4 DIMM increments, using 512 MB, 1 GB, or 2 GB DIMMs, or some combination of these)
- Voltage regulator modules (VRMs)

- Data buses
- Optional link to 12 PCI-X I/O slots

Figure 5 illustrates the cell board architecture processors in each socket. The cell has a peak memory bandwidth of 16 GB/s. A connection to a 12-slot PCI-X card cage is optional for each cell, and the peak bandwidth of this link is 2 GB/s. Bandwidth to the crossbar is 8 GB/s per cell.

Error checking and correcting (ECC) exists on all fabric paths, memory paths, and on CPU cache. Parity protection exists on all CPU and I/O links. Single-wire correction exists on fabric and I/O paths.

Figure 5. HP Integrity Superdome cell board and interconnect architecture
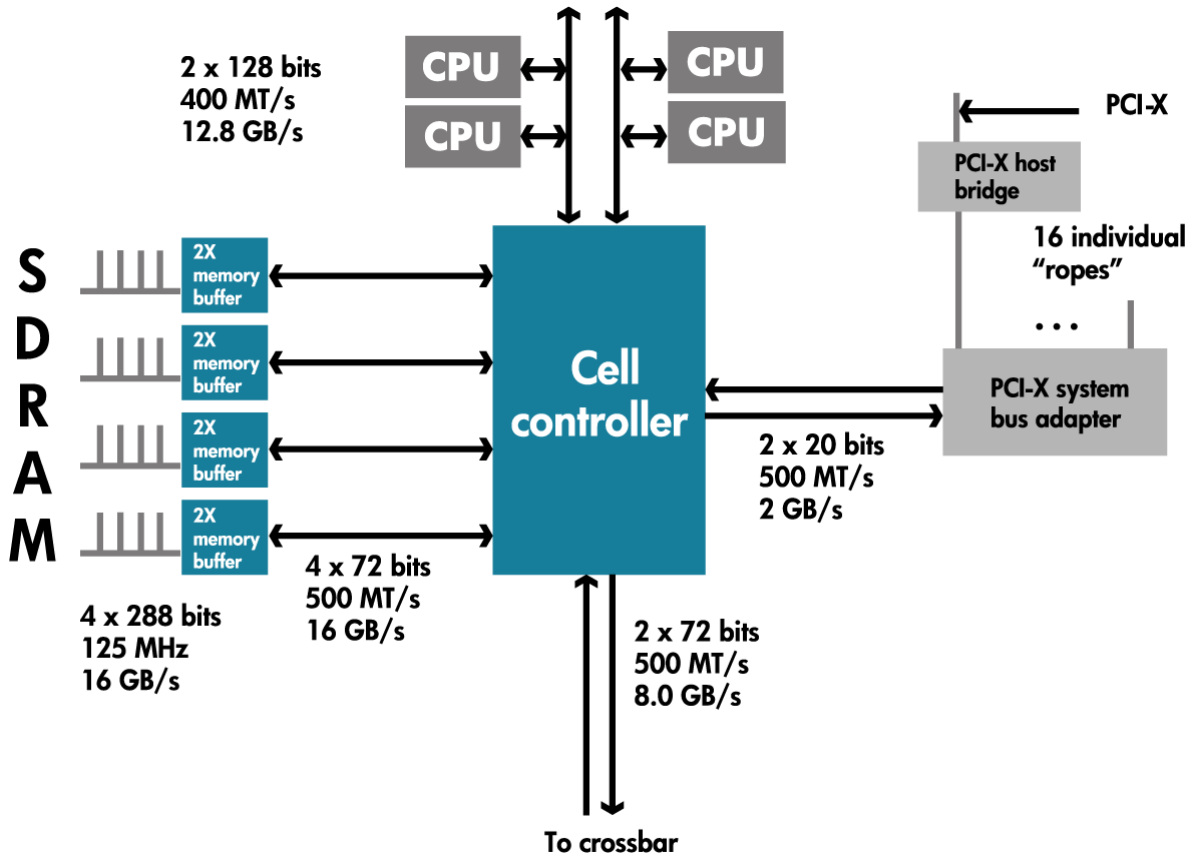
MT = Mega transfers

Figure 6 illustrates the same cell board utilizing HP's new mx2 Dual-Processor Modules. Note that the only difference between this figure and Figure 5 is that now each mx2 Dual-Processor Module can support two CPU cores.

Figure 6. HP Integrity Superdome cell board using mx2 Dual-Processor Modules and interconnect architecture

MT = Mega transfers
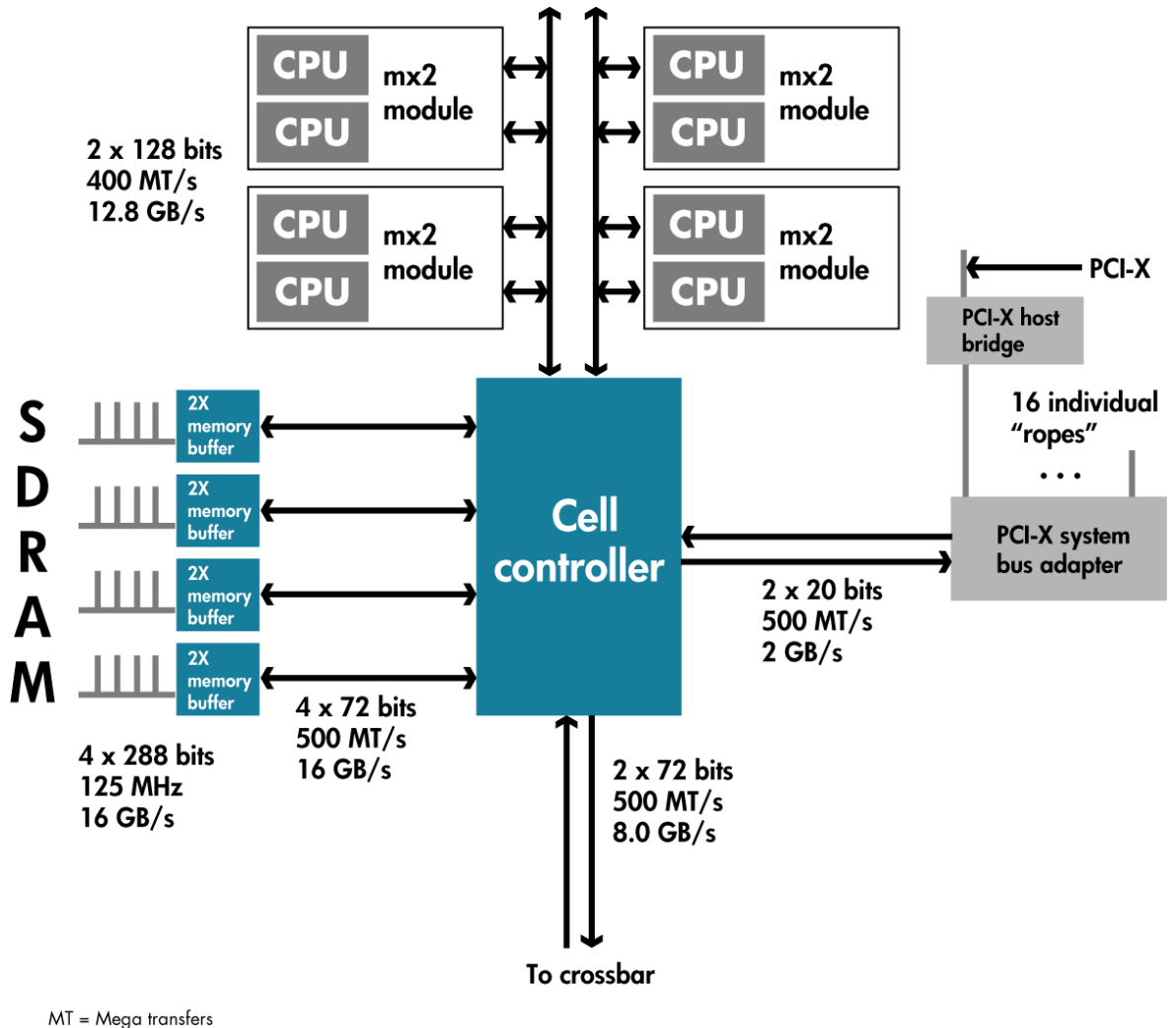
Memory

The first release of the HP Integrity Superdome will support 128-megabit and 256-megabit SDRAM.

Processors

Integrity Superdome servers use Intel Itanium 2 processors or mx2 Dual-Processor Modules. The mx2 Dual-Processor Module supports two Intel Itanium 2 processors with a large shared 32 MB L4 cache in the same cell board socket that is used for a single Intel Itanium 2 processor. This HP innovation offers up to twice the performance density of the previous Integrity Superdome servers.

Cell controller ASIC

Residing on the cell board, the cell controller ASIC is part of the Integrity Superdome chipset. It coordinates traffic between the major components of a cell board and determines if a request requires communication with another cell or with the I/O subsystem. HP believes that this cell controller ASIC is the largest ASIC in the world—it has approximately 41 million transistors.

The cell controller ASIC has five major interfaces:

- 4 memory subsystems
- 2 ports to processors (1 dedicated port per 2 processors)
- Crossbar interface, through which all communication to other cells flows
- Processor-dependent hardware (PDH)
- I/O interface, which connects the cell to an I/O subsystem

In addition to providing the interface logic, the cell controller ASIC maintains cache coherency throughout the system. The cell controller ASIC supports both Intel Itanium 2 and PA-8800 processors as well as the mx2 Dual-Processor Module.

The processor-dependent hardware (PDH) is the module that provides the cell with the local resources required to reset a cell and bring it up to a point where it can join other cells and boot the operating system. PDH contains the system boot firmware, which is also used at run time.

Memory controller ASIC

The memory controller ASIC is also part of the sx1000 Chipset. Its primary function is to multiplex and demultiplex data between the cell controller ASIC and the SDRAM in the memory subsystem. When the cell controller ASIC issues a read transaction on the memory interface command bus, the memory controller ASIC buffers the DRAM read data and returns it as soon as possible. When the cell controller ASIC issues a write transaction, the memory controller ASIC receives the write data from the cell controller ASIC and forwards it to the DRAM.

