Overview of the HP Integrity rx2660, rx3600, and rx6600 Servers

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Executive summary

Today's businesses, from the smallest company to the largest enterprise, are challenged with keeping costs in check while satisfying the increasing and often varying demands on their technology operations. HP Integrity servers are designed to meet these strict, often conflicting requirements.

From the largest HP Integrity Superdome server to the HP Integrity Blade offerings, HP Integrity servers provide flexible capacity, secured availability, and simplified management. The HP Integrity rx2660, rx3600, and rx6600 Servers deliver these attributes while enhancing and extending the HP Integrity entry-level server lineup to new levels of price:performance and types of application deployment.

The overarching goal of the HP Integrity rx2660, rx3600, and rx6600 Servers is to deliver efficient, powerful systems that can be deployed in multiple environments and applications through a balanced system design. The HP Integrity rx2660, rx3600, and rx6600 Servers provide higher levels of availability and scalability and increased internal expansion and performance.

As performance requirements grow, power demands increase, associated costs increase, and power systems are taxed to a greater degree. HP is addressing this problem holistically by implementing more energy efficient server designs and by working to improve industry standards for power and cooling.

HP helped create several industry standards for power and cooling, such as ASHARE TC 9.9, the Uptime Fault Tolerant Power Specification, and the Green Grid Alliance. HP was also one of seven companies (Compaq and Digital Equipment Corporation, now merged into HP, were two of the remaining six) that worked with the U.S. Environmental Protection Agency (EPA) in June 1992 to develop the Energy Star® program.

In addition, the HP Integrity rx2660, rx3600, and rx6600 Servers incorporate new, powerful Intel® Itanium® 2 processors that draw less than half the power per core than previous Intel Itanium 2 processors. HP system designers have also engineered these servers to use new memory (DDR2) and disks (2.5-inch Serial Attached SCSI [SAS] drives) that require less power while providing increased performance. The result is efficient, more powerful servers.

The HP Integrity rx2660, rx3600, and rx6600 Servers have mission-critical availability and scalability, and they support Dynamic Processor Resiliency (DPR), which is the ability to take a failed processor offline without taking down the entire system. They also support error checking and correction (ECC) on the system frontside bus, double DRAM chip sparing (which reduces DIMM replacements by 17 times over single chip spare and is 1,200 times better than single-bit ECC), proactive hardware memory scrubbing, and ECC with PCI Extended (PCI-X) 2.0 cards. Additionally, the HP Integrity rx3600 and rx6600 Servers support PCI card online replacement. These HP Integrity servers also support large internal expansion.

The HP Integrity rx2660 Server supports up to 32 GB of main memory, eight internal hard disk drives, and three I/O expansions slots, with optional support for high bandwidth PCI Express slots. Supplementing the three I/O expansion card slots is an integrated eight-port SAS storage controller, a two-port 1-Gbit LAN controller, and a reserved slot for an optional RAID Smart Array controller.

The HP Integrity rx3600 and rx6600 Servers support 10 I/O card slots (two are reserved for core I/O and eight are available for expansion). They also have optional support for high- bandwidth PCI Express slots.

Individually, the HP Integrity rx3600 Server can have up to 96 GB of main memory and eight disks, while the rx6600 can have up to 192 GB of main memory and 16 disks. The large memory capacity of these systems improves performance by reducing the number of I/O requests. (I/O requests cause process switches to occur, and process switches add instructions that do not process transactions.) Larger memory capacities and more internal disk also help HP bring server consolidation to new, lower price levels. The HP Integrity rx6600 Server, for example, can support up to 160 virtual

machines (requires 173 GB of main memory) using HP Integrity Virtual Machine and the HP Virtual Server Environment.

The flexibility of the HP Integrity rx2660, rx3600, and rx6600 Servers is further demonstrated by their unique support of five operating environments: HP-UX, Red Hat Enterprise Linux, SUSE Linux Enterprise Server, Microsoft® Windows® Server 2003 Enterprise Edition, and OpenVMS.

With thousands of applications supported on HP Integrity servers, including industry-leading applications, such as SAP, Peoplesoft, BEA, Oracle®, Microsoft SQL, and SAS, these servers can truly be deployed wherever they are needed. Simplified management is provided with HP Integrity Integrated Lights Out (iLO) management version 2, which integrates software and hardware management for remote server management.

At the center of the HP Integrity rx2660, rx3600, and rx6660 Servers are the HP-designed Scalable Processor Chipset zx2 and the Intel Itanium 2 Dual-Core processor, which make all of these features and benefits possible.

Introducing the HP Scalable Processor Chipset zx2

The HP-designed Scalable Processor Chipset zx2 is the next-generation follow-on to the HP zx1 chipset, a proven, reliable, and stable chipset that is the foundation of the highly successful HP Integrity rx1620, rx2620, and rx4640 Servers.

The HP zx2 design team made focused enhancements to the HP zx1 chipset to support multiple generations of the Dual-Core Intel Itanium 2 processor and to deliver well balanced systems at price points that entry-level server customers demand.

The zx2 chipset supports up to four processors and eight cores, increased system bandwidth, increased memory address space and bandwidth, increased I/O bandwidth, and increased reliability and availability.

The zx2 chipset also supports the faster 533-MHz frontside bus of the new Dual-Core Intel Itanium 2 processor, which provides 8.5 GB/s of system bandwidth. Memory performance and I/O bandwidth have been increased as well to eliminate performance bottlenecks and achieve a balanced system design.

The zx2 chipset supports two memory controllers, each delivering up to 8.5 GB/s for a total of 17.0 GB/s per system. The following memory page management and optimizations further improve system performance:

- The zx2 memory controller dynamically selects which pages are left open (based on memory access patterns) to reduce access times and reduce average latency by up to 20 ns per transaction.
- Through reordering transactions, memory page management is optimized. Transactions to the same DRAM page are grouped together to amortize the overhead of opening and closing DRAM pages.
- Unnecessary memory transactions are carefully discarded so that memory bandwidth is not consumed with unnecessary transactions.
- I/O capabilities have been increased through support for 266-MHz PCI-X I/O cards and PCI Express I/O cards, doubling the I/O bandwidth of the zx1 chipset to 8 GB/s. The zx2 chipset implements internal data buses between the I/O and memory controllers to minimize the amount of I/O traffic on the processor bus; therefore, only data transfers from processor caches to I/O appear on the processor bus.

Performance improvements are not the end of the story, however. The zx2 chipset adds reliability features above and beyond those that already exist in the highly reliable zx1 chipset, for example:

- The zx2 chipset supports double chip sparing, which reduces scheduled and unscheduled downtime. Double chip sparing reduces DIMM replacements by 17 times over single chip sparing and by 1,200 times over standard single-bit ECC.
- A proactive memory scrubber ensures no measurable impact to system performance by scrubbing soft memory errors at a programmable rate. Transient errors are corrected before they cause a more serious system problem. And the memory scrubber is operating system-independent.
- The zx2 chipset also adds ECC to the I/O slots.
- As in the zx1 chipset, the zx2 chipset supports PCI online replacement.

The zx2 chipset has been designed with businesses' future requirements in mind. The chipset will support the next-generation multicore Intel Itanium 2 processor, an increase in system bandwidth to 667 MHz.

Introducing the Dual-Core Intel Itanium 2 processor

The new Dual-Core Intel Itanium 2 processor extends the roadmap for 64-bit computing and focuses on maintaining Intel's leadership position in performance with the implementation of several new features. Originally co-developed by HP and Intel, the Intel Itanium 2 microarchitecture is a high-performance, parallel 64-bit architecture that has leading performance today and the performance headroom to grow in the future.

The Dual-Core processor places two separate logical processors, referred to as cores, on one physical chip, referred to as the processor, which increases computing density and delivers significant performance gains.

The Intel Itanium performance strategy is to increase performance per thread and then increase the number of threads. The Dual-Core Itanium 2 processor supports course-grain, "event switched" hyper-threading. When the processor makes a request to the cache for data that is not there, the processor stalls while the request is satisfied from memory or disk. While the processor waits for that request to be fulfilled, the Itanium 2 processor allows another process, or "thread," to execute, thereby increasing throughput capacity.

Hyper-threading increases the utilization of the Dual-Core Itanium 2 process by 25 to 50%, which represents a 100% increase in aggregate throughput, effectively adding a processor's worth of performance without an increase in component count. Maximum performance gain, of course, is affected by application and increased demands on other components, such as cache and branch prediction structures. Each core of the new Itanium 2 processor supports two threads, which is four threads per Dual-Core processor. Previous Intel Itanium processors supported one thread per core.

These Dual-Core processors are further enhanced by increasing the on-chip cache by more than two and a half times over the current generation of Itanium processors—up to 26.5 MB across three levels. The level 2 cache has been split, dedicating 1 MB to instruction cache and effectively increasing data cache to 256 KB. Level 3 cache has been increased up to 12 MB per core.

The new Dual-Core processors also support a 533-MHz frontside bus, which is 33% faster than the previous generation processor, and they provide vastly improved performance through improvements in execution (more efficient speculation recovery), improved memory hierarchy (split L2 cache to dedicate a 1-Mb L2 instruction cache per core), and up to 12 MB L3 cache per core. An HP Integrity rx6600 Server supports up to 16 threads per system over four processors and eight cores—four times the execution threads of current four-processor Intel Itanium 2 systems.

A single-core version of this new Intel Itanium 2 processor is supported on the HP Integrity rx2660 Server to accommodate environments and applications with lower performance requirements. The

core of this single-core processor has all the same features, such as hyper-threading, that the core of the Dual-Core processors has.

Specifications for the HP Integrity rx2660 Server

The HP Integrity rx2660 Server offers new levels of entry-class value by providing the most flexibility in a compact system enclosure. At only 3.4 inches in height (86mm), the HP Integrity rx2660 Server supports two single-core or Dual-Core Intel Itanium 2 processors, and it can be configured with up to 32 GB of RAM, eight 2.5-inch hot-pluggable SAS disk drives, and a choice of I/O backplane options.

- An "all PCI-X" backplane option provides up to 5.3 GB/s of sustained bandwidth.
- A combo backplane option provides two PCI Express slots and one PCI-X slot for a total of 6.3 GB/s of sustained bandwidth.

Each of the two backplane choices provides three full-length slots for I/O expansion.

An additional 1.7 GB/s of I/O bandwidth is supplied by an integrated eight-port SAS host bus adapter, an integrated two-port 1-GB LAN, and a reserved PCI Express slot for an optional Smart Array card[1], USB ports, a management LAN, and serial ports.

The HP Integrity rx2660 Server also includes availability and management features, which make it ideal for deployment in mission-critical data centers or computation-intensive server farms. Features such as hot-swappable redundant power and fans, double DRAM chip spare, an integrated Integrity iLO 2 management processor, VGA, and high-availability clustering support make the HP Integrity rx2660 Server ideal for nearly any computing environment.

Furthermore, the HP Integrity rx2660 Server is designed to accommodate the next-generation Intel Itanium 2 processor. You can upgrade with a simple processor swap and the installation of new firmware.

The HP Integrity rx2660 Server also provides operating system flexibility by offering the following 64-bit operating systems:

- HP-UX 11i v2 September 2006 Update
- HP-UX 11i v3[2]
- Linux (Red Hat Enterprise Linux 4 U4 and SUSE Linux Enterprise Server 10[3])
- Microsoft Windows Server 2003 Enterprise Edition
- OpenVMS 8.3

The server can be installed in a rack or in a stand-alone pedestal configuration, along with a host of choices from the full range of HP storage peripherals and I/O adapters.

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[1] The Optional Smart Array card is required for Windows orders. Windows does not support the integrated 8-port SAS host bus adapter.
[2] HP-UX 11i v3 does not support PCI Express I/O slots at this time. Customers requiring PCI-E must operate HP-UX 11i v2 September 2006 Update.
[3] SUSE Linux Enterprise Server 10 will be supported on the rx2660 in Q2 Calendar 2007.

Figure 1. The HP Integrity rx2660 Server can be installed in a rack or as a stand-alone unit.[4]

Product specifications

- Central processor
  - One or two single-core Intel Itanium 2 processors at 1.6 GHz
  - 533-MHz frontside system bus (1.6-GHz single-core processor)
  - One or two Dual-Core Intel Itanium 2 processors at 1.4 GHz or 1.6 GHz
  - 533-MHz frontside system bus (1.4-GHz Dual-Core processor)
  - 533-MHz frontside system bus (1.6-GHz Dual-Core processor)
- Cache (all on-chip)
  - 32-KB data L1 cache
  - 1-MB instruction/256-KB data L2 cache per core
  - 6-MB L3 cache (1.6-GHz single-core processor)
  - 12-MB L3 cache (1.4-GHz Dual-Core processor) per processor (6 MB per core)
  - 18-MB L3 cache (1.6-GHz Dual-Core processor) per processor (9 MB per core)
- Main memory
  - 1 to 32 GB maximum DDR2 memory in 8 DIMM slots (DIMMs must be installed in pairs)
  - Supported memory options: 1 GB (2 x 512-MB DIMMs), 2 GB (2 x 1-GB DIMMs), 4 GB (2 x 2-GB DIMMs), and 8 GB (2 x 4-GB DIMMs)
  - 12.8 GB/s of maximum memory bandwidth[5]
- Chipset
  - HP zx2 chipset
  - 80-ns (closed page) memory latency
  - 8.5-GB/s system bus bandwidth
  - 8.0-GB/s aggregate maximum I/O bandwidth, with the combo I/O backplane option
- Choice of form factors
  - Rack mount
  - Stand-alone (vertical mount)[6]
- I/O expansion slots, two backplane options available

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[4] A pedestal/stand-alone option will be available in Q2 2007.
[5] For maximum performance, all DIMM slots should be populated with DIMMs of the same size.
[6] A pedestal/stand-alone option will be available in Q2 2007.

