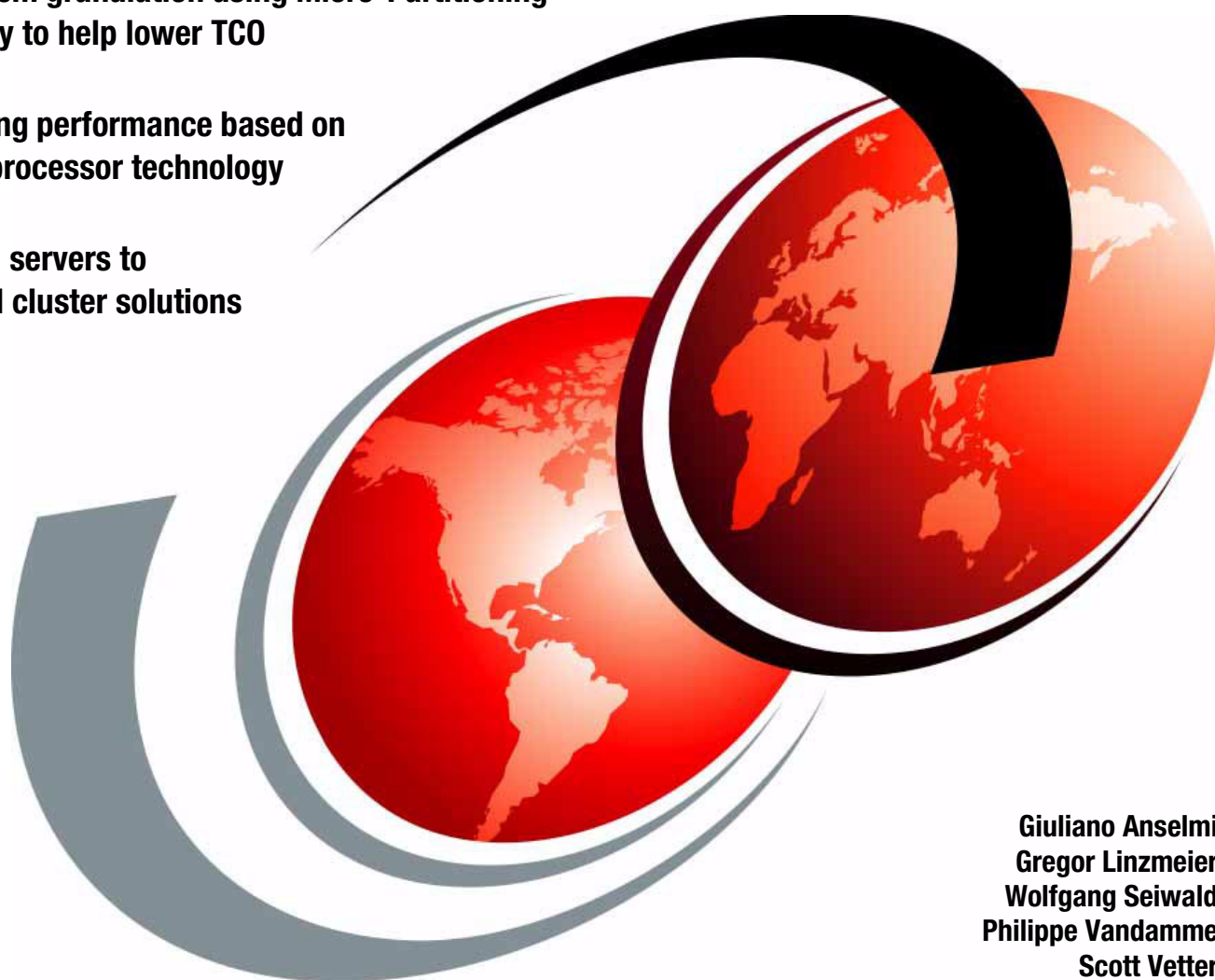


IBM *e*server p5 550 Technical Overview and Introduction

Finer system granulation using Micro-Partitioning technology to help lower TCO

Outstanding performance based on POWER5 processor technology

From Web servers to integrated cluster solutions



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International Technical Support Organization

**IBM @server p5 550 Technical Overview and
Introduction**

October 2004

Note: Before using this information and the product it supports, read the information in “Notices” on page vii.