Note that only the data portion of the memory subsystem goes through the memory controller ASIC. All address and control signals to the DIMMs are generated by the cell controller ASIC and sent directly to the DIMM via the memory interface address bus.

The memory subsystem is a quad-ported implementation. It supports memory DRAM fault tolerance, in which a discrete SDRAM chip can fail without compromising data integrity. The memory subsystem provides 16 GB/s of peak bandwidth to the cell controller ASIC and reduces the overhead typically associated with directory coherency. What's more, the memory subsystem enjoys a very low latency for cell-to-local-memory access: as low as 245 ns average idle load-to-use latency.

HP innovation with the new mx2 Dual-Processor Module

The recently introduced mx2 Dual-Processor Module provides HP Integrity server customers with a unique scalability and performance density option in addition to the traditional single Intel Itanium 2 processors. Now customers will have the choice of plugging a dual-chip module into the exact same socket used for single processors, providing up to double the number of processors and the performance density of the system.

The power of the mx2 Dual-Processor Module comes from two Intel Itanium 2 processors running at 1.1 GHz. They run at a reduced clock speed to limit power consumption and heat production. The mx2 Dual-Processor Module is powered by a single voltage regulator module (VRM). The mx2 Dual-Processor Module contains a bus converter and cache controller chip that enables the daughterboard to work with the rest of the system. In addition, the bus converter adds a large 32 MB of L4 cache to the sizable caches already offered on the Intel Itanium processors. This keeps the data close to the chip and offers improved performance.

The key value to the customer is that the mx2 Dual-Processor Module provides up to twice the number of processors and performance density in a system without changing the sockets, system size, and power requirements. In fact, with HP-UX 11i the HP Integrity Superdome can scale to 128-way. Thus customers who are hitting the top end of the capacity of their current systems (e.g., 32 CPUs in an Integrity Superdome system with 32 single Intel Itanium 2 processors) can now obtain extra capacity without having to add additional systems or cabinets.

In addition, this offers Integrity Superdome customers superior investment protection. To take advantage of the mx2 Dual-Processor Module, all the customer has to do is swap out the existing Intel Itanium 2 processors with the new mx2 Dual-Processor Modules. Furthermore, single Intel Itanium 2 processors and mx2 Dual-Processor Modules can coexist on the same system (as long as they are in different hard partitions). This provides users with the choice of adding this new technology to the partitions they choose at the time they desire.

Figure 7. HP innovation with the mx2 Dual-Processor Module
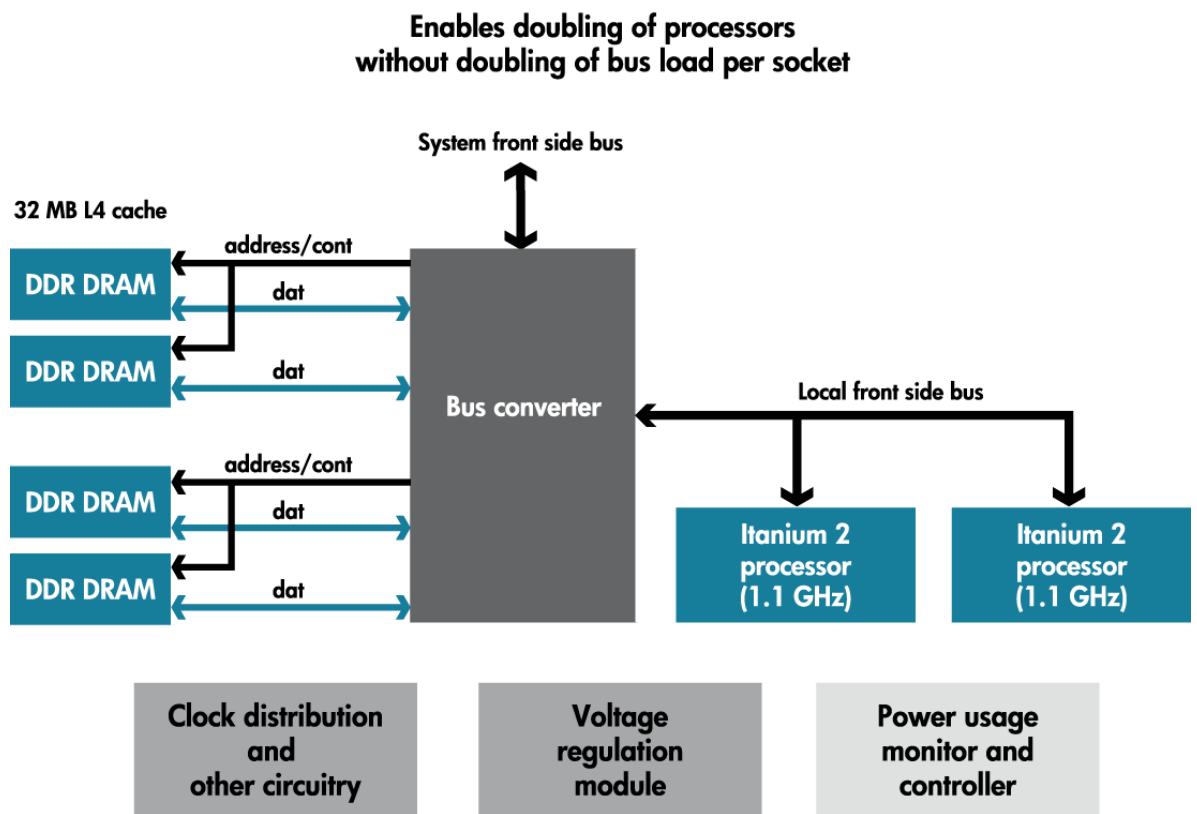
The crossbar backplane

Each crossbar backplane contains two sets of two crossbar ASICs that provide a non-blocking connection between eight cells and the other backplane. Each backplane cabinet can support up to eight cells or 32 processors or mx2 Dual-Processor Modules (in an Integrity Superdome with 32 processors or 32 mx2 Dual-Processor Modules [64 CPUs] in a single cabinet). Two backplanes can be linked together with flex cables to produce a cabinet that can support up to 16 cells or 64 processors or mx2 Dual-Processor Modules (in an Integrity Superdome with 64 processors or 64 mx2 Dual-Processor Modules [128 CPUs] in dual cabinets).

Crossbar ASIC

The crossbar ASIC is yet another part of the sx1000 Chipset. It implements a high-performance 8-port non-blocking crossbar and the 500 MHz crossbar link protocol. All ports are functionally and electrically identical. The Integrity Superdome fabric is a fully connected crossbar mesh with four pairs of crossbar ASICs and four cells per crossbar ASIC pair. Like the cell controller ASIC, the crossbar ASIC has truly impressive scale. HP believes that it also is one of the world's largest ASICs, with 18 million transistors and six layers of metal, using copper technology.

A very important aspect of the crossbar mesh is that all links have the same bandwidth and latency, which is key to increasing overall bandwidth and reducing overall latency. Cell-to-crossbar and crossbar-to-crossbar communication occur at the same speed—there are no excessive latency penalties for going remote. In addition, the server's memory interleaves across cells first, then across memory banks. This interleaving scheme tends to balance out memory traffic across all the links.

The crossbar mesh implements a global point-to-point packet filtering network. This mesh features an extremely high level of integrity, with each crossbar port fully independent. The crossbar mesh has dedicated paths for data and control. Each port can be reset, assigned, or reconfigured fully independent of other ports. The server's crossbar mesh is an excellent foundation for resource isolation.

The crossbar ASIC offers several features that contribute to the high performance of the HP Integrity Superdome:

- Support for scaling up to a 128-way coherent shared memory system (with Intel Itanium 2 and PA-8800 processors, mx2 Dual-Processor Modules, and future PA-RISC [PA-8900] and Intel Itanium 2 processors)
- 250 MHz operation
- 500 mega transfers/second (MT/s) link speed
- Support for two interleaved channels on link protocol
- Support for double-length data packets for Intel Itanium Processor Family mode
- Performance counters to enable software tuning

Each port on the crossbar ASIC has 8 GB/s of peak bandwidth. These ports provide a high-throughput path to cells and other crossbar ASICs:

- Four ports connect to the four cells that reside on the crossbar ASIC (one port per cell).
- Three ports connect to the remaining three crossbar ASICs (in an Integrity Superdome 64-way server).

The total crossbar bandwidth for each Integrity Superdome model is calculated as follows:

(Number of cells × peak crossbar bandwidth per cell) ÷ 2 ports

Crossbar bandwidth for the different Integrity Superdome servers is excellent:

- For the HP Integrity Superdome 16-processor or 16–mx2 Dual-Processor Module (32-CPU) server, the crossbar bandwidth is 16 GB/s.
- For the HP Integrity Superdome 32-processor or 32–mx2 Dual-Processor Module (64-CPU) server, the crossbar bandwidth is 32 GB/s.
- For the HP Integrity Superdome 64-processor or 64–mx2 Dual-Processor Module (128-CPU) server, the crossbar bandwidth is 64 GB/s.

Memory and backplane latencies

HP Integrity Superdome servers have been designed to reduce memory and backplane latencies, providing increased performance. There are three types of memory latencies within the HP Integrity Superdome system:

- **Memory latency within the cell** refers to an application running on an nPartition consisting of a single cell board.

- **Memory latency between cells on the same crossbar** refers to an nPartition consisting of up to four cells that reside on the same crossbar. For example, if there are four cells in the nPartition, ¼ of the requests go to the memory of the cell board in which the processor resides, and ¾ of the requests go to the memory of the other three cell boards.

- **Memory latency between cells on different crossbars** refers to an nPartition consisting of cell boards that do not all reside on the same crossbar. For example, if there are 16 cells in the nPartition, $\frac{1}{16}$ of the requests are to the memory of the cell board in which the processor resides. $\frac{3}{16}$ of the requests go to the memory of the other three cell boards on this same crossbar. Finally, the remaining $\frac{12}{16}$ of the requests transit across two crossbars.