- – All PCI-X backplane: Two PCI-X, 2.1-GB/s sustained, 64-bit, 266-MHz independent full-length slots and one PCI-X, 1.1-GB/s sustained, 64-bit, 133-MHz independent full-length slot
  - – Combo backplane: Two PCI-E, 2.6-GB/s sustained, x8 independent full-length slots, and one PCI-X, 1.1-GB/s sustained, 64-bit, 133-MHz independent full-length slot
- Hot-plug disk drives (eight bays for 2.5-inch SAS disks)
  - – 1,168 GB maximum internal storage with 146-GB SAS disk drives
  - – Integrated HP 8 Internal Port SAS host bus adapter[7] with RAID 1 support, which supports a maximum of two internal RAID 1 volumes (2 x 2 HDDs) and a disk for global hot spare, for a maximum of five disks in RAIDed arrays
  - – Optional PCI Express HP 8 Port SAS Smart Array P400 controller (required for Windows, optional for HP-UX, OpenVMS, and Linux), which supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6 (configured in reserved PCI Express slot)
  - – MirrorUX, which is available for software mirroring on all HDDs in HP-UX-based systems, or HP Volume Shadowing Level 1, which is supported in OpenVMS-base systems
  - – Available disk sizes: 36 GB, 10,000 rpm; 73 GB, 10,000 rpm; and 146 GB, 10,000 rpm
- Removable media
  - – One slimline media bay for optional IDE optical drives
  - – Choice of DVD-ROM or DVD+RW drive (write capability is not supported at this time with HP-UX or OpenVMS)
- Core I/O interconnect ports
  - – Two 10/100/1000BaseTX LAN (automatic speed sensing, RJ-45 connector, Wake on LAN capability)
  - – HP 8 Internal Port SAS host bus adapter[8], which supports up to eight internal 2.5-inch SAS disks and RAID 1
  - – Optional SAS Smart Array P400 controller, which occupies reserved PCI-E slot (does not use one of the three slots provided by the I/O backplane).
- One general-purpose RS-232 serial port
- Integrated HP Integrity iLO 2 processor management card with VGA
  - – 10/100BaseTX management LAN with web console access
  - – RS-232 local console
  - – Standard iLO 2 management features: Web GUI interface, remote power control, DHCP and DDNS enabled, SSL security, SSH access, and SIM group actions
  - – Optional iLO 2 Advanced Pack features: Virtual KVM (Windows only), virtual media CD and DVD, lightweight directory access protocol (LDAP), and LDAP-lite
- Three USB Series A 2.0 ports (two rear and one front)
- Power and cooling
  - – Standard: One hot-swappable power supply (800W @ 90V to 132V AC input/1000W @ 180V to 264V AC input)
  - – Optional: Second hot-swappable power supply (800W @ 90V to 132V AC input/1000W @ 180V to 264V AC input) for N+1 redundancy
  - – Three fan zones, 4 fans per zone, hot-swappable and redundant support

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[7] Not support on Windows-based systems. Windows-based systems must use the optional Smart Array card.
[8] Not supported on Windows-based systems. Windows-based systems must order the optional Smart Array card.

- Power requirements
  - Input current: 100 to 127 V, 10 A/200 to 240 V, 7 A (auto-ranging)
  - Line frequency: 50 Hz to 60 Hz
  - Maximum power input: 798 W

Physical and environmental specifications

- Altitude
  - Operating: 3,000 m (10,000 ft) maximum
  - Storage: 4,600 m (15,000 ft) maximum
- Temperature
  - Operating: +41° F to +95° F (+5° C to +35° C)
  - Nonoperating: –40° F to +158° F (–40° C to +70° C)
- Humidity
  - Operating: 15% to 80% relative (noncondensing)
  - Storage: 90% relative (noncondensing) at +65° C
- Acoustics (operator/bystander) at 25° C
  - Maximum configuration for rack-mount form factor (disk active): 7.0 Bels LwA
  - Maximum configuration for pedestal form factor[9] (disk active): 6.0 Bels LwA or less
- Physical dimensions in rack orientation
  - Height: 86 mm (3.4 inches)/2U
  - Width: 482 mm (19 inches)
  - Depth: 680 mm (26.8 inches)
- Physical dimensions in stand-alone, vertical orientation
  - Height: 512 mm (20.2 inches)
  - Width: 275 mm with the feet (10.8 inches with the feet)
  - Depth: 688 mm (27.1 inches)
- Net weight
  - Minimum rack-mount configuration: 21 kg (46.2 lb)
  - Maximum rack-mount configuration: 28 kg (61.6 lb)
  - Minimum stand-alone configuration: 33 kg (71.2 lb)
  - Maximum stand-alone configuration: 40 kg (86.6 lb)

Mechanical design and packaging

The exploded view shown in Figure 2 reveals the location of major components and the mechanical and architectural features of the HP Integrity rx2660 Server. It is partitioned into three electrical partitions—the system board (including CPUs, memory, and core I/O), the I/O backplane, and the management processor board.

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[9] Pedestal form factor will be available Q2 Calendar Year 2007.

Figure 2. Major components of the HP Integrity rx2660 Server

3-slot I/O cage
- 3 PCI-X OR
- 2 PCI-E; 1 PCI-X

P400 card (optional)

CPUs

Backplane access handle

N+1 power supplies

8x DIMMs slots

6 pairs of redundant system fans (3 cooling zones)
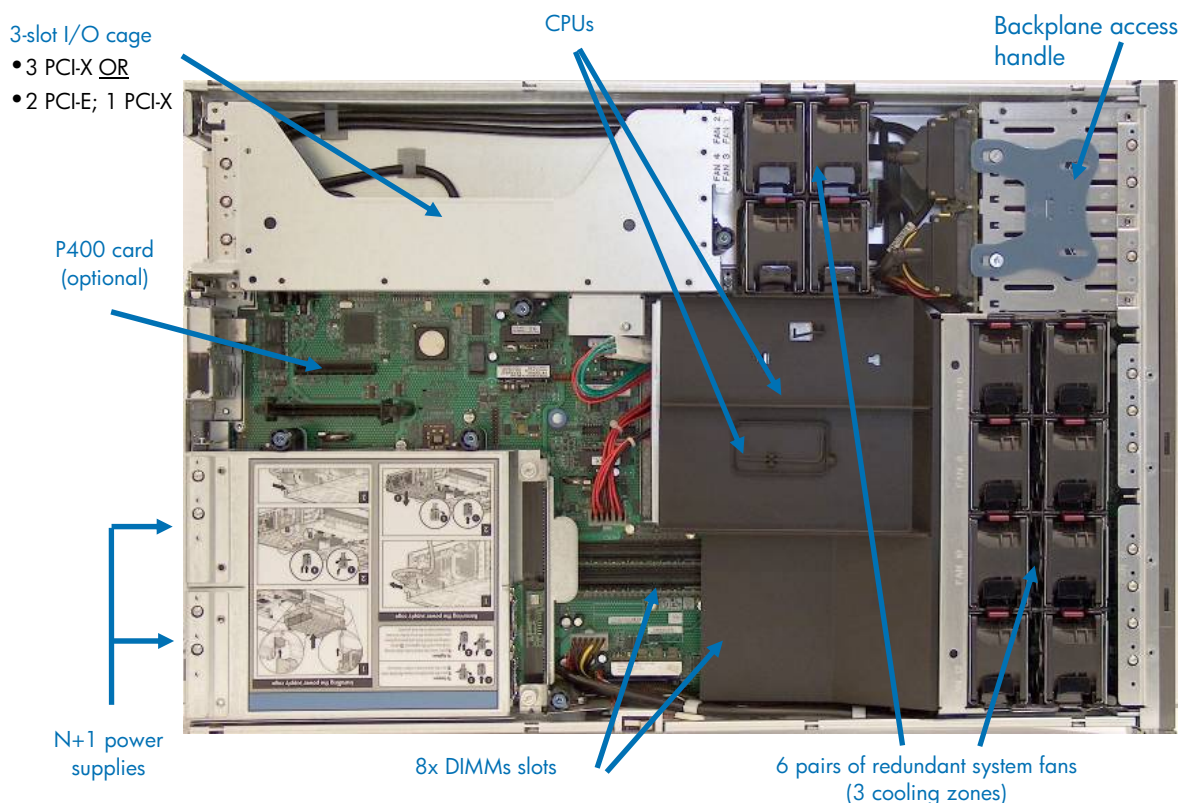
The HP Integrity rx2660 Server occupies 2U or 86 mm (3.4 inches) of rack height, is 482-mm (19-inch) EIA rack compatible, and meets or exceeds all regulatory and safety requirements, including HP environmental tests.

All external cabling enters and exits from the rear of the enclosure. A cable-management arm manages the cable routing. Service access to the system in the rack is enhanced by using chassis slides. The system status indicator and a power switch are on the front of the enclosure, and each individual customer replaceable unit (CRU) has its own set of status indicators located on the diagnostic panel on the front bezel.

Eight 2.5-inch SAS hot-pluggable hard drives, which are arranged vertically on the right side, are conveniently accessible from the front of the system. A system power LED, three health LEDs, and a locator LED are located to the left of the hard drives and under the diagnostic panel. Three font panel buttons include a power button, a locator button, and an INIT button. Also at the left of the front panel, under the fan grill, is a slimline DVD drive bay.

Three N+1 redundant, hot-swappable fan zone assemblies cool the HP Integrity rx2660 Server. They are serviced from the top of the chassis by simply removing the cover panel. The server fans provide excellent cooling by pulling cool air from the front of the unit, flowing the air back over internal system components, and then discharging heated air out the back of the server. Each fan zone has four fans and can sustain one fan failure while continuing to cool the system.

The processors and memory are serviced from the top of the chassis as well. The HP Integrity rx2660 Server supports eight memory DIMM sockets. If some DIMM sockets are not populated, memory DIMMs can be added by removing the cover of the system. For best performance, HP recommends

that all DIMM slots be filled with DIMMs of equal size (that is, all 512-MB DIMMs, all 1-GB DIMMs, and so on). All HP Integrity rx2660 memory options come in pairs of DIMMs.

The HP Integrity rx2660 Server is designed to provide high availability with 1+1 power redundancy. The redundant N+1 hot-swappable power supplies are serviced from the right rear (as viewed from the back) of the chassis. One active power supply at 100 VAC is sufficient to operate the system at its maximum load; however, the system can be operated at 100 to 240 VAC.

To further enhance availability, each power supply has its own dedicated power feed or line cord. Cords can be plugged into separate power grids for the maximum level of power protection. The power supplies are power factor corrected.

Specifications for the HP Integrity rx3600 Server

The HP Integrity rx3600 Server supports two Dual-Core Intel Itanium 2 processors in a compact, yet internally expandable, 4U EIA enclosure. An HP Integrity rx3600 Server can be configured with up to 96 GB of RAM and eight 2.5-inch hot-pluggable Serial Attached SCSI (SAS) disk drives.

There are two I/O backplane options:

- An all PCI-X backplane option provides up to 7.4-GB/s of sustained I/O bandwidth through eight slots:
  - Two PCI-X, 266-MHz, 64-bit full-length slots
  - Two PCI-X, 133-MHz, 64-bit full-length slots
  - Four PCI-X, 66-MHz, 64-bit slots, two of which are full length and two which are less than full length at 8.5 inches
- A combination backplane option provides up to 9.2-G B/s of sustained I/O bandwidth through eight I/O slots:
  - Four PCI-E, x8 full-length I/O slots
  - Two PCI-X, 133-MHz, full-length slots
  - Two PCI-X, 66-MHz, 64-bit slots, which are less than full length at 8.5 inches.

An additional .6-GB/s of I/O bandwidth is supplied by an integrated eight-port SAS host bus adapter, an integrated two-port 1-GB LAN, USB ports, a management LAN, and serial ports.

The HP Integrity rx3600 Server also includes extensive availability and management features, which make it ideal for deployment in mission-critical data centers or computation-intensive server farms. Features such as hot-swappable redundant power and fans, double DRAM chip spare, PCI online repair, an integrated Integrity iLO 2 management processor, and high-availability clustering support make the HP Integrity rx3600 Server ideal for nearly any computing environment.

Furthermore, the HP Integrity rx3600 Server was designed to accommodate the next-generation Intel Itanium 2 processor. You can upgrade with a simple processor swap and the installation of new firmware.

The HP Integrity rx3600 Server also provides operating system environment flexibility by offering the following 64-bit operating systems:

- HP-UX 11i v2 September 2006 Update
- HP-UX 11i v3[10]
- Linux (Red Hat Enterprise Linux 4 U4 and SUSE Linux Enterprise Server 10)
- Microsoft Windows Server 2003 Enterprise Edition

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[10] HP-UX 11i v3 does not support PCI-E I/O slots at this time. HP-UX customers requiring PCI-E must order HP-UX 11i v2 September 2006 update.

• OpenVMS 8.3

The server can be installed in a rack or in a stand-alone pedestal configuration[11] (see Figure 3), along with a host of choices from the full range of HP storage peripherals and I/O adapters.