Second Edition (October 2004)

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Preface

This document is a comprehensive guide covering the IBM *eServer*® p5 550 UNIX® servers. We introduce major hardware offerings and discuss their prominent functions.

Professionals wishing to acquire a better understanding of IBM *eServer* p5 products should consider reading this document. The intended audience includes:

- ▶ Customers
- ▶ Sales and marketing professionals
- ▶ Technical support professionals
- ▶ IBM Business Partners
- ▶ Independent software vendors

This document expands the current set of IBM *eServer* documentation by providing a desktop reference that offers a detailed technical description of the p5-550 system.

This publication does not replace the latest IBM *eServer* pSeries® marketing materials and tools. It is intended as an additional source of information that, together with existing sources, can be used to enhance your knowledge of IBM server solutions.

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General description

The IBM *@server* p5 550 desktide and rack-mount servers are designed for greater application flexibility, with innovative technology, to capitalize on the e-business revolution at the entry-level or server environments. Introduced with the POWER4 and POWER4+ technology in 2001, available from the 1-way entry-level through the 32-way high-end pSeries systems, the IBM POWER architecture achieved a new stage of capability characteristics by including features such as logical partitioning (LPAR). With POWER5 microprocessor technology, the p5-550 is the first cost-effective, high-performance entry UNIX server to include the next development of the IBM partitioning concept, Micro-Partitioning.

Dynamic LPAR on a 4-way p5-550 allows up to four dedicated partitions. In addition, the optional Advanced POWER Virtualization feature enables the support up to 40 Micro-Partitions on a 4-way system. Micro-Partitioning technology is an advanced feature of the POWER5 processor that enables multiple partitions to share a physical processor. The extended POWER Hypervisor controls dispatching the physical processors to each of the partitions using Micro-Partitioning technology. In addition to Micro-Partitioning technology, the Advanced POWER Virtualization feature allows sharing of physical network adapters and enables the virtualization of SCSI storage.

In combination with the extraordinary POWER5 processor, Micro-Partitioning is designed to increase the system management efficiency and lowers the operating expenses by allowing multiple use of single physical resources installed on the p5-550 system.

Simultaneous multi-threading is a standard feature of POWER5 technology that allows two threads to be executed at the same time on a single processor. Simultaneous multi-threading is selectable with dedicated or processors in a shared pool for use with partitions using Micro-Partitioning technology.

The symmetric multiprocessor (SMP) p5-550 system features base 1-way, 2-way, or 4-way, 64-bit, copper and silicon on insulator (SOI)-based POWER5 microprocessors running at 1.5 GHz for 1-way and 2-way configurations and 1.65 GHz for 2-way and 4-way configurations. 36 MB off-chip Level 3 cache is available on 2-way and 4-way configurations. Additional processor configurations are allowed with the addition of IBM *@server* Capacity on Demand (CoD) features. Main memory starting at 512 MB (on 1.5 GHz models) or 1 GB (on 1.65 GHz models) can be expanded up to 64 GB, based on the available DIMMs, for higher

performance and exploitation of 64-bit addressing to meet the demands of enterprise computing, such as large database applications.

Included with the p5-550 are five hot-plug PCI-X slots with Enhanced Error Handling (EEH), one embedded Ultra320 SCSI dual-channel controller, one 10/100/1000 Mbps integrated dual-port Ethernet controller, two serial ports, two USB 2.0 capable ports, two HMC ports, two RIO-2 ports, and two System Power Control Network (SPCN) ports.

The p5-550 includes four front-accessible, hot-swap-capable disk bays in a minimum configuration with an additional four hot-swap-capable disk bays orderable as an optional feature. The eight disk bays can accommodate up to 1.17 TB of disk storage using the 146.8 GB Ultra320 SCSI disk drives. Three non hot-swappable media bays are used to accommodate additional devices. Two media bays only accept slim line media devices, such as DVD-ROM or DVD-RAM, and one half-height bay is used for a tape drive. The p5-550 also has I/O expansion capability using the RIO-2 bus, which allows attachment of the 7311 Model D20 I/O drawers.