HP Integrity Superdome memory latency depends on the number of CPUs in the server and the location of their corresponding cell board. Assuming that traffic is equally distributed to all memory controllers and that cell boards are installed to minimize latency, the average memory idle latency (when nothing is executing on the system) and memory latency (load-to-use) are shown below.

Number of cell boards	Number of CPUs	Average idle load-to-use memory latency
1	4 (8 with mx2 Dual-Processor Modules)	246 ns
2	8 (16 with mx2 Dual-Processor Modules)	330 ns
4	16 (32 with mx2 Dual-Processor Modules)	371 ns
8	32 (64 with mx2 Dual-Processor Modules)	417 ns
16	64 (128 with mx2 Dual-Processor Modules)	440 ns

The I/O subsystem

Each HP Integrity Superdome cell has an optional link to an I/O chassis. This enhances modularity and means there are no trade-offs for scaling of processors, memory, and I/O. Each cell connects to its remote I/O chassis through an I/O cable link.

The HP Integrity Superdome I/O subsystem has plenty of capability for today and expansion for tomorrow. Each I/O module consists of 12 PCI-X connections, divided among eight standard PCI-X and four high-bandwidth PCI-X slots, with an I/O controller ASIC and power. Each PCI-X slot has its own PCI-X bus—the standard PCI-X slot has 533 MB/s bandwidth, and the high-bandwidth PCI-X slot achieves a bandwidth of 1066 MB/s. The point-to-point connectivity allows the earliest detection, containment, and recovery from errors.

Any I/O module can support a core I/O card (required for each independent nPartition).

	HP Integrity Superdome— 16 processors or mx2 Dual-Processor Modules (32 CPUs)	HP Integrity Superdome— 32 processors or mx2 Dual-Processor Modules (64 CPUs)	HP Integrity Superdome— 64 processors or mx2 Dual-Processor Modules (128 CPUs)
I/O modules	4	4	8
PCI-X slots	48	48	96
Total I/O subsystem bandwidth (2.0 GB/s per cell)	8 GB/s	16 GB/s	32 GB/s

An I/O expansion cabinet can also be added. On the Integrity Superdome 32-processor or 32–mx2 Dual-Processor Module (64-CPU) server, this yields an additional 48 PCI-X slots, giving a maximum connectivity of 96 PCI-X slots for 8 cells. For an HP Integrity Superdome 64-processor or 64–mx2 Dual-Processor Module (128-CPU) server, the I/O expansion cabinet provides an additional 96 PCI-X slots, for a maximum connectivity of 192 PCI-X slots for 16 cells.

Note: If an existing HP 9000 Superdome with an I/O expansion cabinet is being upgraded to an HP Integrity Superdome with the sx1000 Chipset, the side panels must be replaced and upgraded.

A system configured with 16 cells—each with its own I/O module and core I/O card—can support up to 16 independent nPartitions. Note that cells can be configured without I/O modules attached, but I/O modules cannot be configured in the system unless they are attached to a cell.

The HP Integrity Superdome I/O expansion cabinet is based on the HP Rack products, which are designed and built to the highest HP quality standards. Ease of use, integration, and installation characterize the racking solution for HP Integrity servers. The HP Rack System/E comes with optimized ventilation, with a fully perforated top, front, and rear door that let the equipment breathe and eliminate the need for any fans. Factory integration is available with HP Rack System/E for HP Integrity servers.

HP Integrity Superdome: performance and scalability

HP Integrity Superdome servers offer a host of features that are especially important in the online transaction processing (OLTP), business intelligence, and technical markets. And bandwidth and scalability are two important areas of Integrity Superdome leadership.

System bandwidth

	HP Integrity Superdome— 16 processors or mx2 Dual-Processor Modules (32 CPUs)	HP Integrity Superdome— 32 processors or mx2 Dual-Processor Modules (64 CPUs)	HP Integrity Superdome— 64 processors or mx2 Dual-Processor Modules (128 CPUs)
Crossbar bandwidth (peak)	16 GB/s	32 GB/s	64 GB/s
Cell controller to I/O subsystem bandwidth (peak)	2 GB/s	2 GB/s	2 GB/s
I/O bandwidth (peak)	8 GB/s	16 GB/s	32 GB/s
Memory bandwidth	64 GB/s	128 GB/s	256 GB/s

Scalability

	HP Integrity Superdome— 16 processors or mx2 Dual-Processor Modules (32 CPUs)	HP Integrity Superdome— 32 processors or mx2 Dual-Processor Modules (64 CPUs)	HP Integrity Superdome— 64 processors or mx2 Dual-Processor Modules (128 CPUs)
1.5 GHz Intel Itanium 2 processors			
Number of 2-CPU or 4-CPU cell boards	1–4	1–8	3–16
Number of processors	2–16	2–32	6–64
Max. processors per partition	16	32	64
mx2 Dual-Processor Module			
Number of 4-CPU or 8-CPU cell boards	1–4	1–8	3–16
Number Intel Itanium 2 processors	4–32	4–64	12–128
Max. processors per partition	32	64	128
Memory	2 GB–256 GB	2 GB–512 GB	6 GB–1 TB
12-slot I/O card cages	4	8	16
Hot-swap PCI-X I/O slots (see note)	48 slots (32 std. PCI-X slots, 16 high-BW PCI-X slots)	96 slots (64 std. PCI-X slots, 32 high-BW PCI-X slots)	192 slots (128 std. PCI-X slots, 64 high-BW PCI-X slots)
nPartitions	4	8	16

Note: For I/O expansion up to 168 slots, one expansion cabinet (6 I/O card cages) is required. For I/O expansion up to 192 slots, two expansion cabinets (12 I/O card cages) are required. Any remaining space in the I/O expansion cabinets can be used to store peripherals. Both 1.96 m and 1.6 m heights are available for the I/O expansion cabinet.

HP StorageWorks and HP servers

The cornerstone of an Adaptive Enterprise

At the heart of an Adaptive Enterprise—where IT and business are synchronized to capitalize on change—is application processing and information storage. HP delivers storage and server portfolios that can accommodate the needs of any IT infrastructure through adaptive infrastructure solution offerings—from the most price-sensitive small or medium-sized business to the largest corporate enterprise.

Without question, HP has one of the broadest portfolios in the industry. As the worldwide leader[1] in UNIX, Microsoft Windows, and Linux servers, the HP server portfolio encompasses ProLiant, Integrity, 9000 series, Alpha, and NonStop servers. As the worldwide leader[2] in storage, the HP StorageWorks portfolio includes disk arrays, integrated management software, tape and optical devices, network attached storage (NAS), and storage area network (SAN) infrastructures. HP also

[1] IDC, Q2 CY2003 Quarterly Server Tracker
[2] IDC, Q2 CY2003 Quarterly Disk Tracker

consistently demonstrates the caliber of its HP StorageWorks and HP server lines as these products continually receive best-in-class industry and customer awards.

Figure 8. HP storage and server portfolio
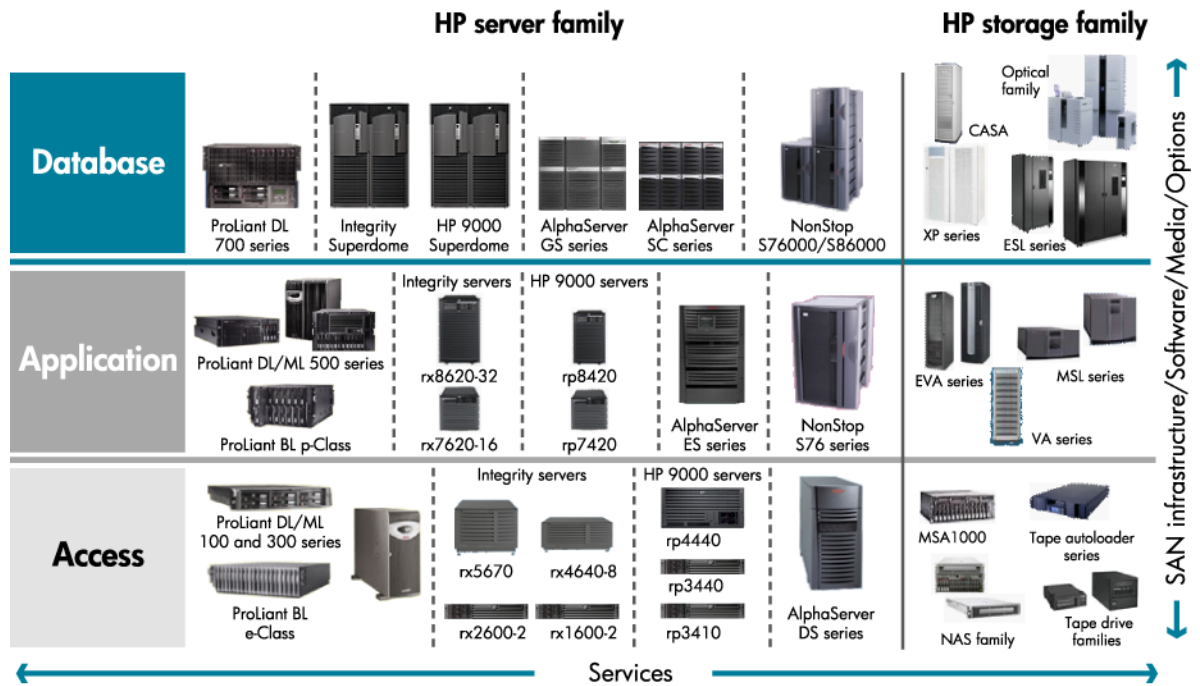
Delivering more together

At the most basic level, HP delivers best-in-class products that are open for connectivity to any heterogeneous environment consisting of multivendor servers, operating systems, storage, applications, and other components. "Open" has always been the foundation of the HP strategy for doing business. Yet using HP StorageWorks solutions and HP servers together in the same environment can yield additional advantage for the Adaptive Enterprise. By deploying HP storage and HP servers, along with HP services, customers gain more for their IT environment and overall business—more stability, efficiency, adaptability, and, ultimately, more return on their IT investment.