Figure 3. The HP Integrity rx3600 Server can be installed in a rack or as a stand-alone unit.[12]

Product specifications

- Central processor
  - One or two Dual-Core Intel Itanium 2 processors at 1.4 GHz or 1.6 GHz
  - 533-MHz frontside system bus (1.4-GHz Dual-Core processor)
  - 533-MHz frontside system bus (1.6-GHz Dual-Core processor)
- Cache (all on-chip)
  - 32-KB data L1 cache
  - 1-MB instruction/256-KB data L2 cache per core
  - 12-MB L3 cache (1.4-GHz Dual-Core processor) per processor (6 MB per core)
  - 18-MB L3 cache (1.6-GHz Dual-Core processor) per processor (9 MB per core)
- Main memory
  - 2 to 96 GB maximum DDR2 memory in 24 DIMM slots (DIMMs must be installed in groups of four.)
  - Choice of an 8-DIMM (2 x 4 DIMM carrier) or 24-DIMM (2 x 12 DIMM carrier) memory board option
  - Supported memory options: 2 GB (4 x 512-MB DIMMs), 4 GB (4 x 1-GB DIMMs), 8 GB (4 x 2-GB DIMMs), and 16 GB (4 x 4-GB DIMMs)
  - 12.8 GB/s of maximum memory bandwidth[12]
- Chipset
  - HP zx2 chipset

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[11] A stand-alone pedestal option will be available in Q1 2007.
[12] For maximum performance, two memory carrier boards should be installed and fully populated with DIMMs of the same size.

- – 80-ns (closed page) memory latency
- – 8.5-GB/s system bus bandwidth
- – 9.8-GB/s aggregate I/O bandwidth, with the combination I/O backplane option
- Choice of form factors
  - – Rack mount
  - – Stand-alone (vertical mount)[13]
- I/O expansion slots, two options
  - – All PCI-X backplane option: Two PCI-X, 2.1-GB/s sustained, 64-bit, 266-MHz independent full-length slots; two PCI-X, 1.1-GB/s sustained, 64-bit, 133-MHz independent full-length slots; and four PCI-X, 0.5-GB/s sustained, 64-bit ,66-MHz shared slots (two full-length slots and two half-length [8.5 inch] slots)
  - – Combination backplane option: Two PCI Express, 2.6-GB/s sustained, x8 independent full-length slots; two PCI Express 1.3-GB/s sustained, x8 shared full-length slots, two PCI-X, 1.1-GB/s sustained, 64-bit, 133-MHz independent full-length slots; and two half-length PCI-X, 0.5-GB/s sustained, 64-bit ,66-MHz shared slots
- Hot-plug disk drives (eight bays for 2.5-inch SAS disks)
  - – 1,168 GB maximum internal storage with 146-GB SAS disk drives
  - – Integrated PCI-X HP 8 Internal Port SAS host bus adapter[14] with RAID 1 support, which supports a maximum of two internal RAID 1 volumes (2 x 2 HDDs) and a disk for global hot spare, for a maximum of five disks in RAIDed arrays
  - – Optional PCI-X HP 8 Port SAS Smart Array Controller[15] (required for Windows and Linux-based systems), which supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6
  - – Optional PCI Express HP 8 Port SAS Smart Array P400 Controller (supported on HP-UX, Windows, Linux, and OpenVMS), which requires the combination I/O backplane option and supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6
  - – MirrorUX, which is available for software mirroring on all HDDs in HP-UX-based systems, or HP Volume Shadowing Level 1, which is supported in OpenVMS-base systems
  - – Available disk sizes: 36 GB, 10,000 rpm; 73 GB, 10,000 rpm; and 146 GB, 10,000 rpm
- Removable media
  - – One slimline media bay for optional IDE optical drives
  - – Choice of DVD-ROM or DVD+RW drive (write capability is not supported at this time with HP-UX or OpenVMS)
- Core I/O interconnect ports
  - – PCI-X two-port 10/100/1000BaseTX LAN (automatic speed sensing, RJ-45 connector, Wake on LAN capability)
  - – PCI-X HP 8 Internal Port SAS host bus adapter, which supports up to eight internal 2.5-inch SAS disks and RAID 1 for HP-UX and OpenVMS (supports a maximum of two internal RAID 1 volumes - 2 x 2 HDDs - and a disk for global hot spare, for a maximum of five disks in RAIDed arrays)
  - – PCI-X HP 8 Port SAS Smart Array controller, which supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6 for Windows and Linux
  - – PCI Express HP 8 Port SAS Smart Array P400 controller (supported on HP-UX, Windows, Linux, and OpenVMS), which requires the combo I/O backplane option and supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6
- One general-purpose RS-232 serial port

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[13] A stand-alone pedestal option will be available in Q1 2007.
[14] Not supported on Windows and Linux-based systems. Windows and Linux customers must order the 8 Port SAS Smart Array option.
[15] Not supported on HP-UX and OpenVMS-based systems.

- Integrated HP Integrity iLO 2 processor management card with VGA (An upgrade to VGA is required for Windows but is optional for HP-UX, Linux, and OpenVMS.)
  – 10/100BaseTX management LAN with web console access
  – RS-232 local console
  – Standard iLO 2 management features: Web GUI interface, remote power control, DHCP and DDNS enabled, SSL security, SSH access, and SIM group actions
  – Optional iLO 2 Advanced Pack features: Virtual KVM (Windows only), virtual media CD and DVD, LDAP, and LDAP-lite
- Three USB Series A 2.0 ports (two rear and one front)
- Power and cooling
  – Standard: One 1,200-W hot-swappable power supply
  – Optional: Second 1,200-W hot-swappable power supply for N+1 redundancy
  – Three N+1 redundant, hot-swappable fan pack assemblies
- Power requirements
  – Input current: 100 to 127 V, 14 A/200 to 240 V, 7 A (auto-ranging)
  – Line frequency: 50 Hz to 60 Hz
  – Maximum power input: 1,095 W

Physical and environmental specifications

- Altitude
  – Operating: 3,000 m (10,000 ft) maximum
  – Storage: 4,600 m (15,000 ft) maximum
- Temperature
  – Operating: +41° F to +95° F (+5° C to +35° C)
  – Nonoperating: –40° F to +158° F (–40° C to +70° C)
- Humidity
  – Operating: 15% to 80% relative (noncondensing)
  – Storage: 90% relative (noncondensing) at +65° C
- Acoustics (operator/bystander) at 25° C
  – Typical configuration (disk idle): Less than 6.8 Bels LwA
  – Maximum configuration (disk idle): Less than 6.8 Bels LwA
  – Maximum configuration (disk active): Less than 6.9 Bels LwA
- Physical dimensions in rack orientation
  – Height: 173 mm (6.8 inches)/4U
  – Width: 440 mm (17.32inches)
  – Depth: 696 mm (27.4 inches)
- Physical dimensions in stand-alone, vertical orientation
  – Height: 512 mm (20.2 inches)
  – Width: 216 mm without the feet, 369 mm with the feet (8.5 inches without the feet, 14.5 inches with the feet)
  – Depth: 696 mm (27.4 inches)
- Net weight
  – Minimum stand-alone configuration: 45 kg (99 lb)
  – Maximum stand-alone configuration: 52 kg (114 lb)

- Minimum rack-mount configuration: 34 kg (75 lb)
- Maximum rack-mount configuration: 41 kg (90 lb)

Mechanical design and packaging

The exploded view shown in Figure 4 reveals the location of major components and the mechanical and architectural features of the HP Integrity rx3600 Server. It is partitioned into three electrical partitions—the system board (including CPUs, memory, and core I/O), the I/O backplane, and the management processor board.

Figure 4. Major components of the HP Integrity rx3600 Server

8 or 24 DDR2 DIMM slots

2 CPU sockets

I/O card area

Hot-swappable power supplies

Hot-swappable fans
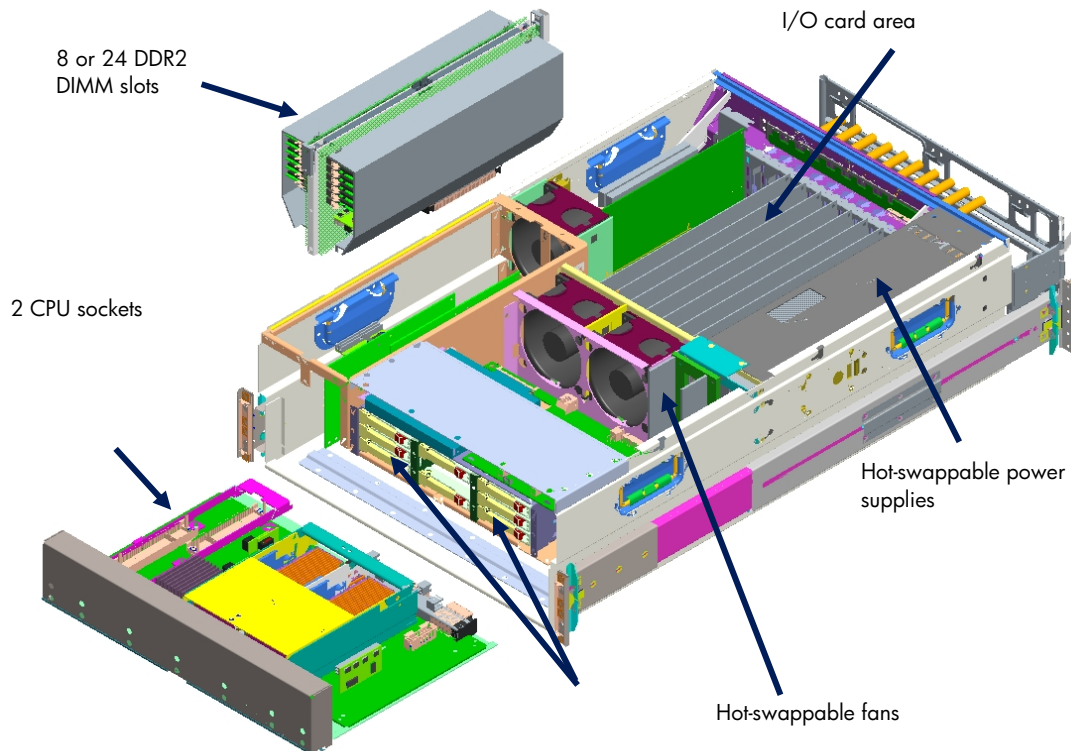
The HP Integrity rx3600 Server occupies 4U or 173 mm (6.8 inches) of rack height, is 48.3-cm (19-inch) EIA rack compatible, and meets or exceeds all regulatory and safety requirements, including HP environmental tests.

All external cabling enters and exits from the rear of the enclosure. A cable-management arm manages the cable routing. Service access to the system in the rack is enhanced by using chassis slides. The system status indicator and a power switch are on the front of the enclosure, and each individual field replaceable unit (FRU) has its own set of status indicators located on the diagnostic panel inside the top cover.

Eight 2.5-inch SAS hot-pluggable hard drives, which are arranged horizontally on the right side, are conveniently accessible from the front of the system. A front panel is just above the hard drives. It provides a system power LED, three health LEDs, and a locator LED. Three font panel buttons include a power button, a locator button, and an INIT button. Also just above the hard drives is a slimline DVD drive bay.

Three N+1 redundant, hot-swappable fan pack assemblies (two rotors per pack) cool the HP Integrity rx3600 Server. They are serviced from the top of the chassis by simply removing the cover panel. The server fans provide excellent cooling by pulling cool air from the front of the unit, flowing the air back over internal system components, and then discharging heated air out the back of the server.

The processors and memory are serviced from the front and top of the chassis as well. The memory extenders must be removed before the processor assembly can be serviced. The HP Integrity rx3600 Server supports eight or 24 memory DIMM sockets. If some DIMM sockets are not populated, memory DIMMs can be added by removing the extenders, adding the memory, and replacing the extenders in the system. For best performance, HP recommends the 24-DIMM option, with all DIMM slots filled with DIMMs of equal size (that is, all 512-MB DIMMs, all 1-GB DIMMs, and so on). All HP Integrity rx3600 memory options come in quad DIMMs.

The I/O cards are serviced from the top, and the I/O backplane is serviced from the rear of the chassis. The I/O backplane is mounted on a removable tray for easy servicing. All eight I/O slots of the all PCI-X backplane option support online replacement, while all but two of the PCI Express slots of the combo backplane option support online replacement.

Each slot is mechanically separated with a divider that contains a card extraction mechanism and a mechanical retention latch. Attention LEDs, doorbell buttons, and a power LEDs for each slot are located on a separate panel card assembly mounted above the top of the I/O cards in the area where the bulkhead is retained. The two reserved core I/O slots do not support online replacement.

The HP Integrity rx3600 Server is designed to provide high availability with 1+1 power redundancy. The redundant N+1 hot-swappable power supplies are serviced from the left rear (as viewed from the back) of the chassis. One active power supply at 100 VAC is sufficient to operate the system at its maximum load; however, the system can be operated at 100 to 240 VAC.

To further enhance availability, each power supply has its own dedicated power feed or line cord. Cords can be plugged into separate power grids for the maximum level of power protection. The power supplies are power factor corrected, and the maximum DC power output of each supply is 1,200 W.

Specifications for the HP Integrity rx6600 Server

The HP Integrity rx6600 Server supports up to four Dual-Core Intel Itanium 2 processors. An HP Integrity rx6600 Server can be configured with as much as 192 GB of RAM and sixteen 2.5-inch hot-pluggable SAS hard disk drives.

There are two I/O backplane options:

- An all PCI-X backplane option provides up to 7.4-GB/s of sustained I/O bandwidth through eight slots:
  - Two PCI-X, 266-MHz, 64-bit full-length slots
  - Two PCI-X, 133-MHz, 64-bit full-length slots
  - Four PCI-X, 66-MHz, 64-bit slots, two of which are full length and two which are less than full length at 8.5 inches
- A combo backplane option provides up to 9.2-GB/s of sustained I/O bandwidth through eight I/O slots:
  - Four PCI-E, x8 full-length I/O slots
  - Two PCI-X, 133-MHz full-length slots
  - Two PCI-X, 66-MHz, 64-bit slots, which are less than full length at 8.5 inches

An additional .6-GB/s of I/O bandwidth is supplied by an integrated eight-port SAS host bus adapter, an integrated two-port 1-GB LAN, USB ports, a management LAN, and serial ports.