"There are so many advantages to having one powerful vendor like HP that can integrate all our solutions into a cohesive, flexible infrastructure…we looked at SAN solutions from Sun/Hitachi, EMC, IBM, and HP…only HP offered the total solution we needed."

Nader Karimi
Chief Information Officer
Screen Actors Guild Producers Pension and Health Plans

More return on IT investment with HP StorageWorks and HP servers

HP delivers one of the broadest total product portfolios in the industry. HP StorageWorks and server product lines are second to none at providing best-in-class standalone functionality in any operating environment. HP StorageWorks hardware and software, HP servers, and HP Services together provide a more synergistic and powerful solution that enables an Adaptive Enterprise. Customers gain more control of their data center and overall business with more stability, efficiency, and adaptability, which all lead to increased return on their IT investment.

Combined deployments can reduce a customer's operating costs, with better price/performance, investment protection, virtualization, unified management capabilities, and total IT consolidation providing a better return on investment and a lower total cost of ownership.

IT availability is crucial in today's business environment. If an infrastructure is slow or down, revenue will go to the competition. HP storage and servers together deliver maximum uptime with complete, seamless, and *total* integration. With HP solutions and services, customers can count on HP as a trusted partner with a single point of accountability. The result is faster time to problem resolution and overall increased IT availability.

HP is best suited to drive business adaptability. With solutions and technology from HP, customers can change and adapt quickly to market needs. HP servers and storage can be delivered onsite in complete integrated turnkey solutions that are ready to deploy. Virtualization removes traditional boundaries. HP UDC delivers "wire once" capability for the entire data center. The full portfolio of HP services and managed solutions enables customers to build and manage an Adaptive Enterprise. It is all possible with HP.

HP Integrity Superdome: high availability

HP Integrity Superdome offers unprecedented single-system availability in the following areas:

- System reliability
- Supportability
- Repairability
- HP Serviceguard HA Cluster-in-a-Box
- Microsoft Cluster Service (MSCS) support

HP Integrity Superdome: system reliability

The HP Integrity Superdome product family is bolstered by design enhancements and production techniques that substantially enhance system reliability. Among these enhancements are the following:

- Machine check architecture
- Memory DRAM fault tolerance—recovery of a single SDRAM failure
- DIMM address parity protection
- Dynamic memory resilience—page de-allocation of bad memory pages during operation (not supported on Windows Server 2003 or Linux)
- Dynamic processor resilience (not supported on Windows Server 2003 or Linux)
- CPU cache ECC protection and automatic de-allocation
- CPU bus parity protection
- Full single-bit error detection and correction on crossbar and I/O links

- I/O error recovery and system resilience to I/O card failures
- I/O cards with fully isolated buses
- Prevention of silent corruption of data going to I/O
- Recovery of a single I/O-to-cell controller link failure
- Recovery of a single crossbar wire failure
- Localization of crossbar failures to the partitions using the link
- Automatic de-allocation of bad crossbar link upon boot
- ASIC full burn-in and high-quality production process, resulting in 10X improvement in ASIC failure rates
- Full "test to failure" and accelerated life testing on all critical HP Integrity Superdome assemblies
- Strong emphasis on quality for multiple nPartition single points of failure (SPOFs)
- System resilience to Guardian Service Processor (GSP)
- Isolation of nPartition failures—failure of one nPartition will not bring down another partition
- Protection of nPartitions against spurious interrupts or memory corruption

Supportability

Supportability is another key feature of the Integrity Superdome product line. Listed here are some of the supportability features of these servers:

- Event Monitoring Service (EMS) (only available on HP-UX)
- HP Systems Insight Manager support for Windows Server 2003
- Support Management Station (SMS)
- Instant Support Enterprise Edition (ISEE)

Event Monitoring Service

For the Integrity Superdome, HP Event Monitoring Service (EMS) on HP-UX aids system management by keeping track of the system's vital signs. EMS is installed and activated by default. It allows monitoring of virtually all of the hardware on the system, including:

- Mass storage
- Memory
- Fibre Channel components (multiplexer, switch, card, fabric, etc.)
- I/O cards
- ECC errors on the main system bus
- ECC errors in the CPU cache
- System temperature
- Support processor problems
- Processor-dependent hardware problems
- Processor-dependent hardware low-battery conditions
- Cabinet fans
- Cabinet power supplies
- Chassis code logging failure
- Processor-dependent code (firmware) problems

The system hardware configuration and selected kernel parameters are also monitored.

When a hardware monitor detects a problem, it generates a report. Administrators can be notified via SNMP, HP OpenView Vantagepoint Operations, e-mail, page, syslog, console, or a selected text log file. Each event report contains a complete description of the problem, a severity classification (informational, warning, serious, critical), and text that shows the probable cause and the suggested action to take.

When excessive processor cache errors are detected, the processor is automatically removed from use until it is replaced. If the customer has Instant Capacity processors on HP-UX available in the partition, EMS will automatically activate one of these processors to replace the processor that has been removed from use. The failed processor is also marked so it will be removed from use on the next system reboot.

Hardware inventory in Support Tools Manager

With Integrity Superdome servers, HP Support Tools Manager (STM) has been enhanced to give you detailed information about the system. Integrity Superdome servers have been designed with the ability for each individual field-replaceable unit (FRU) to report information such as serial number, part number, revision level, etc. This information is available in the system information tool in STM. In addition, some of the hardware inventory information is accessible via desktop management interface (DMI).

HP Systems Insight Manager support for Windows Server 2003

Each Windows-based hard partition in Integrity Superdome ships with HP Systems Insight Manager management agents. HP Systems Insight Manager increases system uptime and provides powerful monitoring and control. It delivers pre-failure alerting for servers, so potential server failures are detected before they result in unplanned system downtime. It also provides inventory reporting capabilities that dramatically reduce the time and effort required to track server assets and help system administrators make educated decisions about which system may required hardware upgrades or replacement. And Systems Insight Manager is an effective tool for managing your HP desktops and notebooks, as well as non-HP devices instrumented to SNMP or DMI.

Each Windows-based hard partition in Integrity Superdome will have a System Management Homepage, which displays critical management information through a simple, task-oriented user interface. All system faults and major subsystem status are now reported within the initial System Management Homepage view. In addition, the new tab-based interface and menu structure provide one-click access to the server log. The System Management Homepage is accessible either directly through a browser (with the partition's IP address) or through a management application such as Systems Insight Manager or an enterprise management application.

Support Management Station (SMS)

To further decrease the possibility of unscheduled downtime, the HP Integrity Superdome Support Management Station (SMS), a separate server, provides diagnosis and test capabilities for the Integrity Superdome. The SMS includes ASIC-level scan tools that can be used by HP support engineers to diagnose Integrity Superdome servers in your data center. (For more details on the SMS, see "HP Integrity Superdome Support Management Station" on page 34.)

HP Instant Support Enterprise Edition (ISEE)

The Integrity Superdome can be supported by HP Instant Support Enterprise Edition (ISEE), which is designed to keep mission-critical environments up and running. The ISEE lets HP Mission Critical Support Centers (MCSC) reduce the number, duration, and impact of outages on covered systems.

The ISEE is a leading-edge remote support solution, a combination of processes and support personnel that provide powerful support capabilities for systems covered by mission-critical HP support contracts. The HP ISEE solution improves the availability of the Integrity Superdome by:

• Conducting frequent, automated data collection of the customer's mission-critical environment

- Providing a secure, high-bandwidth link for HP support personnel to remotely access the customer's environment in order to conduct diagnostic tests and potentially solve reported problems
- Providing reactive and proactive support for HP mission-critical customers

HP Mission Critical Support Center

The MCSC resides inside HP. Its job is to act as the primary support center to collect and track customer information and to perform proactive problem analysis. It also provides a control point in the ISEE remote support architecture. To maintain the security of the customer's environment, the MCSC allows only authorized high-availability (HA) support engineers to access the isolated LAN.

ISEE collects configuration data from the customer's mission-critical environment on a weekly basis for providing both reactive and proactive support. HP qualified support engineers interpret the data in order to expedite the problem resolution process. The HP account support team will also analyze the data to provide the following proactive services:

- **HP-UX Patch Analysis**—a detailed review of the systems' current patch level, with recommendations to install, update, or remove patches to align the environment with the pre-selected patch management strategy
- **HP-UX OS, hardware, and firmware analysis**—a detailed assessment to assist in improving system availability; reducing business interruptions caused by technical configurations, operating system, hardware, and software; and recommending proven best practices
- **System HealthChecks**—a suite of server assessment tools that perform analysis relating to system management, availability, security, and performance to enhance your system
- **Environment assessment**—a detailed assessment of your HP-UX environment (can also be applied to MC/Serviceguard clusters), which identifies opportunities to increase environmental availability through planned configuration change management

HP network support customers who are entitled to ISEE Advanced Configuration will also receive the benefits of HP Network Support Tools (NST). Network Support Tools provide HP's network support engineers with powerful diagnostics and mapping tools for network discovery, configuration collection, and troubleshooting to resolve network problems quickly. NST takes advantage of the ISEE platform, features, and single remote access point. HP performs remote support only with customer authorization.

Repairability

HP Integrity Superdome servers have a substantial number of features that make them easier to repair with little or no downtime. Among these features are:

- Machine check architecture
- N+1 CPUs and cell boards with Instant Capacity (only available on HP-UX 11i and Windows)
- Hot-swap N+1 fans, power supplies, and backplane DC/DC converters
- Online replacement of PCI-X I/O cards (only available on HP-UX and Windows Server 2003)
- Online addition and replacement (OLAR) of cell boards (available in a follow-on release to HP-UX 11i)
- Dual power sources

N+1 CPUs and cell boards with iCOD

Integrity Superdome servers have support for Instant Capacity with HP-UX. This feature lets you bring additional CPUs or cell boards (i.e., CPUs and memory) online without a system reboot. Because no reboot is needed, the system has no loss of availability, even while capacity is being increased.