The HP Integrity rx6600 Server also includes extensive availability and management features, which make it ideal for deployment in mission-critical data centers or computation-intensive server farms. Features such as hot-swappable redundant power and fans, double DRAM chip spare, PCI online repair, an integrated Integrity iLO 2 management processor, and high-availability clustering support make the HP Integrity rx6600 Server ideal for nearly any computing environment.

Furthermore, the HP Integrity rx6600 Server was designed to accommodate the next-generation Intel Itanium 2 processor. You can upgrade with a simple processor swap for investment protection.

The HP Integrity rx6600 Server is flexible, too. It offers the following 64-bit operating systems:

- HP-UX 11i v2 September 2006 Update
- HP-UX 11i v3[16]
- Linux (Red Hat Enterprise Linux 4 U4 and SUSE Linux Enterprise Server 10)
- Microsoft Windows Server 2003 Enterprise Edition
- OpenVMS 8.3

The server can be installed in a rack or in a stand-alone, pedestal configuration[17] (see Figure 5) along with a host of choices from the full range of HP storage peripherals and I/O adapters.

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[16] HP-UX 11i v3 does not support PCI-E I/O slots at this time. HP-UX customers requiring PCI-E must order HP-UX 11i v2 September 2006 Update.
[17] A stand-alone pedestal option will be available in Q1 2007.

Figure 5. The HP Integrity rx6600 Server is suitable for rack-mount or stand-alone duty.[18]
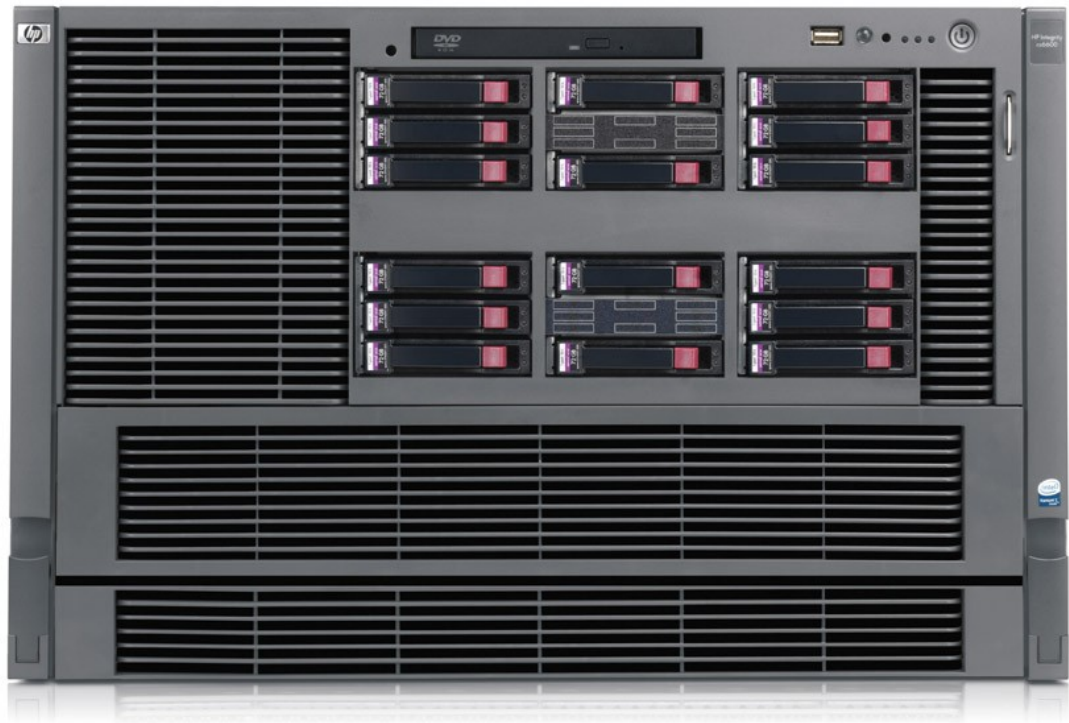
Product specifications

- Central processor
  - Up to four Dual-Core Intel Itanium 2 processors at 1.4 GHz or 1.6 GHz
  - 533-MHz frontside system bus (1.4 -Hz Dual-Core processor)
  - 533-MHz frontside system bus (1.6-GHz Dual-Core processor)
- Cache (all on-chip)
  - 32-KB L1 cache
  - 1-MB instruction/256-KB data L2 cache per core
  - 12-MB L3 cache (1.4-GHz Dual-Core processor) per processor (6 MB per core)
  - 18-MB L3 cache (1.6-GHz Dual-Core processor) per processor (9 MB per core)
  - 24-MB L3 cache (1.6-GHz Dual-Core processor) per processor (12 MB per core)
- Main memory
  - 2 to 192 GB maximum DDR2 memory in 48 DIMM slots (DIMMs must be installed in groups of four.)
  - Choice of a 24-DIMM (2 x 12-DIMM carrier) or 48-DIMM (2 x 24-DIMM carrier) memory board option
  - Supported memory options: 2 GB (4 x 512-MB DIMMs), 4 GB (4 x 1-GB DIMMs), 8 GB (4 x 2-GB DIMMs), and 16 GB (4 x 4-GB DIMMs)

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[18] The pedestal/stand-alone option will be available in Q1 2007

- 17.0 GB/s of maximum memory bandwidth[19]
- Chipset
  - HP zx2 chipset
  - 80-ns (closed page) memory latency
  - 8.5-GB/s system bus bandwidth
  - 9.8-GB/s aggregate I/O bandwidth, with the combination I/O backplane option
- Choice of form factors
  - Rack mount
  - Stand-alone (vertical mount)[20]
- I/O Expansion slots, two options
  - All PCI-X backplane option: Two PCI-X, 2.1-GB/s sustained, 64-bit, 266-MHz independent full-length slots; two PCI-X, 1.1-GB/s sustained, 64-bit, 133-MHz independent full-length slots; and four PCI-X, 0.5-GB/s sustained, 64-bit ,66-MHz shared slots (two full-length slots and two half-length slots)
  - Combination backplane option: Two PCI Express 2.6-GB/s sustained, x8 independent full-length slots; two PCI Express, 1.3-GB/s sustained, x8 shared full-length slots, two PCI-X, 1.1-GB/s sustained, 64-bit, 133-MHz independent full-length slots; and two half-length PCI-X, 0.5-GB/s sustained, 64-bit ,66-MHz shared slots
- Hot-plug disk drives (16 bays for 1-inch-high 2.5-inch SAS disks)
  - 2,336 GB maximum internal storage with 146-GB SAS disk drives
  - Integrated PCI-X HP 8 Internal Port SAS host bus adapter,[21] which supports up to eight internal 2.5-inch SAS disks and RAID 1 for HP-UX and OpenVMS (supports a maximum of two internal RAID 1 volumes - 2 x 2 HDDs - and a disk for global hot spare, for a maximum of five disks in RAIDed arrays
  - Optional PCI-X HP 8 Port SAS Smart Array Controller[22] (required for Windows and Linux-based systems), which supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6
  - Optional PCI-E HP 8 Port SAS Smart Array P400 Controller (supported on HP-UX, Windows, Linux, and OpenVMS), which requires the combo I/O backplane option and supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6
  - MirrorUX, which is available for software mirroring on all HDDs in HP-UX-based systems, or HP Volume Shadowing Level 1, which is supported in OpenVMS-base systems
  - Available disk sizes: 36 GB, 10,000 rpm; 73 GB, 10,000 rpm; and 146 GB, 10,000 rpm
- Removable media
  - One slimline media bay for optional IDE optical drives
  - Choice of DVD-ROM or DVD+RW drive (write capability is not supported at this time with HP-UX and OpenVMS)
- Core I/O interconnect ports
  - PCI-X Two 10/100/1000BaseTX LAN (automatic speed sensing, RJ-45 connector, Wake on LAN capability)
  - PCI-X HP 8 Internal Port SAS host bus adapter, which supports up to eight internal 2.5-inch SAS disks and RAID 1 for HP-UX and OpenVMS (supports a maximum of two internal RAID 1 volumes -2 x 2 HDDs - and a disk for global hot spare, for a maximum of five disks in RAIDed arrays)

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[19] For maximum performance, HP recommends the 48-DIMM option, with all DIMM slots filled with like-sized DIMMs.
[20] The pedestal/stand-alone option will be available in Q1 2007.
[21] Not supported on Windows and Linux-based systems. Windows and Linux customers must order the 8 Port SAS Smart Array P400 option.
[22] Not supported on HP-UX and OpenVMS-based systems.

- PCI-X HP 8 Port SAS Smart Array controller, which supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6 for Windows and Linux
- PCI Express HP 8 Port SAS Smart Array P400 controller (supported on HP-UX, Windows, Linux, and OpenVMS), which requires the combo I/O backplane option and supports up to eight internal 2.5-inch SAS disks and RAID 1, 5, and 6
- Integrated Integrity iLO 2 processor management card with VGA (An upgrade to VGA is required for Windows but is optional for HP-UX, Linux, and OpenVMS.)
  - 10/100BaseTX management LAN with web console access
  - RS-232 local console
  - Standard iLO 2 management features: Web GUI interface, remote power control, DHCP and DDNS enabled, SSL security, SSH access, and SIM group actions
  - Optional iLO 2 Advanced Pack features: Virtual KVM (Windows only), virtual media CD and DVD, LDAP, and LDAP-lite
- Three USB Series A 2.0 ports (two rear and one front)
- Power and cooling
  - Standard: One 1,600-W hot-swappable power supply
  - Optional: Second 1,600-W hot-swappable power supply for N+1 redundancy
  - Six redundant, hot-swappable fan pack assemblies
- Power requirements
  - Input current: 200 to 240 V, 9 A (auto-ranging)
  - Line frequency: 50 Hz to 60 Hz
  - Maximum power input: 1,633 W

Physical and environmental specifications

- Altitude
  - Operating: 3,000 m (10,000 ft) maximum
  - Storage: 4,600 m (15,000 ft) maximum
- Temperature
  - Operating: +41° F to +95° F (+5° C to +35° C)
  - Nonoperating: –40° F to +158° F (–40° C to +70° C)
- Humidity
  - Operating: 15% to 80% relative (noncondensing)
  - Storage: 90% relative (noncondensing) at +65° C
- Acoustics (operator/bystander) at 25° C
  - Typical configuration (disk idle): Less than 6.8 Bels LwA
  - Maximum configuration (disk idle): Less than 6.8 Bels LwA
  - Maximum configuration (disk active): Less than 6.9 Bels LwA
- Physical dimensions in rack orientation
  - Height: 306 mm (12.0 inches)/7U
  - Width: 440 mm (17.3 inches)
  - Depth: 696 mm (27.4 inches)
- Physical dimensions in stand-alone, vertical orientation
  - Height: 422 mm (16.7 inches)
  - Width: 489 mm (19.3 inches)

    – Depth: 696 mm (27.4 inches)
- Net weight
  – Minimum stand-alone configuration: 70 kg (154 lb)
  – Maximum stand-alone configuration: 86 kg (189 lb)
  – Minimum rack-mount configuration: 55 kg (120 lb)
  – Maximum rack-mount configuration: 68 kg (150 lb)

Mechanical design and packaging

Figure 6 and Figure 7 show the exploded views of the HP Integrity rx6600 Server.

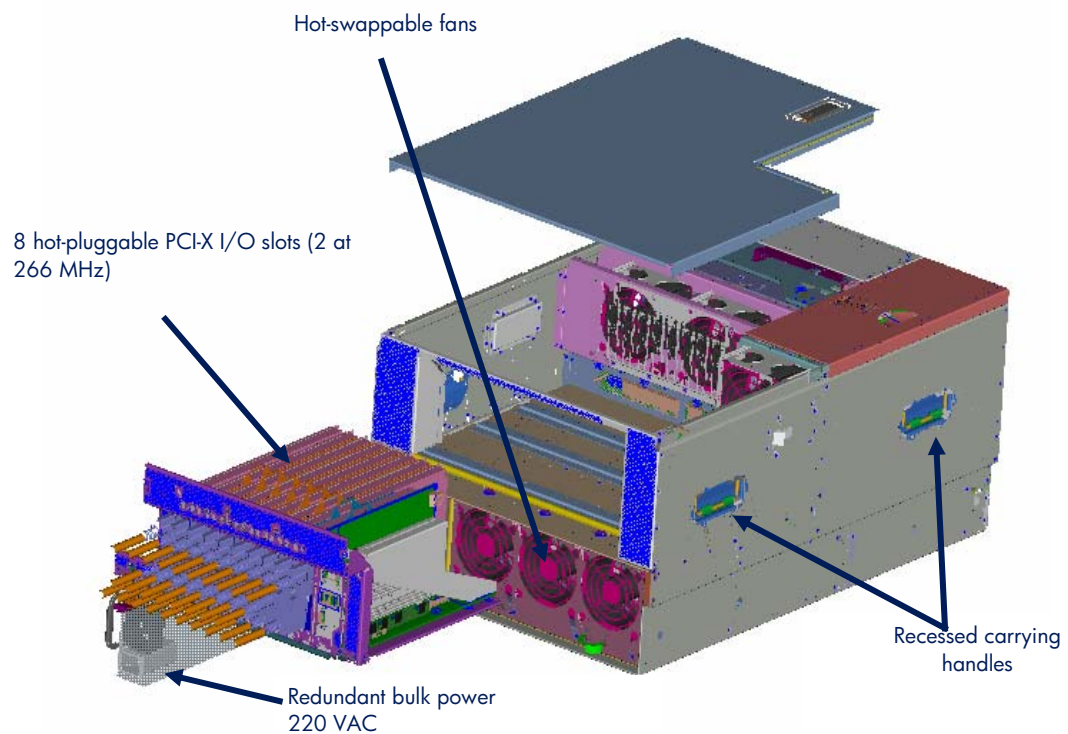**Figure 6.** **Rear view of** major components of the HP Integrity rx6600 Server