Another advantage of Instant Capacity is that it allows setting up a system of N+1 CPUs or cell boards, providing high single-system availability. If one CPU or one cell board (i.e., CPU or memory) fails, another is already running and prepared to take its place automatically without disturbing system operation.

N+1 fans, power supplies, and backplane DC/DC converters

Integrity Superdome servers are equipped with N+1 fans, power supplies, and backplane DC/DC converters, providing high availability for these components.

Dual power sources

Dual power sources in these servers mean the power supply can be protected against becoming a single point of failure.

Online addition and replacement (OLAR) of PCI I/O cards and chassis

PCI card OLAR enables the online addition and replacement of PCI I/O cards on HP Integrity Superdome servers running HP-UX and Windows Server 2003. The system hardware uses per-slot power control combined with operating system support for the PCI card OLAR feature to allow you to add a new card and replace an existing card without affecting other components or requiring a reboot.

Online addition and replacement of cell boards

Integrity Superdome servers and a future HP-UX release (after 11i v2) will support online addition and replacement of cell boards, allowing repair and maintenance of these critical components without bringing the system down.

Online addition of nPartitions

These servers allow you to add nPartitions without affecting other running nPartitions. Such dynamic reconfiguration is another reason why HP Integrity Superdome servers provide increased uptime. And HP Integrity Superdome servers will fully support dynamic cell board migration with the next release of HP-UX 11i.

HP Serviceguard HA and Microsoft Cluster Service (MSCS) Cluster-in-a-Box

In order to increase the uptime of applications within an Integrity Superdome, you can configure nPartitions in an HP Serviceguard HA or Microsoft Cluster Service (MSCS) cluster so that the cluster membership is within the system. Upon detection of a failure within an nPartition, the HP Serviceguard HA or MSCS cluster software fails-over the application to another nPartition within the HP Integrity Superdome system.

Below is the HA clustering software supported for each operating system:

- **HP-UX 11i version 2:** HP Serviceguard
- **Windows Server 2003:** Microsoft Cluster Service (MSCS) for Windows Server 2003, Datacenter Edition for Itanium-based systems
- **Linux:** HP Serviceguard

Uptime Institute Certification

The interaction of a server with its physical environment is a critical component of maintaining the availability of the environment. As such, the HP Integrity Superdome line demonstrates its mission-critical capabilities by being fully certified by The Uptime Institute's Fault Tolerant Power Compliance Certification version 1.2. The certification verifies that all computer and communication hardware maintains full functionality through various power-testing manipulations. The HP Integrity Superdome

qualified as "fault tolerance power compliant" based on requirements collectively developed by the 48 members of the Uptime Institute's Site Uptime Network.

Support services

In order to provide high availability, there is much more to consider than just the hardware capabilities of the HP Integrity Superdome. For example, customers should keep in mind not only the overall HA solutions being offered by HP products (delivering both single-system and cluster HA), but also support services (such as business-continuity support and critical-systems support), IT process support (consulting, disaster-recovery services, etc.), and partnerships with third parties (e.g., databases, ERP, and telecommunication solutions) for fully integrated high-availability solution offerings. When HP support is purchased, fault management events can be forwarded to the HP support organization. HP can then monitor, filter, and interpret the events and take action on items that need attention.

HP Integrity Superdome: investment protection

The HP Integrity Superdome family provides outstanding customer investment protection and lasting value, thanks in part to a system infrastructure designed to accommodate several generations of processor upgrades. For example, existing HP 9000 Superdome servers are board-upgradable to the PA-8800 and Intel Itanium 2 processors and the HP mx2 Dual-Processor Module as well as future PA-RISC (PA-8900) and Intel Itanium processors. All major system components other than the cell board and power conversion card remain the same—these processors even use the same memory DIMMs. An Intel Itanium 2 processor and an HP mx2 Dual-Processor Module can be combined in the same complex, but not in the same partition, thus enhancing the flexibility and investment protection within the system.

Figure 9. HP microprocessor roadmap
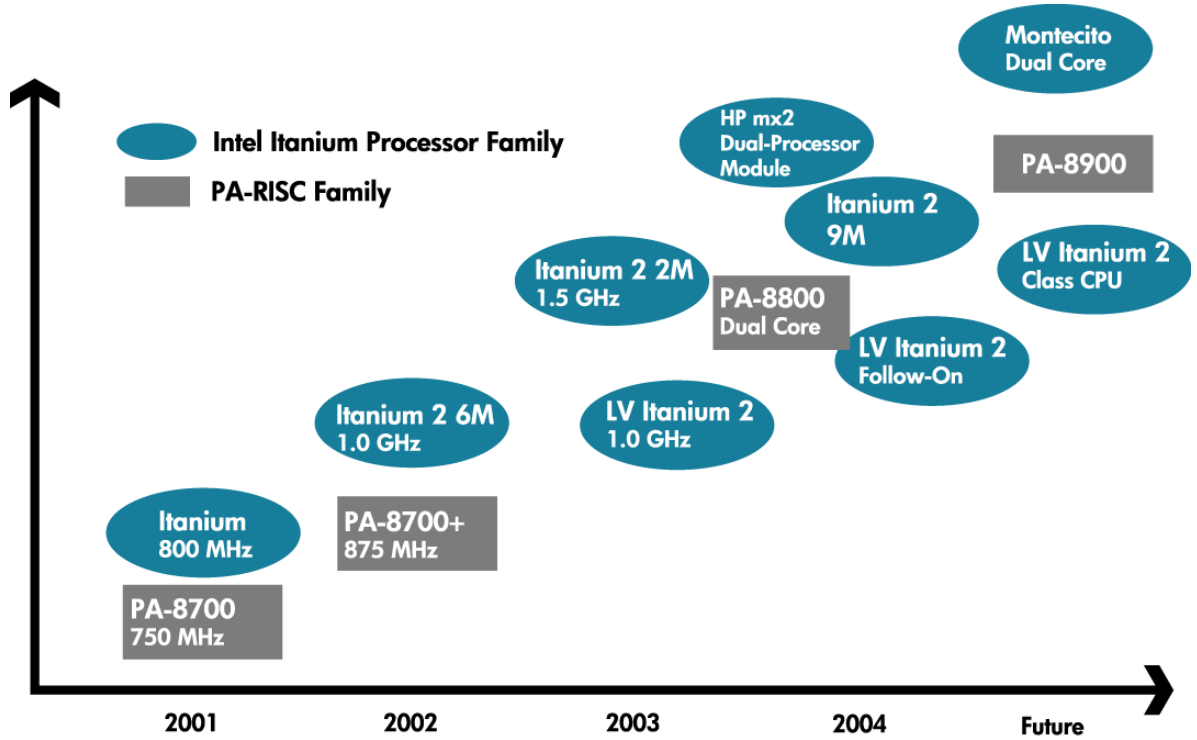
The processor roadmap in Figure 9 shows not only HP's leading line of RISC processors but also the binary-compatible Intel Itanium processors. Notice that HP is investing in several PA-RISC enhancements after the introduction of Itanium-based systems, so HP 9000 Superdome customers will be able to move to the new Intel Itanium architecture when they are ready, not when they are forced to by a vendor. Superior microprocessors and binary compatibility help make the HP Integrity Superdome the fastest high-end server on the market, and the safest investment for the future.

Binary compatibility across PA-RISC

You can continue to rely on binary compatibility across the PA-RISC family, enabling seamless interoperability with legacy applications on HP systems. Binary compatibility protects your investments, enabling rapid growth and adoption of new technology infrastructures. For performance improvements, you can use existing applications and operating systems with new or more advanced processor technology as it develops.

Binary compatibility for the Intel Itanium Processor Family

HP will continue to support binary compatibility through the introduction of Itanium-based systems. As a result of HP's work with Intel on Explicitly Parallel Instruction Computing (EPIC) architecture—the technology foundation for the Intel Itanium architecture—today's HP-UX, Windows, and Linux applications from their PA-RISC and x86 heritage will run unchanged on Itanium-based systems. To provide the best performance, you can recompile applications without source changes.

Upgrading an HP Integrity Superdome with Intel Itanium 2 processors to take advantage of the HP mx2 Dual-Processor Module

Upgrading an existing Integrity Superdome is quick and easy:

- Remove the cell boards.
- Replace the existing processors with new mx2 Dual-Processor Modules.
- Plug the cell boards back into the cabinet.

The Intel Itanium 2 processors and mx2 Dual-Processor Modules can coexist in the same complex in different partitions. As such, processor upgrades can occur on a cell-board basis and can be performed one nPartition at a time in order to decrease downtime for the entire complex.

Upgrading an HP 9000 Superdome

Upgrading an existing HP 9000 Superdome is simple:

- Remove the cell boards.
- Transfer all memory to the new cell board.
- Plug the cell board and the separate power board into the cabinet.
- Replace existing cell blockers if the upgraded system requires cell blockers.
- Replace side panels on the system cabinet if the upgraded system is going to be used with an I/O expansion cabinet.
- Change system cabinet skins and I/O expansion cabinet skins to the graphite color.

Note: The original HP 9000 Superdome cells and HP Integrity Superdome cells cannot coexist in the same system, even in different partitions.

Processor upgrades occur on a cell board basis and can be performed one nPartition at a time in order to decrease downtime for the entire complex. You can upgrade PA-8600, 750 MHz PA-8700, and 875 MHz PA-8700 processors in this manner. (Mixing PA-RISC and Intel Itanium processors in one system is currently not supported.)

Today's HP Integrity Superdome line is already prepared for the next generation of processors, ensuring that it will stay ahead of tomorrow's performance demands. Integrity Superdome servers deliver investment protection through in-chassis upgrades.

HP Integrity Superdome server virtualization

Server virtualization enables administrators to increase the usage and simplify the management of single-server or multiple-server environments by configuring them as reusable pools of resources. Virtualization is an approach to IT that pools and shares resources so utilization is optimized and supply automatically meets demand.

One key solution for enabling an infrastructure of this nature is the HP Virtual Server Environment (VSE), which offers increased return on IT investment by improving server resource utilization in real time according to business priorities. In addition to increased server utilization, the HP Virtual Server Environment also enables rapid deployment of computing resources, improves availability, and significantly reduces costs.

Figure 10. The HP Virtual Server Environment for HP-UX 11i improves utilization while maintaining service levels.

Intelligent policy engine:

HP-UX Workload Manager

Server virtualization techniques:

Resource management
Partitioning
On demand
Clustering

- Automates the virtualized environment
- Goal-based or policy-based resource management
- Exclusive integration:
  - CPU resource allocation
    - within and across partitions
    - between multiple apps in a single OS image
  - Automatic re-allocation of resources upon Serviceguard package activation
- Application-transparent
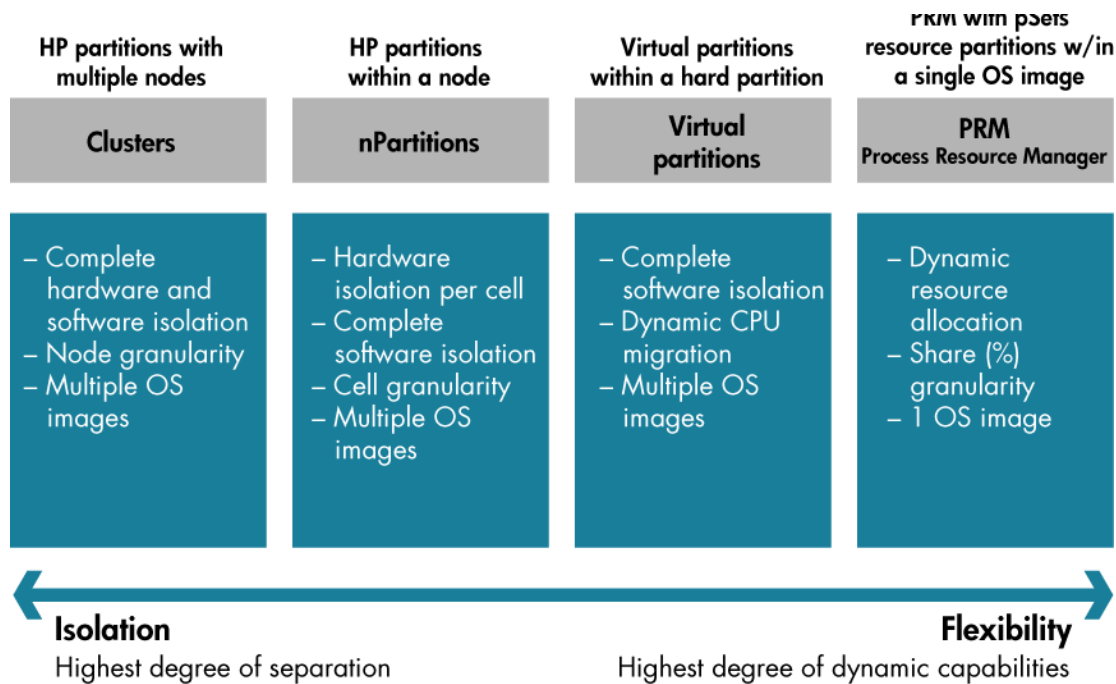- Application-specific toolkits

The core functionality of the VSE is delivered by the intelligent policy engine, HP-UX Workload Manager, which continuously assesses whether a server environment is meeting its service-level objectives (SLOs) and either advises administrators or adjusts resources automatically when SLOs are not met. This base functionality is enhanced by the VSE's ability to orchestrate the real-time allocation of all virtual server resources—partitions, on-demand solutions, and cluster solutions—assigned to executing applications, users, and processes.

VSE includes a number of fully integrated, complementary components that enhance the functionality and flexibility of your server environment. These include:

- **HP-UX Workload Manager (HP-UX WLM)**, an intelligent policy engine, performs real-time assessment of resource usage and advises and acts based on SLOs and business priorities to adjust the supply of resources according to demand.

- **The HP Partitioning Continuum** provides a range of hard, virtual, and resource partitioning tools that offer resource virtualization at the server or partition level, improve overall system and subsystem utilization, and lower costs in consolidated environments. Partitions are physical or logical mechanisms for isolating operational environments within single or multiple servers. Partitioning provides IT managers with the flexibility to dynamically resize an application's resource usage while making sure that all applications enjoy protection from disruptive events that could cause service interruption or performance degradation.

Figure 11. The HP Partitioning Continuum for HP-UX 11i combines high isolation with excellent flexibility

HP partitions with multiple nodes	HP partitions within a node	Virtual partitions within a hard partition	PRM with pSets resource partitions w/in a single OS image
Clusters	nPartitions	Virtual partitions	PRM Process Resource Manager
– Complete hardware and software isolation – Node granularity – Multiple OS images	– Hardware isolation per cell – Complete software isolation – Cell granularity – Multiple OS images	– Complete software isolation – Dynamic CPU migration – Multiple OS images	– Dynamic resource allocation – Share (%) granularity – 1 OS image

Isolation
Highest degree of separation

Flexibility
Highest degree of dynamic capabilities

HP offers four different types of partitioning solutions that work in the VSE, each designed to support a different balance of application isolation and resource optimization.

- **Hard partitions**—Hard partitions within a node are designed to isolate application environments from single points of failure. This means that applications running within hard partitions are not affected by hardware or software events occurring in other partitions. On the Integrity Superdome servers, hard partitions are within the node and are called nPartitions, or nPars. An HP Integrity Superdome can support anywhere from one to 16 nPartitions, each supporting its own operating system, applications, peripherals, and networks. Each nPartition can host HP-UX, Linux, and Windows operating environments.

  Within HP Integrity Superdome servers, cell boards are grouped into physical structures. An nPartition consists of one or more cells that communicate coherently over a high-bandwidth, low-latency crossbar fabric. Special programmable hardware in the cell boards defines the boundaries of an nPartition in such a way that isolation from the actions of other nPartitions is enforced.

  Each nPartition runs its own independent operating system, and different nPartitions can be executing the same or different versions of an OS. In an Integrity Superdome, they can even be executing different operating systems altogether (such as HP-UX, Linux, and Windows).

Each nPartition has its own independent set of CPUs, memory, and I/O resources. You can use system management commands to move resources from one nPartition to another without having to physically change the hardware. In addition, dynamic additions of new nPartitions are supported.

- **Virtual partitions**—Virtual partitions provide complete software fault isolation within an individual server or a hard partition. This means that any application or OS-related failure impacts only the partition in which it is executing—without having any effect on other virtual partitions running on the same system. In a system with virtual partitions, each OS instance is completely independent of all others. Operating systems in different partitions can either be different versions or have different tuning parameters. Therefore, virtual partitions are useful for testing new OS versions or applications without the need to replicate the deployment environment. HP Integrity Superdome servers will not support virtual partitions on HP-UX, Windows, or Linux at first release. However, it will support them in the future.

- **Resource partitions**—Resource partitions address the need for the dynamic allocation of dedicated resources, within a single OS instance and between competing applications, in order to avoid resource contention. For HP-UX environments, HP offers HP Process Resource Manager, which allows system administrators to control the amount of resources that applications, users, or groups may use during peak system load. For Windows environments, Microsoft's Windows System Resource Manager (WSRM) is available to provide resource partitions.

- **Utility pricing solutions from HP**—Instant Capacity, Temporary Instant Capacity, and Pay per use (PPU) enable dormant processors and memory to be dynamically activated and paid for as required.

- **Clustering solutions**—HP Serviceguard, Extended Campus Clusters, Metrocluster, and Continentalclusters enable the implementation of cost-effective failover and disaster-tolerant environments without the acquisition of redundant hardware. HP geographically dispersed cluster solutions such as Serviceguard Extension for RAC (SGeRAC) extend clustering capability from a single data center solution to a transparent "virtual application environment" between two data centers up to 100 km apart in an active-active environment with no redundant hardware.

HP Integrity Superdome: ease of management

In spite of all of its power and flexibility, the HP Integrity Superdome is remarkably simple to manage, making your life easier with a host of management features and technologies. These include the following:

- HP Integrity Superdome Support Management Station
- Partition Manager
- System-level and workload management tools for HP-UX, Windows, and Linux

HP Integrity Superdome Support Management Station

The Support Management Station (SMS) is used to run HP Integrity Superdome scan tools. The server is a PC device running Windows. However, existing HP 9000 Superdome systems can use the current UNIX SMS device with Integrity Superdome as long as the SMS software is updated. The scan tools are used to enhance diagnosis and testability of the platform throughout server development and manufacturing, and they are now available to HP field engineering organizations. Additionally, the SMS for HP Integrity servers is now supported for use as a console, with the addition of a display, monitor, and keyboard. This translates into better management, as well as faster and easier upgrades and hardware replacement.

SMS installation

One SMS is installed per customer site (or data center) and connected to each HP Integrity Superdome via a private LAN. Ideally, the SMS is installed near the associated HP Integrity Superdome servers, so the HP customer engineer will run the scan tools and then be able to immediately make any necessary hardware repairs. The physical connection from the platform is a private Ethernet connection.

The SMS can support two LAN interfaces:

- The dedicated connection to the systems to be supported
- The connection to interface with the customer's general LAN

These two LAN connections allow SMS operations to be performed remotely. More than one SMS can exist on a private LAN, but only one SMS should be actively using the LAN.