Hot-swappable fans

8 hot-pluggable PCI-X I/O slots (2 at 266 MHz)

Recessed carrying handles

Redundant bulk power 220 VAC

Figure 7. Front view of major components of the HP Integrity rx6600 Server

48 DDR2 DIMM slots

4 CPU sockets

7U chassis

16 SAS HDDs
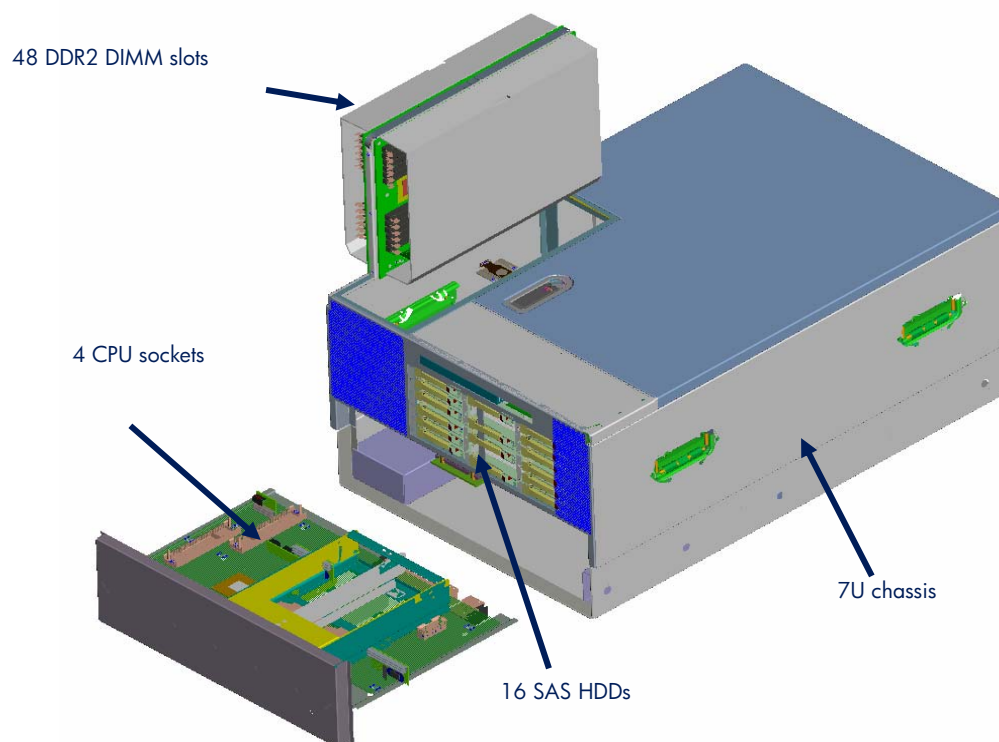
The HP Integrity rx6600 Server occupies 7U or 267 mm (10.5 inches) of rack height, is 483-cm (19-inch) EIA rack compatible, and meets or exceeds all regulatory and safety requirements, including HP environmental tests.

All external cabling enters and exits from the rear of the enclosure. A cable-management arm manages the cable routing. Service access to the system in the rack is enhanced by using chassis slides. The system status indicator and a power switch are on the front of the enclosure, and each individual FRU has its own set of status indicators located on the diagnostic panel inside the top cover.

Sixteen 2.5-inch SAS hot-pluggable hard drives, which are arranged in horizontally on the right side, are conveniently accessible from the front of the system. A front panel is just above the hard drives. It provides a system power LED, three health LEDs, and a locator LED. Three font panel buttons include a power button, a locator button, and an INIT button. Also just above the hard drives is a slimline DVD drive bay.

Six N+1 redundant, hot-swappable fan pack assemblies (two fans per pack) cool the HP Integrity rx6600 Server. They are serviced from the top and rear of the chassis by removing the cover panel. The server fans provide excellent cooling by pulling cool air from the front of the unit, flowing the air back over internal system components, and then discharging heated air out the back of the server.

The processors and memory are serviced from the front and top of the chassis as well. The memory extenders must be removed before the processor assembly can be serviced. The HP Integrity rx6600 Server supports either 24 or 48 DIMM sockets. Systems with 24 DIMM sockets can be upgraded to 48 DIMM sockets. If some DIMM sockets are not populated, DIMMs can be added by removing the extenders, adding the memory, and replacing the extenders in the system. For best performance, HP recommends the 48-DIMM option (two 24-DIMM memory extenders), with all DIMM slots filled with

DIMMs of equal size (that is, all 512-MB DIMMs, all 1-GB DIMMs, and so on). All HP Integrity rx6600 memory options come in quad DIMMs.

The I/O cards are serviced from the top, and the I/O backplane is serviced from the rear of the chassis. The I/O backplane is mounted on a removable tray for easy servicing. All eight I/O slots of the all PCI-X backplane option support online replacement, while all but two of the PCI-E slots of the combo backplane option support online replacement.

Each slot is mechanically separated with a divider that contains a card extraction mechanism and a mechanical retention latch. Attention LEDs, doorbell buttons, and a power LEDs for each slot are located on a separate PCA mounted above the top of the I/O cards in the area where the bulkhead is retained. The two reserved core I/O slots do not support online replacement.

The HP Integrity rx6600 Server is designed to provide high availability with 1+1 power redundancy. The redundant, N+1 hot-swappable power supplies are serviced from the left rear (as viewed from the back) of the chassis. One active power supply at 220 VAC is sufficient to operate the system at its maximum load; however, the system can be operated at 200 to 240 VAC.

To further enhance availability, each power supply has its own dedicated power feed or line cord. Cords can be plugged into separate power grids for the maximum level of power protection. The power supplies are power factor corrected, and the maximum DC output power of each supply is 1,600 W.

Overview of the HP Scalable Processor Chipset zx2

HP develops chipsets to meet the needs of enterprise and technical businesses. In a world where every company has access to the same 64-bit processors, the strength of HP is in developing and tuning systems to deliver the kind of performance and reliability that IT, engineering, and research professionals demand.

The HP zx2 chipset is the central building block of the HP Integrity rx2660, rx3600 and rx6600 Servers. The HP zx2 chipset is a modular, three-chip solution designed for cost-effective, high-bandwidth, low-latency, four-processor/eight-core servers. Designed entirely by HP, the HP zx2 chipset is an exclusive value-add in the standards-based world of Itanium 2-based platform computing.

The HP zx2 chipset consists of three modular components (see Figure 8):

- The HP zx2 chipset memory and I/O controller (zx2 MIO) connects to the processor bus and contains dual memory controllers and the I/O cache controller. It interfaces with the Intel Itanium 2 processor bus and provides a low-latency connection to DDR2 memory, either directly or through zx2 chipset scalable memory expanders (zx2 SMEs). The controller can connect up to 12 memory expanders for quadruple the base memory capacity. It can also connect up to eight zx2 chipset I/O adapters.
- The HP zx2 chipset I/O adapter chip (zx2 IOA) is a scalable solution designed to support PCI-X (266 MHz, 133 MHz, and 66 MHz) and PCI Express bus architectures. It provides a scalable I/O implementation for a wide variety of systems.
- zx2 SMEs are an optional component that increase memory capacity and memory bandwidth. Acting as a memory hub, they decrease the number of signal loads on the memory bus, thereby allowing the system to increase its memory transfer rate.

Figure 8. The three components of the HP zx2 chipset

zx2 memory and I/O controller
Connects to processor bus
Contains memory controller
Contains I/O cache controller

zx2
MIO

zx2 I/O adapters
PCI, PCI-X 66, PCI-X133, PCI-X 266
PCI-E, PCI-X 2.0

zx2
IOA

zx2 scalable memory expander
Optional component used to:
Increase memory capacity
Increase memory bandwidth

zx2
SME
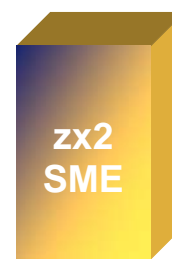
The HP zx2 chipset was designed with several goals in mind:

- Provide the best performance—For demanding applications that do not fit within the processor cache, the memory system design is the key to performance. The HP zx2 chipset memory bandwidth is enhanced with dual memory controllers to provide 14.2 GB/s to 17.0 GB/s of memory bandwidth with 60 to 78 ns of open-page latency.

- Provide the right functionality—Many systems include both memory capability and PCI-X and PCI Express support. At 32 GB, 96 GB and 192 GB, respectively, the HP Integrity rx2660, rx3600 and rx6600 Servers provide enough memory capacity for the most demanding tasks. The servers also support x8 PCI Express buses capable of handling the latest generation of high-speed I/O adapters.

- Enable a family of systems through a modular, multichip design—Designers can choose the chipset components they need and select the number of these components to meet system cost and design requirements. For example, the more-expandable HP Integrity rx6600 Server deploys zx2 SMEs for greater memory capacity.

- Provide industry leading reliability—Double chip spare memory protection, frontside bus ECC, PCI-X ECC, and End to End CRC for PCI Express are all examples of built-in reliability features that provide measurable benefit to the secured availability of HP Integrity servers.

The HP zx2 chipset is ideal for use with the Dual-Core Intel Itanium 2 processor because it complements the processor's price:performance advantages. Moreover, the new zx2 chipset leverages the HP co-developer knowledge of the processor itself.

Table 1. Features and benefits of the HP zx2 chipset

Feature	User benefit
High memory bandwidth, low memory latency	Top application performance, faster time to solution
High memory capacity	Excellent performance for large models/databases
266-MHz PCI-X and PCI Express	Highest-performance I/O adapters
Modularity	Family of Intel Itanium processor-based servers and workstations, each customized for the right level of cost and scalability

Architectural overview of the HP Integrity rx2660 Server

As shown in Figure 9, the HP Integrity rx2660 Server supports one or two single-core or Dual-Core Intel Itanium 2 processors linked to the zx2 MIO through a 533-MHz, double-pumped, 128-bit frontside system bus. Total bandwidth on the system bus is 8.5 GB/s.

Memory DIMMs are attached directly to two 266-MHz, 6.4-GB/s memory buses. Combined memory bandwidth across both buses is 12.8 GB/s. Each bus links up to 4 DDR2 DRAM memory DIMMs. Total system memory capacity is 32 GB through eight 4-GB DIMMs.

The I/O architecture consists of six channels allocated among six zx2 IOAs. Each of the six adapters provides an I/O bus to the available I/O slots and core I/O devices. The total sustained bandwidth of the all PCI-X I/O backplane option is 7.0-GB/s and the total sustained bandwidth of the combo I/O backplane option is 8.0-GB/s.

rx2660 Block Diagram with All PCI-X I/O Card Cage Option[1]

Montecito Processor[2]

Montecito Processor[2]

Dynamic Processor Resiliency (DPR)

ECC Protection on FSB

Memory:
Up to 4-GB DIMMs supported,
32-GB total system, 85ns latency
ECC protection
Double chip-kill + HW memory
   scrubber

533-MT/s FSB
8.5-GB/s[3]

zx2
MIO

DIMM

400-MT/s
6.4-GB/s[4]

400-MT/s
6.4-GB/s[4]

7.0-GB/s
400ns DMA read

PCI-X 266 (2.1-GB/s) — zx2 IOA

zx2 IOA — (1.1-GB/s) Dedicated slot for
                    Optional RAID Enablement Board

PCI-X 266 (2.1-GB/s) — zx2 IOA

zx2 IOA — (.5-GB/s) 8-port SAS Controller,
                    2-port 1GB LAN

PCI-X 133 (1.1-GB/s) — zx2 IOA

zx2 IOA — (133-MB/s) 3 USB ports – 1 front, 2 rear;
                    RN50 Graphics;
                    2 serial ports – 1 for core
                    management, 1 other

Note 1: This Option is not supported with Windows and Linux-based Systems.
Note 2: Can be upgraded to Montvale.
Note 3: At Montvale, FSB increases to 667-MT/s, 10.4-GB/s.
Note 4: With Montvale, increases to 444-MT/s, 7.1-GB/s.

rx2660 Block Diagram with Combo I/O Card Cage Option

Montecito Processor[1]

Montecito Processor[1]

Dynamic Processor Resiliency (DPR)

ECC Protection on FSB

533-MT/s FSB
8.5-GB/s[2]

Memory:
Up to 4-GB DIMMs supported,
32-GB total system, 85ns latency
ECC protection
Double chip-kill + HW memory
   scrubber

DIMM

zx2
MIO

400-MT/s
6.4-GB/s[3]

400-MT/s
6.4-GB/s[3]

8.0-GB/s
400ns DMA read

PCI Express (2.6-GB/s) — zx2 IOA

PCI Express (2.6-GB/s) — zx2 IOA

PCI-X 133 (1.1-GB/s) — zx2 IOA

zx2 IOA — (1.1-GB/s) Dedicated slot for
        Optional RAID Enablement Board

zx2 IOA — (.5-GB/s) 8-port SAS Controller,
        2-port 1GB LAN

zx2 IOA — (133-MB/s) 3 USB ports – 1 front, 2 rear;
        RN50 Graphics;
        2 serial ports – 1 for core
        management, 1 other

Note 1: Can be upgraded to Montvale
Note 2: At Montvale, FSB increases to 667-MT/s, 10.4-GB/s.
Note 3: With Montvale, increases to 444-MT/s, 7.1-GB/s.