SMS functional capabilities

The SMS can:

- Allow remote access via customer LAN (no modem access)
- Be disconnected from the Integrity Superdome servers without disrupting their operation
- Be connected to a new Integrity Superdome and be recognized by scan software
- Support multiple, heterogeneous Integrity Superdome platforms with scan software capability
- Scan one Integrity Superdome while other Integrity Superdome servers are connected, without disrupting the operational platforms
- Run the scan software tools
- Run up to four scan processes concurrently, each on a different HP Integrity Superdome
- Support utility firmware updates

Partition Manager

Another invaluable management feature for HP Integrity Superdome is the Partition Manager. This tool provides control and management of HP Integrity Superdome nPartitions and is available in native mode on HP-UX. Windows and Linux partitions can be managed by Partition Manager running on HP-UX. In addition, a native Windows command-line solution is available to run on the Support Management Station. You can launch Partition Manager either as a GUI or directly from the command line. With it you can:

- Display server status
- Create, delete, and modify nPartitions
- Display a complete hardware inventory
- Display status of key server components
- Check for problems or unusual server conditions
- Manage power to cells and I/O chassis
- Toggle attention indicators for cells, I/O chassis, I/O cards, and cabinets

Partition Manager on HP-UX 11i v2 has been significantly improved to include:

- A new Web interface
- Graphical "big picture" views of
  - nPars
  - Hardware components
- Easy-to-see status lights

- Smart action menus that adjust per selected element
- Remote administration

Additional features are available on HP-UX servers:

- Partition Manager can be launched by Servicecontrol Manager 3.0
- Partition Manager is aware of Instant Capacity and Pay per use

Central point of administration

HP Systems Insight Manager is the central point of administration for managing all HP servers running HP-UX, Windows, Linux, and OpenVMS. HP Systems Insight Manager delivers powerful monitoring and control, notifying the administrator of potential hardware or software problems before they occur. It also provides inventory reporting capabilities that dramatically reduce the time and effort required to track server assets. HP Systems Insight Manager provides secure communications as well as role-based security so that its powerful capabilities are kept secure from unauthorized users. And HP Systems Insight Manager is an effective tool for managing your HP storage, power, client, and printer products. HP Systems Insight Manager integrates with many other operating system–specific tools described below.

HP-UX

Software deployment

- **Ignite-UX** addresses the need for HP-UX system administrators to perform fast deployment for one or many servers. It provides the means for creating and reusing standard system configurations, enables replication of systems, permits post-installation customizations, and is capable of both interactive and unattended operating modes.
- **Software Distributor (SD)** is the HP-UX administration toolset used to deliver and maintain HP-UX operating systems and layered software applications. Delivered as part of HP-UX, SD can help you manage your HP-UX operating system, patches, and application software on HP Integrity servers.
- **Update-UX** is a tool for customizing the behavior of and automating the process for HP-UX operating environment updates.
- **Software Package Builder** is an intuitive, GUI-based tool for packaging software into SD-UX packages so they can be installed and managed in the same way as HP's system software.

Configuration

- **System Administration Manager (SAM)** is used to manage accounts for users and groups, perform auditing and security operations, and handle disk and file system management and peripheral device management. Servicecontrol Manager allows these tasks to be distributed to multiple systems and delegated using role-based security.
- **HP-UX Kernel Configuration** is used for self-optimizing kernel changes. The new HP-UX Kernel Configuration tool allows users to tune both dynamic and static kernel parameters quickly and easily from a Web-based GUI to improve system performance. This tool also sets kernel parameter alarms that notify you when system usage levels exceed thresholds.
- **HP-UX webmin-based Admin** is a Web-based system management framework that allows a wide variety of open source webmin system management modules to be plugged in. HP supports this tool for the configuration of the HP-UX Apache-based Web server and the HP-UX Tomcat-based Servlet Engine.
- **HP-UX Bastille** is a security hardening/lockdown tool that enhances the security of an HP-UX host. It accommodates the various degrees of hardening required of servers used for the Web, applications, and databases.

- **Security Patch Check** determines how current a system's security patches are, recommends patches for continuing security vulnerabilities, and warns administrators about recalled patches still present on the system.

- **Serviceguard Manager** can monitor and manage Serviceguard on HP-UX and Linux clusters from a single point. It provides a graphical user interface to display status and administer HP Serviceguard, Serviceguard Extension for RAC, Metrocluster, and Continentalclusters.

- **Event Monitoring Service (EMS)** keeps the administrator of multiple systems aware of system operation throughout the cluster and notifies the administrator of potential hardware or software problems before they occur. HP Servicecontrol Manager can launch the EMS interface and configure EMS monitors for any node or node group that belongs to the cluster, resulting in increased reliability and reduced downtime.

- **Management Processor** enables remote server management over the Web, regardless of the system state. In the unlikely event that the operating system is not running, the Management Processor can be accessed to power-cycle the server, view event and status logs, enable console redirection, and more. The Management Processor is embedded into the server and does not take a PCI slot.

- **Process Resource Manager (PRM)** controls the resources that processes use during peak system load. PRM can manage the allocation of CPU, memory resources, and disk bandwidth. It allows administrators to run multiple mission-critical applications on a single system, improve response time for critical users and applications, allocate resources on shared servers based on departmental budget contributions, provide applications with total resource isolation, and dynamically change configuration at any time—even under load.

- **HP-UX Workload Manager (WLM)** provides automatic CPU resource allocation and application performance management based on prioritized service-level objectives (SLOs). In addition, WLM allows administrators to set real memory and disk bandwidth entitlements (guaranteed minimums) to fixed levels in the configuration. The use of workload groups and SLOs improves response time for critical users, allows system consolidation, and helps manage user expectations for performance.

- **OpenView Operations Agent** provides a fully integrated, single-pane-of-glass management solution for systems, networks, applications, and databases. A powerful ability to monitor, filter, correlate, and respond to events enables IT organizations to establish central management control over their managed environments and improve overall availability and reliability.

- **OpenView Performance Agent** monitors and analyzes the performance of systems and applications to compare service-level objectives with actual application performance. It enables real-time performance monitoring as well as action on alarm.

- **OpenView Glanceplus** is a powerful system monitoring and diagnostic tool that provides online performance information, examination of system activities, identification and resolution of performance bottlenecks, and system fine-tuning.

- **OpenView Data Protector (Omniback II)** provides reliable, high-performance data protection for enterprise-wide heterogeneous environments without impacting system or application performance. It centralizes and automates backup and recovery operations and tracks file versions and media to enable swift recovery of information.

- **OpenView Network Node Manager (NNM)** management station will run on Itanium 2–based HP-UX servers. NNM provides a powerful network management solution that includes concise, in-depth views of network devices and their status in an intuitive graphical format. NNM helps network managers evaluate network performance, pinpoint problem sources, and proactively manage their networks and network availability.

- All other **OpenView** management tools, such as OpenView Operations, Service Desk, and Service Reporter, will be able to collect and process information from the agents running on Integrity servers with HP-UX.

Windows Server 2003

The HP Integrity Essentials Foundation Pack for Windows is a complete toolset for installing, configuring, and managing HP Integrity Superdome servers running Windows. The following tools are included in the pack:

- **Smart Setup CD** includes an EFI-based setup utility (EBSU) designed for easy server and array controller configuration. The CD also includes all the latest tested and compatible HP drivers, HP firmware, HP utilities, and HP management agents that assist in the server deployment process (by preparing the server for installation of a standard Windows operating system) and in the ongoing management of the server. Customers who are interested in even easier deployment are advised to order their Itanium 2–based HP servers preloaded with Windows.

- **HP Systems Insight Manager support for Windows Server 2003** is available to manage Integrity servers with Windows Server 2003. See above for additional details.

- **System Management Home Page for HP Integrity Servers with Windows** helps system administrators rapidly respond to potential and actual system failures, increases system stability, and reduces troubleshooting complexity. It provides consolidated information about system health and configuration through a simple, Web-based user interface. All system faults and major subsystem status are reported within the System Management Home Page. The System Management Home Page is accessible either directly through a browser or through a management application such as Systems Insight Manager or an enterprise management application.

Also available for managing HP Integrity servers running Windows are the following:

- **Partition Manager** creates and manages nPartitions—hard partitions for high-end servers. Once the partitions are created, the systems running on those partitions can be managed consistently with all the other server management tools available for Windows servers. At first release, Partition Manager will require a PC SMS running Partition Manager Command Line or an HP-UX 11i v2 partition or separate device (e.g., Itanium 2–based workstation or server running HP-UX 11i v2) in order to configure Windows partitions.

- **Management Processor** enables remote server management over the Web regardless of the system state. In the unlikely event that the operating system is not running, the Management Processor can be accessed to power-cycle the server, view event and status logs, enable console redirection, and more. The Management Processor is embedded into the server and does not take a PCI slot.

- **Microsoft Windows System Resource Manager** (WSRM) provides resource management and enables the allocation of resources, including processor and memory resources, among multiple applications based on business priorities. An administrator sets targets for the amount of hardware resources that running applications or users are allowed to consume. This means that you can allocate resources among multiple applications on a server according to your business priorities.

- **OpenView** management tools, such as OpenView Operations and Network Node Manager, will be able to collect and process information from the SNMP agents and WMI running on Itanium 2–based Windows servers, proactively monitoring and measuring the availability and performance of heterogeneous servers and applications from a services perspective and a Windows management platform. In addition, OpenView Operations and performance agents directly collect and correlate event, storage, and performance data from Itanium 2–based Windows servers, enhancing the information OpenView management tools will process and present.

Linux

- **Systems Insight Manager** is available to manage Integrity servers with Linux. See above for additional details.

- **The HP Enablement Kit for Linux** facilitates setup and configuration of the operating system. This kit includes SystemImager, an open source operating-system-deployment tool. SystemImager is a golden image–based tool and can be used for initial deployment as well as updates.
- **Partition Manager** creates and manages nPartitions—hard partitions for high-end servers. Once the partitions are created, the systems running on those partitions can be managed consistently with all the other server management tools available for Linux servers. At first release, Partition Manager will require an HP-UX 11i v2 partition or separate device (e.g., Itanium 2–based workstation or server running HP-UX 11i v2) in order to configure Linux partitions.
- **Management Processor** enables remote server management over the Web regardless of the system state. In the unlikely event that the operating system is not running, the Management Processor can be accessed to power-cycle the server, view event and status logs, enable console redirection, and more. The Management Processor is embedded into the server and does not take a PCI slot.
- **OpenView** management tools, such as OpenView Operations and Network Node Manager, collect and process information from the SNMP agents running on Itanium 2–based Integrity servers running Linux. In addition, HP OpenView Operations and Performance agents will directly collect information for Integrity servers running Linux.

HP Services for the HP Integrity servers

Evolve your infrastructure confidently with a partner that stands accountable

When you're ready to take advantage of the performance improvements Itanium-based systems offer, HP has a full range of multi-OS services to help make the transition as seamless and painless as possible. We'll help you quickly and confidently introduce HP Integrity systems into your existing IT environment and maximize their potential for your business. We offer assessment services to precisely define porting requirements and chart a course to deployment, implementation services to install and configure equipment rapidly, and education services to provide your staff with the expertise required to achieve heightened system performance. Throughout the evolution process, HP accepts full accountability for delivering on the service commitments that we and our partners have made. And our commitment to your satisfaction doesn't stop with the transition process itself. Our multi-OS support offerings—from simple reactive to comprehensive mission-critical—reduce the risks associated with downtime once your HP Integrity systems are installed. We are looking ahead to help with your long-term success by working with leading independent software vendors (ISVs) in both the technical and commercial markets to tailor their applications to the Intel Itanium 2 architecture, thereby exploiting the full potential of your HP Integrity servers.

HP Services delivers end-to-end solutions that offer consistent quality and service levels across multiple platforms such as UNIX, Windows, and Linux, as well as systems from other well-known vendors. With the introduction of the Itanium 2–based midrange servers, HP is the only vendor that offers the services to support the implementation of multiple operating systems (UNIX, Windows, and Linux) on a single Itanium-based server. HP Services will utilize its wide range of offerings and its experienced services personnel to help companies fully exploit the capabilities of the Intel Itanium architecture while protecting their existing infrastructures.

Full lifecycle services

HP Services offers a portfolio of services across your IT lifecycle that meet your business requirements. Whether it's a discrete short-term engagement or a full-scale project deployment, HP helps you fully exploit the Intel Itanium architecture capabilities while protecting your existing infrastructures and IT investments by positioning you to meet your evolving business needs.

- **Evaluation and planning:** HP Services experts help your company determine the best strategy for seamlessly integrating Itanium-based systems into your existing infrastructure to improve performance, reduce costs, and gain control of your IT environment. Working closely with your

team, HP helps you develop an architecture that matches your IT environment to your business requirements and then creates a detailed migration plan that provides specific recommendations based upon your IT needs.

- **Porting and migration:** HP offers flexible porting and migration services that help you retain or enhance your application functionality, minimize disruptions during migration, and take full advantage of the distinctive capabilities of the Intel Itanium architecture. HP will work with you to determine your porting and migration needs, devise a strategy for moving applications to Itanium-based platforms, and create a detailed migration plan. And if you choose, HP can manage all the details, including porting and migrating your applications, migrating your data, integrating your applications with existing ones, and performing application tuning.

- **IT consolidation:** HP offers IT consolidation solutions that help you optimize the use of your IT resources, achieve new performance and productivity levels, and evolve your IT environment to meet changes in demand. HP Services personnel help you identify your company's business and IT objectives; create an investment justification and architectural blueprint; develop a detailed design plan that incorporates specifics on the configuration and technologies of your company's solution; and deliver a complete, tested infrastructure implementation.

- **Deployment:** HP Services personnel have the experience and expertise to deliver services that can help reduce the risks, time, and costs associated with deploying new technology. Acting as your single point of contact, HP develops and implements a deployment plan—including configuration, testing, and installation of all equipment—that helps provide the seamless deployment of Itanium-based solutions into full production.

- **Ongoing support:** HP offers a variety of support levels that cover your entire IT infrastructure and meet your specific needs. Companies can count on HP Services to help them acquire the assistance they need to maintain control of and deliver business value through their IT investments. You benefit from proactive onsite services, defined escalation processes, and rapid fixes. Corresponding HP services for your storage and network systems provide an integrated support solution for your environment.

  - **Hardware and software support:** HP has a full spectrum of proven preventive, diagnostic, remedial, and repair services that include high-quality remote and onsite support, upgraded hardware service response times and coverage periods, fast and reliable access to HP Response Centers for software phone-in assistance, and software updates for selected HP and third-party products.

  - **Integrated support:** Support Plus and Support Plus 24 are integrated hardware and software services that are available to customers who require assistance that complements their internal IT resources. HP Proactive 24 Service includes proactive advice and assistance that helps you improve the effectiveness of your IT environment.

  - **Mission-critical support:** In order to reduce downtime exposure, HP can deliver optimum support for businesses running critical applications. HP uses proven processes, best practices, and leading remote support technologies to help provide maximum IT availability and performance. The Critical Service offering combines proactive and reactive services, including availability assessments and modeling, benchmarking, performance optimization, remote monitoring, security, capacity planning, configuration, availability, and performance management services. No other vendor matches our worldwide standard 6-hour call-to-repair commitment (subject to specific terms and conditions). In addition, through the HP Mission Critical Partnership, you have the opportunity to create a custom agreement with HP to achieve your business objectives through customized business-level commitments that eliminate exposure to abrupt negative acts.

- **Education:** HP offers a full curriculum of education courses that can help improve the productivity and performance of your workforce. Through these courses, programmers and IT administrators can quickly become in-house experts on the Intel Itanium architecture and the operation of Itanium-based solutions for HP-UX, Linux, and Windows. Courses are delivered using a variety of methods—from

customized onsite classes to self-paced, Web-based sessions—that meet your company's learning requirements.

- **Technical services:** Even the most technically proficient IT staff may need assistance when implementing and managing its Itanium-based platforms. That's why HP offers technical services—discrete, focused engagements that provide on-demand expertise to supplement your own IT resources. HP delivers proactive technical consulting services across the entire IT lifecycle, from assessment and planning to high availability and performance to security and system administration.

- **Business continuity services:** HP business continuity offerings—including consulting, disaster tolerant, business recovery, and backup and recovery services—can protect your critical high-value business processes against potentially serious outages. HP uses a proven best-practices-based methodology to design and implement a solution and continuity plan that fits your company's specific business needs.

- **Managed services:** HP offers comprehensive managed services that deliver innovative on-demand and traditional outsourcing offerings to simplify the management of your IT infrastructure and reduce costs while helping you quickly address changes in the marketplace. Our proven, flexible approach enables you to outsource your entire IT infrastructure—hardware, processes, and people—with the knowledge that you will receive predictable support levels based upon approved service-level agreements.

The HP difference

HP Services provides a full range of services to help companies like yours quickly and confidently introduce Itanium-based systems into their IT infrastructures. Through our world-class methodologies, proven processes, IT expertise, advanced support technologies, and partnerships with industry leaders, HP Services can help you gain the full benefits from this technology—optimal resource utilization, reduced costs, and improved return on IT investment.

HP provides consistent delivery of its services via a global network of operations, education, and competency centers. HP Services employs more than 65,000 skilled and experienced professionals working in more than 160 countries, including 18,000 experts in UNIX, 28,000 in Microsoft, and 3,000 in Linux. Through this expertise, companies are assured of end-to-end solutions that offer consistent quality, availability, and cost across multiple platforms and operating systems.

Proven experience and expertise

Our global network of services personnel have unmatched experience and expertise in deploying go-to-market solutions using best-in-class processes across the lifecycle. And no matter what services you choose—from assessment or porting and migration, to complete deployment and education offerings, to ongoing support or full outsourcing solutions—HP will help you take advantage of this next-generation architecture quickly and cost-effectively.

To learn more about HP Services, visit: www.hp.com/hps/

Note: Services and support for each operating system will be available at the time the specific operating system is available or supported by the server.

The rest of the HP Integrity Superdome story

This white paper has barely touched the surface of the capabilities of the HP Integrity Superdome family. Here are some other areas of interest.

The Adaptive Enterprise and HP Integrity Superdome

Because no HP Integrity Superdome stands in isolation, you can expect even more from HP. The HP Integrity Superdome can be part of your Adaptive Enterprise, meeting the needs of your total IT environment throughout the life of the solution.

HP Integrity Superdome servers are delivered with a Foundation Configuration of services that help you get the right configuration for your solution the first time—and in record time. The services begin with up-front assessments of business/IT alignment, IT technical skills, and environment and mission-critical readiness. You'll get a detailed architecture design based on your solution; factory pre-integration for software, peripherals, and middleware; and an HP solution manager assigned to make sure you are satisfied. You'll also be able to add mission-critical support services to meet the demanding stability and availability requirements so characteristic of the Internet powerhouse.

Conclusion

In this era of 24 x 7 applications and mission-critical Internet operations, businesses need a bulletproof infrastructure. That infrastructure is powered by HP's industry-leading, high-performance enterprise servers. The HP Integrity Superdome represents another giant step forward for the HP server line. With the recent introduction of the HP mx2 Dual-Processor Module, the sx1000 Chipset can now support two Intel Itanium 2 processors in the same cell board socket that is used for a single Intel Itanium 2 processor. This HP innovation offers up to twice the performance density of the previous HP Integrity Superdome servers.

Availability: With industry-leading multi-system availability, single-system reliability, and superior nPartition resilience, the Integrity Superdome servers are designed to meet the needs of large enterprises, service providers, and established online economy companies.

Capacity: Integrity Superdome servers provide a computing utility infrastructure unmatched by any competitor offering. The superior system and processor architecture provides scalability that outstrips the competition.

Connectivity: Integrity Superdome servers offer massive amounts of I/O connectivity and have high-speed connectivity, too.

Security: Thanks to HP Virtualvault and other leading security products, Integrity Superdome servers can offer unparalleled levels of security. Virtualvault today has been entrusted with protecting some $7 trillion in assets—testimony to its industry-wide acceptance.

Manageability: HP's suite of management products are all ready to make HP Integrity Superdome management easier.

For more information

If you are looking for more information about HP Integrity Superdome servers and Integrity Superdome services, go to:
www.hp.com/products1/servers/integrity/superdome_high_end/index.html

See the following Web pages for additional information:

HP StorageWorks	www.hp.com/go/storage
Adaptive Enterprise	www.hp.com/go/adaptive
TPC-C benchmark	www.tpc.org/tpcc/results/tpcc_perf_results.asp
Rack products	http://h30140.www3.hp.com/
OpenVMS	www.hp.com/go/openvms