Architectural overview of the HP Integrity rx3600 Server
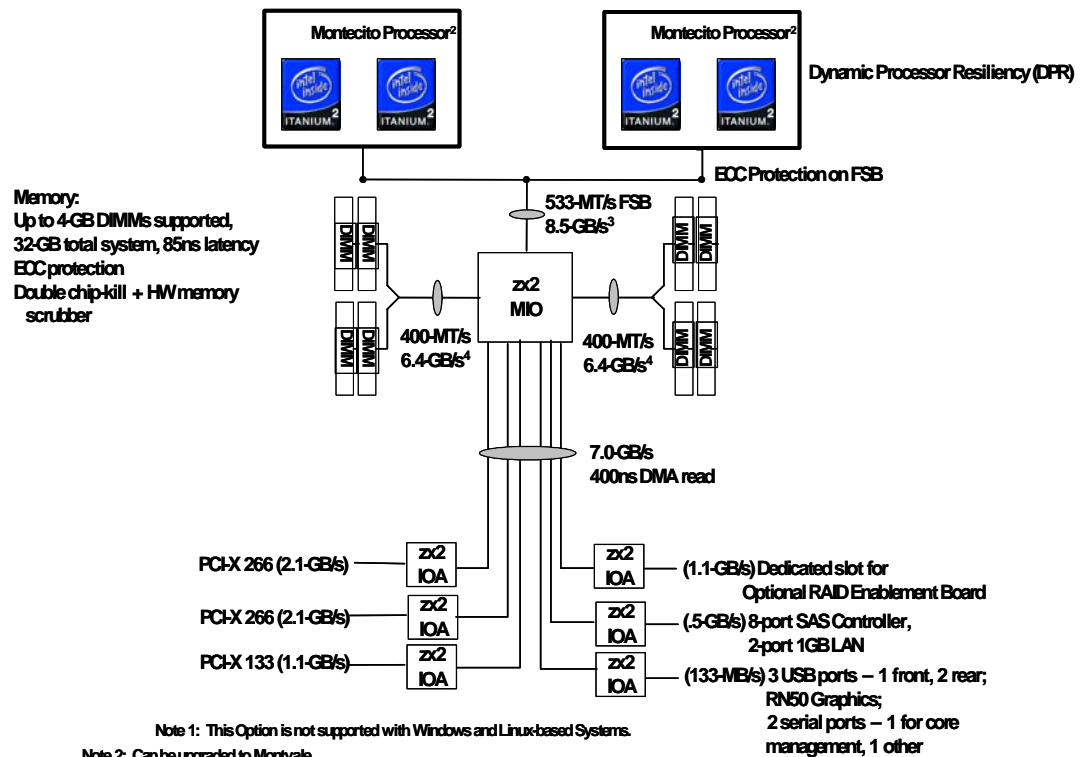
As shown in Figure 10, the HP Integrity rx3600 Server supports one or two Dual-Core Intel Itanium 2 processors linked to the zx2 MIO through a 533-MHz, double-pumped, 128-bit frontside system bus. Total bandwidth on the system bus is 8.5 GB/s.

Memory DIMMs are attached directly to two 266-MHz, 6.4-GB/s memory buses. Combined memory bandwidth across both buses is 12.8 GB/s. Each bus links up to 24 DDR2 DRAM memory DIMMs. Total system memory capacity is 96 GB through twenty-four 4-GB DIMMs.
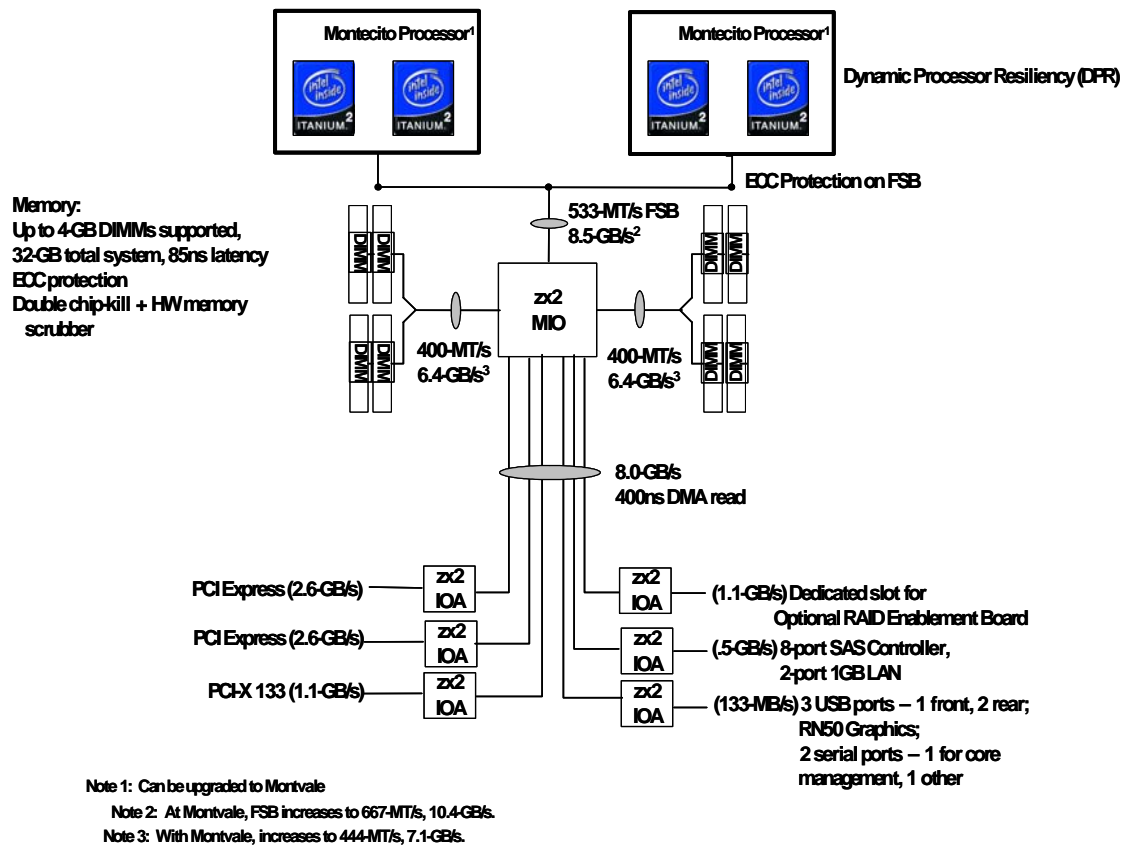
The I/O architecture consists of 10 channels allocated among eight zx2 IOAs. Each of these eight adapters provides an I/O bus to the available I/O slots and core I/O devices. The total sustained bandwidth of the all PCI-X I/O backplane options is 8.0-GB/s and the total sustained bandwidth of the combo I/O backplane option is 9.8-GB/s.

rx3600 Block Diagram with All PCI-X I/O Backplane Option

rx3600 Block Diagram with Combo I/O Backplane Option

Montecito Processor[1] **Montecito Processor[1]**

Dynamic Processor Resiliency (DPR)

ECC Protection on FSB

128-bits
533-MT/s FSB
8.5-GB/s

Memory:
Up to 4-GB DIMMs supported
96-GB total system
ECC protection
Double chip-sparing
HW memory scrubber

zx2 MIO

400-MT/s 6.4-GB/s[2]   400-MT/s 6.4-GB/s[2]

9.8-GB/s

Core management
USB (5 ports)
DVD (in system bay) — **zx2 IOA** (.1-GB/s)   (1.1-GB/s) **zx2 IOA** — PCI-X 133MHz

Core I/O: 8-port SAS Controller
2-port 1-GB LAN — **zx2 IOA** (.5-GB/s)   (1.1-GB/s) **zx2 IOA** — PCI-X 133MHz

PCI Express x8[4]
PCI Express x8[4] — **zx2 IOA** (1.3-GB/s)   (.5-GB/s) **zx2 IOA** — PCI-X 66MHz[3] / PCI-X 66MHz[3]

PCI Express x8 — **zx2 IOA** (2.6-GB/s)

PCI Express x8 — **zx2 IOA** (2.6-GB/s)

Note 1: Can be upgraded to Montvale.
Note 2: Increases in a future release.
Note 3: Slot is less than full length, slot is 8.5" in length.
Note 4: Slot does not support OLAR.

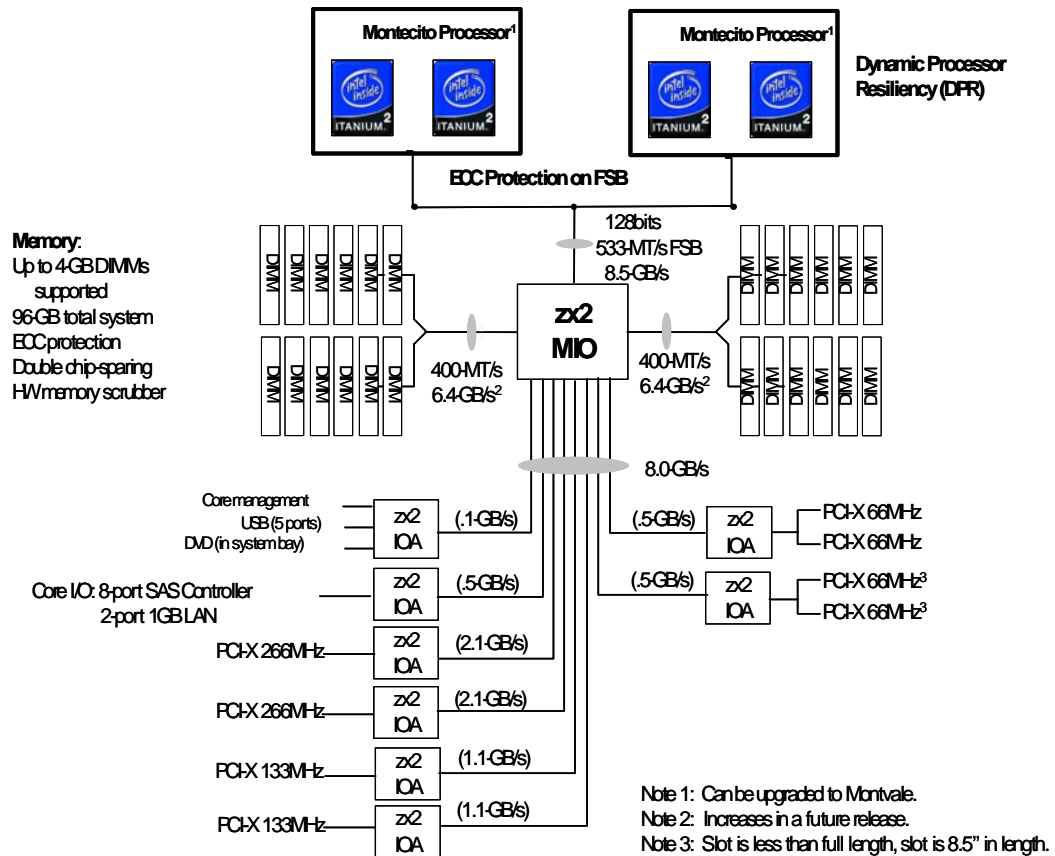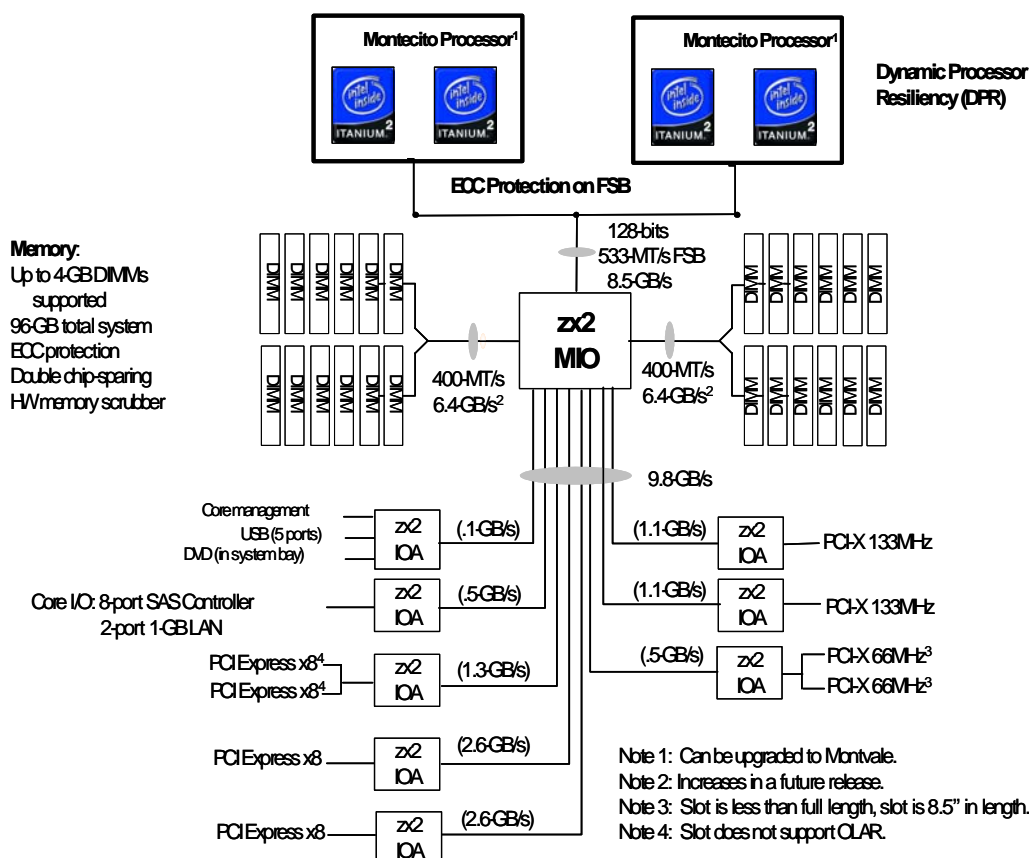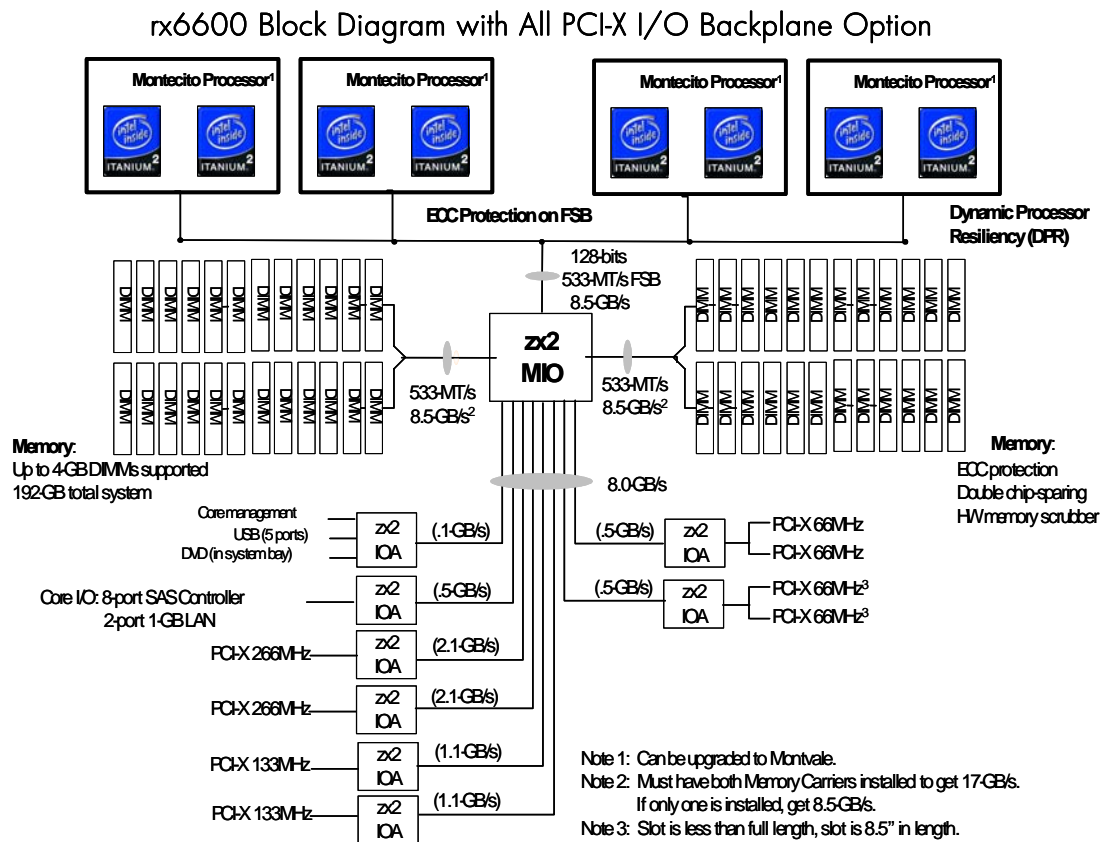# Architectural overview of the HP Integrity rx6600 Server

As shown in Figure 11, the HP Integrity rx6600 Server supports up to four Dual-Core Intel Itanium 2 processors linked to the zx2 MIO through a 533-MHz, double-pumped, 128-bit system bus. Total bandwidth on the system bus is 8.5 GB/s.

The zx2 MIO links to two independent 533-MHz, 8.5-GB/s memory buses. Each bus connects to three zx2 SMEs, which in turn allocate bandwidth to the DDR2 DRAM memory DIMMs. Total DIMM capacity is 24 or 48 units on a single memory carrier board.

The I/O architecture consists of ten 0.5 channels allocated among eight zx2 IOAs. Each of eight adapters provides a bus to the available I/O slots and core I/O devices. The total sustained bandwidth of the all PCI-X I/O backplane option is 8.0-GB/s and the total sustained bandwidth of the combo I/O backplane option is 9.8-GB/s.

rx6600 Block Diagram with All PCI-X I/O Backplane Option

Montecito Processor[1] Montecito Processor[1] Montecito Processor[1] Montecito Processor[1]

ECC Protection on FSB

Dynamic Processor Resiliency (DPR)

128-bits
533-MT/s FSB
8.5-GB/s

zx2 MIO

533-MT/s 8.5-GB/s[2]   533-MT/s 8.5-GB/s[2]

Memory:
Up to 4-GB DIMMs supported
192-GB total system

Memory:
ECC protection
Double chip-sparing
H/W memory scrubber

8.0-GB/s

Core management
USB (5 ports)
DVD (in system bay)   zx2 IOA   (.1-GB/s)

Core I/O: 8-port SAS Controller
2-port 1-GB LAN   zx2 IOA   (.5-GB/s)

PCI-X 266MHz   zx2 IOA   (2.1-GB/s)

PCI-X 266MHz   zx2 IOA   (2.1-GB/s)

PCI-X 133MHz   zx2 IOA   (1.1-GB/s)

PCI-X 133MHz   zx2 IOA   (1.1-GB/s)

(.5-GB/s)   zx2 IOA   PCI-X 66MHz / PCI-X 66MHz

(.5-GB/s)   zx2 IOA   PCI-X 66MHz[3] / PCI-X 66MHz[3]

Note 1: Can be upgraded to Montvale.
Note 2: Must have both Memory Carriers installed to get 17-GB/s.
          If only one is installed, get 8.5-GB/s.
Note 3: Slot is less than full length, slot is 8.5" in length.

rx6600 Block Diagram with Combo I/O Backplane Option

Montecito Processor[1] Montecito Processor[1] Montecito Processor[1] Montecito Processor[1]

ECC Protection on FSB

Dynamic Processor Resiliency (DPR)

128-bits
533-MT/s FSB
8.5-GB/s

DIMM (×16, left bank)

zx2 MIO

DIMM (×16, right bank)

533-MT/s
8.5-GB/s[2]

533-MT/s
8.5-GB/s[2]

Memory:
Up to 4-GB DIMMs supported
192-GB total system

Memory:
ECC protection
Double chip-sparing
HW memory scrubber

9.8-GB/s

Core management
USB (5 ports)
DVD (in system bay) — zx2 IOA — (.1-GB/s)

(1.1-GB/s) — zx2 IOA — PCI-X 133MHz

Core I/O: 8-port SAS Controller
2-port 1-GB LAN — zx2 IOA — (.5-GB/s)

(1.1-GB/s) — zx2 IOA — PCI-X 133MHz

PCI Express x8[4]
PCI Express x8[4] — zx2 IOA — (1.3-GB/s)

(.5-GB/s) — zx2 IOA — PCI-X 66MHz[3] / PCI-X 66MHz[3]

PCI Express x8 — zx2 IOA — (2.6-GB/s)

PCI Express x8 — zx2 IOA — (2.6-GB/s)

Note 1: Can be upgraded to Montvale.
Note 2: Must have both Memory Carriers installed to get 17-GB/s.
         If only one is installed, get 8.5-GB/s.
Note 3: Slot is less than full length, slot is 8.5" in length.
Note 4: Slot does not support OLAR.

Extensible Firmware Interface

Extensible Firmware Interface (EFI) is an interface between the Intel Itanium 2-based platform firmware and the HP-UX 11i v2, HP-UX 11i v3, Linux, and Windows operating systems. The file system supported by EFI is based on the file allocation table (FAT) file system. EFI allows the use of FAT32 for the system partition. (The system partition is required on a bootable disk for the Itanium 2-based platform.)

For a hard disk, the system partition is a contiguous grouping of sectors on the disk. The starting sector and size are defined by the EFI partition table, which resides on the second logical block of the hard disk, or by the master boot record (MBR), which resides on the first sector of the hard disk. The system partition can contain directories, data files, and EFI images.

The EFI system firmware can search the \EFI directory of the EFI system partition, EFI volume, to find possible EFI images that can be loaded. (The HP-UX 11i v2 and HP-UX 11i v3 boot loader is one example of an EFI image.)

Baseboard management controller and Integrity iLO 2

The baseboard management controller eases system management and supports the industry-standard Intelligent Platform Management Interface (IPMI) specification. This specification describes the management features that have been built into the system, which include diagnostics, configuration management, hardware management, and troubleshooting. The baseboard management controller interacts with the integrated Integrity iLO 2 management processor to provide the highest level of system manageability and high-availability monitoring.

The baseboard management controller provides the following:

- 40-MHz ARM7TDMI RISC core, 1 MB of flash ROM, and 512 KB of battery-backed RAM
- Power and reset management
- System health management: Fans, power supplies, temperatures, and voltages
- Event logging and reporting: System event log, forward progress log, and diagnostic LEDs on status panel
- Device inventory
- Hardware and data protection: Automatic clean operating system shutdown on critical events, secure storage of system configuration parameters, and protection of system flash ROM
- Link to dedicated out-of-band integrated Integrity iLO 2 management processor through intelligent platform management bus (IPMB), enabling remote management through the Management Processor LAN or Management Processor serial ports
- Compliance with IPMI 1.0
- Total system management in coordination with the HP management processor (Integrity iLO 2)

The Integrity iLO 2 management processor is included as a standard part of the HP Integrity rx2660, rx3600, and rx6600 Servers. This processor provides a remote interface into the baseboard management controller to manage system resources, diagnose the health of the system, and facilitate system repair. Administrators can interact with the Integrity iLO 2 management processor on a dedicated, out-of-band (that is, independent of the main system data paths) communication link that can be accessed through RS-232 serial ports or a 10/100BaseT management LAN.

The Integrity iLO 2 management processor reduces or eliminates the need for the system administrator to be physically at the system to perform tasks such as diagnostics, system management, or even hard resets. The management processor has its own battery backup, so it can be accessed even in the unlikely event that the main system power is out and the operating system has stopped functioning.

The Integrity iLO 2 management processor enables the following features and more:

- System management over the Internet or intranet (web console)
- System console redirection
- Console mirroring
- System configuration for automatic restart
- Viewing history log of system events
- Viewing history log of console activity
- Setting MP inactivity timeout thresholds
- Remote system control
- Remote power cycle (except for MP housekeeping power)
- Viewing system status
- Event notification to system console, email, pager, and HP Response Centers (Email and pager notification work with the HP Event Monitoring Service [EMS].)
- Automatic hardware protection of critical environmental problems
- Access to management interface and consoles on WAN failure (modem required)
- Automatic system restart
- Forward progress indicator (through a virtual front panel)
- Out-of-band manageability and system firmware update
- Configuration of manageability and console security
- Secure Sockets Layer (SSL) encryption on web console access

- SSH
- SIM group actions
- Virtual keyboard, video, and mouse (optional for Windows customers only)
- Virtual media CD and DVD (optional)
- LDAP and LDAP lite (optional)

High-availability features

The HP Integrity rx2660, rx3600, and rx6600 Servers are designed to be an integral part of a mission-critical environment, delivering up to 99.999% availability, depending on the specific solution configuration. Delivering these levels of uptime requires a strong base of single-system high availability (SSHA) in the hardware. The HP Integrity rx2660, rx3600, and rx6600 Servers have redundancy and resiliency built in from the ground up, starting with the chassis infrastructure, through the I/O, and continuing through the memory and processor subsystems.

The servers' strong SSHA is further bolstered by the HP EMS. And for the highest uptime, any of the three servers can be configured as an integral part of a high-availability cluster, using clustering software such as HP Serviceguard.

High-availability chassis infrastructure (power and cooling)

Fans in each server provide excellent cooling by pulling cool air from the front of the unit, flowing the air back over internal system components, and then discharging heated air out the back of the server. The fans are easily accessible and provide N+1 redundancy.

The three servers have high-availability power supplies, too. The HP Integrity rx2660, rx3600, and rx6600 Server power subsystems provide high availability with N+1 redundant power options. The HP Integrity rx2660, rx3600, and rx6600 Servers come standard with one hot-swappable power supply, and an optional second supply can be ordered for 1+1 redundancy. To further enhance availability, each power supply has its own dedicated power feed or line cord. Cords can be plugged into separate power grids for the maximum level of power protection.

Hot-pluggable disk drives

The HP Integrity rx2660 and rx3600 Servers support up to eight hot-pluggable, 2.5-inch SAS disk drives, while the HP Integrity rx6600 Server supports up to 16 hot-pluggable, 2.5-inch SAS disk drives.

All disks are accessible from the front of each system and can be removed (or hot plugged) while the server runs. An eight-port SAS controller manages up to eight disks in the HP Integrity rx2660, rx3600 and rx6600 Servers.

The disks can be configured to support a maximum of two RAID 1 sets (2 drives per set, for a total of 4 drives) and a disk for global hot spare. The remaining three disks can be accessed normally, but not configured for RAID.

The eight-port SAS host bus adapter is not supported by Windows and Linux; Windows and Linux-based systems must order the eight-port SAS Smart Array controller, which supports RAID 1, 5, and 6.For the HP Integrity rx6600 Server, you must order a second optional eight-port SAS controller and a second optional hard drive backplane if you want to install nine to 16 disks.

MirrorUX is available for software mirroring on all HDDs in HP-UX-based systems. HP Volume Shadowing Level 1 is supported in OpenVMS-base systems.

Multiple I/O channels

The multiple zx2 chipset I/O channels in the HP Integrity rx2660, rx3600, and rx6600 Servers provide failover, load balancing, and failure isolation. In these servers, failures on one channel do not disrupt activities on other channels. Furthermore, the servers deploy fully independent buses to certain I/O slots to isolate traffic on I/O adapters. If a problem occurs on one adapter, it does not interfere with traffic on another bus.

ECC and double chip spare memory

The memory systems for the HP Integrity rx2660, rx3600, and rx6600 Servers use error-correcting code to correct single-bit errors, and they use HP chip sparing technology to protect against multibit errors.

Double chip spare enables an entire SDRAM chip on a DIMM to be bypassed in the event that a multibit error is detected on that SDRAM. To use the double chip spare functionality, four identical DIMMs must be loaded. Different DIMM sizes are supported, as long as they are in groups of four. For example, if four 512-MB DIMMs are loaded along with a second set of four 1-GB DIMMs, chip spare is enabled on all the DIMMs.

Memory options come in DIMM pairs for the HP Integrity rx2660 Server, and they come in DIMM quads for the HP Integrity rx3600 and rx6600 Servers; two identical memory options must be configured in an HP Integrity rx2660 Server to enable chip sparing.

Because of the double chip spare feature, the HP Integrity rx2660, rx3600, and rx6600 Servers are completely resilient to all SDRAM failures, regardless of the number of bits involved in the fault condition. This feature virtually eliminates memory failures as a source of system errors.

DRAM sparing reduces scheduled and unscheduled downtime, reducing DIMM replacements by up to 17 times over single chip spare and is 1,200 times better than standard single-bit ECC. Some other vendors deal with multibit SDRAM failures by accepting that they will occur. That is, they use a scheme that supports only failure detection, not failure correction.

HP believes that this condition is unacceptable and is dangerous for servers in business-critical environments. In fact, server systems that employ failure detection but not correction are at high risk of failure resulting from memory problems.

Processor error correction and dynamic processor resiliency

In the HP Integrity rx2660, rx3600, and rx6600 Servers, the L1 and L2 cache have full single-bit ECC and double-bit error detection. Additionally, all the instruction and data paths also have single-bit ECC capabilities, the system processor bus has parity detection, and the data path is covered by error correction.

The HP Integrity rx2660, rx3600, and rx6600 Servers employ DPR as well. With DPR, any processor generating correctable cache errors at a rate deemed unacceptable is deallocated from use by the system. This feature helps protect against a processor degrading to the point at which it could cause system crashes.

When excessive errors are reported against a processor, the processor is deactivated (that is, the operating system will not schedule any new processes on it). The system firmware remembers the processor serial number and the time when this action was taken. From then on, at each poll interval, the system monitor determines whether the processor has been replaced (by comparing the serial numbers).

When the processor is replaced, its history is reset. If the system is rebooted before the offending processor is replaced, the monitor generates a warning message and immediately deallocates the processor. (Such processor deallocation is supported only in the HP-UX 11i v2 and HP-UX 11i v3 operating systems. Deallocation is not supported in Windows or Linux.)

Comprehensive error logs

All system events are stored in the system event log (SEL) in nonvolatile memory. In addition, system firmware creates activity and forward progress logs (FPLs) in nonvolatile memory. In all but the most extreme situations—that is, in more than 95% of cases—the information in these logs is sufficient to diagnose system failures to a single replaceable part. The SEL and FPLs are available to the MP (and therefore also to available remotely) and to system-level tools, leading to quick and accurate diagnosis.

Fault management throughout the lifecycle

Fault management is the overall HP strategy to provide a complete value chain for detection, notification, and repair of system problems. Fault management starts during the design phase, when hardware and operating system designers include capabilities and instrumentation points that provide the ability to detect and isolate system anomalies. Monitors are created to poll for system health information or to asynchronously respond to instrumentation points that have been designed into the system to report problems or faults.

Fault management also involves implementing several methods for maintaining historical event information, allowing preservation of information for analysis or trending. Faults that generate errors and warnings are automatically logged to syslog, while notes and audit information are copied to an event log. Other options are available for preserving historical information as well.

Fault management provides immediate alerts of problems—and even potential problems—as soon as they are detected so that you can take corrective action. In some cases, fault monitors are actually smart enough to repair faults or prevent them from occurring.

Capabilities of fault monitors

Fault management and monitoring capabilities track the health of system components and generate close to real-time events when problems develop. These events can trigger corrective action to enable the system to continue functioning, or they can trigger alerts to warn system administrators to handle situations before the situations become more severe.

Fault monitors are able to:

- Poll the system for health information
- Handle asynchronous events that have been designed into the hardware or software
- Perform corrective actions when possible
- Deallocate failing memory before it fails (dynamic memory resiliency)
- Deallocate failing processors before they fail (DPR)
- Deconfigure failed processors from the working set before the next reboot
- Shut down the system when a power failure causes a switch to an uninterruptible power supply (UPS)
- Manage events so that system performance is not hindered in the face of errors
- Provide information on problem causes and what actions to take

Notification and integrated enterprise management

Fault management currently uses the HP EMS infrastructure for its notification methodology. EMS enables a wide variety of notification methods, including pager, email, SNMP traps, system console, system log, text log file, TCP/UDP, and HP OpenView Operations Center (OPC) messaging.

Fault management events can be viewed directly on the server or through HP Systems Insight Manager, which can aggregate information from multiple systems in the data center.

You can also integrate fault management events with enterprise management software from HP (OpenView) or from BMC, Tivoli, Computer Associates, or MicroMuse.

Added options with HP support

If you purchase HP support, fault management events can be forwarded to the HP support organization. In this case, HP can take responsibility for monitoring, filtering, and trending the events and for taking action on items that need attention.

At the premium end of HP support offerings, you can also sign up to receive services from HP Instant Support Enterprise Edition (ISEE), the HP single, common remote-support solution across multivendor environments.

ISEE provides features to manage diverse environments, spanning from simple to complex, including mission-critical IT data centers. ISEE uses continuous hardware event monitoring and automated notification to identify and prevent potential critical problems. Through ISEE remote diagnostic scripts and vital information collected about the status and configuration of your environment, ISEE enables fast restoration of supported systems, storage, and network devices.

For mission-critical support customers, ISEE provides proactive capabilities to assess and help optimize your environment:

- Benchmarking and trending analysis about the availability of your HP-UX systems
- Fast recognition of unreachable systems to enable support processes to be activated quickly to determine the cause of outage
- ISEE activity summary of incidents, remote access sessions, and unreachable device notification incidents
- Systematic analysis of your HP-UX configurations for software patch irregularities (missing patches, superseded patches, and so on), providing a consolidated view of the patch status in your environment and simplifying patch maintenance activities to save you time

ISEE helps to minimize the risk of unplanned system downtime and maximize business productivity through continuous remote monitoring and fault detection.

Proactive approach to high availability

Fault management uses the philosophy of proactive (as opposed to reactive) management of problems. Fault management provides highly accurate fault diagnosis the first time, even as the problem occurs, and initiates or enables fast corrective action. Fault management results in a substantial decrease in unplanned downtime.

Backward compatibility for RISC and IA-32 users

A major feature of the Intel Itanium 2 processor and new HP servers is backward compatibility of the Intel Itanium 2 processor with IA-32 and PA-RISC processors. Backward compatibility is particularly useful for applications that are not performance-intensive or for system utilities and development tools that aid in porting and migration. Although most existing IA-32 and PA-RISC binaries are compatible,

optimal performance can be achieved only after an application is compiled specifically for the Intel Itanium 2 processor.

Running Windows 32-bit applications

Microsoft Windows 32-bit binaries can run on the 64-bit Windows operating system using the Intel Value Engine (IVE) hardware and Windows on Windows 64 (WOW64) software emulation, which is already part of 64-bit Windows. The operating system automatically detects whether the application is 32-bit or 64-bit and handles it accordingly.

Additionally, Microsoft and Intel have made available the IA-32 Execution Layer (IA-32 EL) software. IA-32 EL is a software binary that is available for download from Microsoft; it is integrated into Microsoft Windows Server 2003 Service Pack 1.

When a 32-bit application is launched, the operating system calls IA-32 EL to translate the 32-bit application into a native Intel Itanium 2-based application. IA-32 EL will continue to provide compatibility and will deliver further performance improvements on faster Intel Itanium processors released in the future.

Running Linux 32-bit applications

Linux 32-bit binaries can be run on Intel Itanium 2-based systems using the processor's built-in hardware translation feature. The IVE hardware is part of the Intel Itanium 2 processor, and it provides basic IA-32 functionality. If an application is performance-critical, recompiling the application enables it to take advantage of the strengths of the Intel Itanium 2 microarchitecture.

Running RISC applications

You can run PA-RISC binaries unchanged and completely transparently, thanks to the HP Aries dynamic code translator that is part of HP-UX 11i v2 and HP-UX 11i v3. This translator facilitates running 32-bit and 64-bit PA.

RISC applications run on the Intel Itanium 2 microarchitecture without the need to recompile, which can prolong the longevity of legacy applications from HP 9000 Servers to HP Integrity servers.

A straightforward recompilation of 32-bit and 64-bit PA-RISC applications yields native Intel Itanium 2 processor binaries. In addition, the HP-UX 11i v2 and HP-UX 11i v3 operating systems have built-in source and data compatibilities.

The HP-UX 11i environment enables Linux binary and source compatibility to run Linux applications. Finally, the HP transition assistance program provides peace of mind in upgrading to industry-leading technology.

Porting and migration services: Transition help from HP

Thousands of programs run well in Intel Itanium processor compatibility mode with few changes. However, porting these applications to the Intel Itanium 2 processor enables them to run even better because they can then take full advantage of the new processor's distinctive capabilities.

To help you make the transition to the Intel Itanium 2 processor family and get the most from this exciting new technology, HP offers a flexible set of services. You can select from the following:

- Porting and migration workshop
- Porting and migration guidance
- Porting and migration detailed assessment

- Porting and migration solution delivery
- Online services

HP Services for HP Integrity servers

Evolve your infrastructure confidently with a partner that stands accountable

When you are ready to take advantage of the performance improvements that Itanium-based solutions offer, HP has a full range of multiOS services to help make the transition as seamless and painless as possible. HP can help you quickly and confidently introduce HP Integrity servers into your existing IT environment and maximize their potential for your business.

HP offers:

- Assessment services to precisely define porting requirements and chart a course to deployment
- Implementation services to install and configure equipment rapidly
- Education services to provide your staff with the expertise required to achieve optimal system performance

Throughout the evolution process, HP accepts full accountability for delivering on the service commitments that HP and its partners make. And, the HP commitment to your satisfaction does not stop with the transition process itself. The HP multiOS support offerings—from simple reactive to comprehensive mission-critical—reduce the risks associated with downtime after your HP Integrity servers are installed.

HP is 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 microarchitecture, 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 uses its wide range of offerings and its experienced services personnel to help companies fully exploit the Intel Itanium architecture's capabilities while protecting their existing infrastructures.

HP StorageWorks and HP servers

The cornerstone of an adaptive enterprise

At the heart of an adaptive enterprise—in which business and IT needs 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 in UNIX, Microsoft Windows, and Linux servers, the HP server portfolio encompasses ProLiant, Integrity, 9000 series, Alpha, and NonStop servers.

As the worldwide leader 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. The HP StorageWorks and HP server product lines continually receive numerous best-in-class industry and customer awards.

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 products, applications, and other components.

"Open" has always been the foundation of the HP strategy for doing business, but using HP StorageWorks solutions and HP servers together in the same environment can yield additional advantages for the adaptive enterprise.

By deploying HP storage products and HP servers along with HP services, you gain more for your IT environment and your overall business—more stability, efficiency, and adaptability, and, ultimately, more return on your IT investment.

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 stand-alone 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. You gain more control of your data center and overall business with more stability, efficiency, and adaptability, which all lead to increased return on IT investment.

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

IT availability is crucial in today's business environment. If an infrastructure is slow or down, revenue goes to the competition. HP storage products and servers together deliver maximum uptime with complete, seamless, and total integration. With HP solutions and services, you 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, you can change and adapt quickly to market needs. HP servers and storage products can be delivered on-site in complete, integrated turnkey solutions that are ready to deploy. In addition, virtualization removes traditional boundaries and helps to maximize data center resource utilization. The full portfolio of HP services and managed solutions enables you to build and manage an adaptive enterprise. It is all possible with HP.

Conclusion

On the road to becoming truly pervasive, the Dual-Core Intel Itanium 2 processor is faster and more capable than its predecessor. Now, with the HP Integrity rx2660, rx3600, and rx6600 Servers, HP offers powerful servers based on the Intel Itanium 2 processor and featuring the new HP zx2 chipset.

The HP Integrity rx2660 Server uses one or two single-core or Dual-Core Intel Itanium 2 processors and up to 32 GB of memory. The HP Integrity rx3600 Server uses one or two Dual-Core Intel Itanium 2 processors and up to 96 GB of memory, and the HP Integrity rx6600 Server uses up to four Dual-Core Intel Itanium 2 processors and up to 192 GB of memory. These servers offer cutting-edge, 64-bit power along with excellent price:performance.

These new servers are tailored for complex, floating-point-intensive computations, providing faster time to solution for demanding applications. They are especially suited to SSL Web serving, and they offer significant performance advantages over both IA-32-based and RISC-based systems for Windows and database applications. They are also perfect for running SAP, Siebel, PeopleSoft, and SAS business application suites.

The Dual-Core Intel Itanium 2 processor's ability to run IA-32 and RISC binaries without modification helps protect your previous software investments, and HP porting services can effect a complete transition that takes full advantage of the Intel Itanium architecture.

Another advantage of these servers is that you can run any of the five industry-leading operating systems—HP-UX 11i v2, HP-UX 11i v2 v3, Linux, Windows, or OpenVMS 8.3. This multiOS capability overcomes the complexities and challenges associated with deploying and maintaining a heterogeneous operating environment.

For technical computing and for commercial IT environments, the HP Integrity rx2660, rx3600, and rx6600 Servers offer superior power, scalability, and efficiency—with lower costs.

For more information

For more information about Intel Itanium processors, their architecture, and how HP can help you make your transition:

- See the following websites:
  - http://www.hp.com/go/itanium
  - http://www.hp.com/products1/itanium/servers_workstations/index.html
- Contact any of the HP worldwide sales offices or HP channel partners (in the U.S., call toll-free 1-800-637-7740).

HP product information and technical documentation is available online at:

- http://www.hp.com/go/rx2660
- http://www.hp.com/go/rx3600
- http://www.hp.com/go/rx6600

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