Additional reliability and availability features include redundant hot-plug cooling fans and redundant power supplies. Along with these hot-plug components, the p5-550 is designed to provide an extensive set of reliability, availability, and serviceability (RAS) features that include improved fault isolation, recovery from errors without stopping the system, avoidance of recurring failures, and predictive failure analysis.

1.1 System specifications

Table 1-1 lists the general system specifications of the p5-550 system.

Table 1-1 p5 550 specifications

Description	Range
Operating temperature	5 to 35 degrees Celsius (41 to 95 F)
Relative humidity	8% to 80%
Operating voltage	2-way: 100 to 127 or 200 to 240 V AC (auto-ranging) 4-way: 200 to 240 V AC
Operating frequency	47/63 Hz
Maximum power consumption	1100 watts maximum
MAximum thermal output	3754 Btu ^a /hour (maximum)

a. British Thermal Unit

1.2 Physical package

The following sections discuss the major physical attributes found on a p5-550 in rack-mounted and deskside versions (Figure 1-1), as shown in Table 1-2. The p5-550 is a 4U, 19-inch rack-mounted system or deskside system depending on the feature code.

Table 1-2 Physical packaging of the p5-550

Dimension	Rack (FC 7886)	Deskside (FC 7887)
Height	178 mm (7.0 inches)	533 mm (21.0 inches)
Width	437 mm (17.2 inches)	201 mm (7.9 inches)
Depth	731 mm (28.8 inches)	779 mm (30.7 inches)
Minimum configuration	41.4 kg (91 pounds)	
Maximum configuration	57.0 kg (125 pounds)	



Figure 1-1 Rack-mount and desktide versions of the p5-550

1.2.1 IBM eServer p5 550 desktide

The p5-550 is a desktide server that is ideal for environments requiring the user to have local access to the hardware. A typical example of this would be applications requiring a native graphics display.

To order a p5-550 system as a desktide version, FC 7887 is required. The system is designed to be set up by the customer and, in most cases, will not require the use of any tools. Full set-up instructions are included with the system.

The GXT135P 2D graphics accelerator with analog and digital interfaces (FC 2849) is available and is supported for SMS, firmware menus, and other low-level functions, as well as when AIX or Linux starts the X11-based graphical user interface. Graphical AIX system tools are usable for configuration management if the adapter is connected to the primary console, such as the IBM L200p Flat-Panel Monitor (FC 3636) or the IBM T541H 15-inch TFT Color Monitor (FC 3637).

1.2.2 IBM eServer p5 550 rack-mounted

The p5-550 is a 4U rack-mounted server and is intended to be installed in a 19-inch rack, thereby enabling efficient use of computer room floor space. If the IBM 7014-T42 rack is used to mount the p5-550, it is possible to place up to 10 systems in an area of 644 mm (25.5 inches) x 1147 mm (45.2 inches).

To order a p5-550 system as a rack-mounted version, FC 7886 is required. In addition to the rack-mounted version, the p5-550 can be installed in IBM or OEM racks. Therefore you are required to select one of the following features:

- ▶ IBM Rack-mount Drawer Rail Kit (FC 7162)
- ▶ OEM Rack-mount Drawer Rail Kit (FC 7163)

Included with the p5-550 rack-mounted server packaging are all of the components and instructions necessary to enable installation in a 19-inch rack using suitable tools.

The GXT135P 2D graphics accelerator with analog and digital interfaces (FC 2849) is available and is supported for SMS, firmware menus, and other low-level functions, as well as when AIX or Linux starts the X11-based graphical user interface. Graphical AIX system tools are usable for configuration management if the adapter is connected to a common maintenance console, such as the 7316-TF3 Rack-Mounted Flat-Panel display.

Figure 1-2 shows the basic ports available on the p5-550.

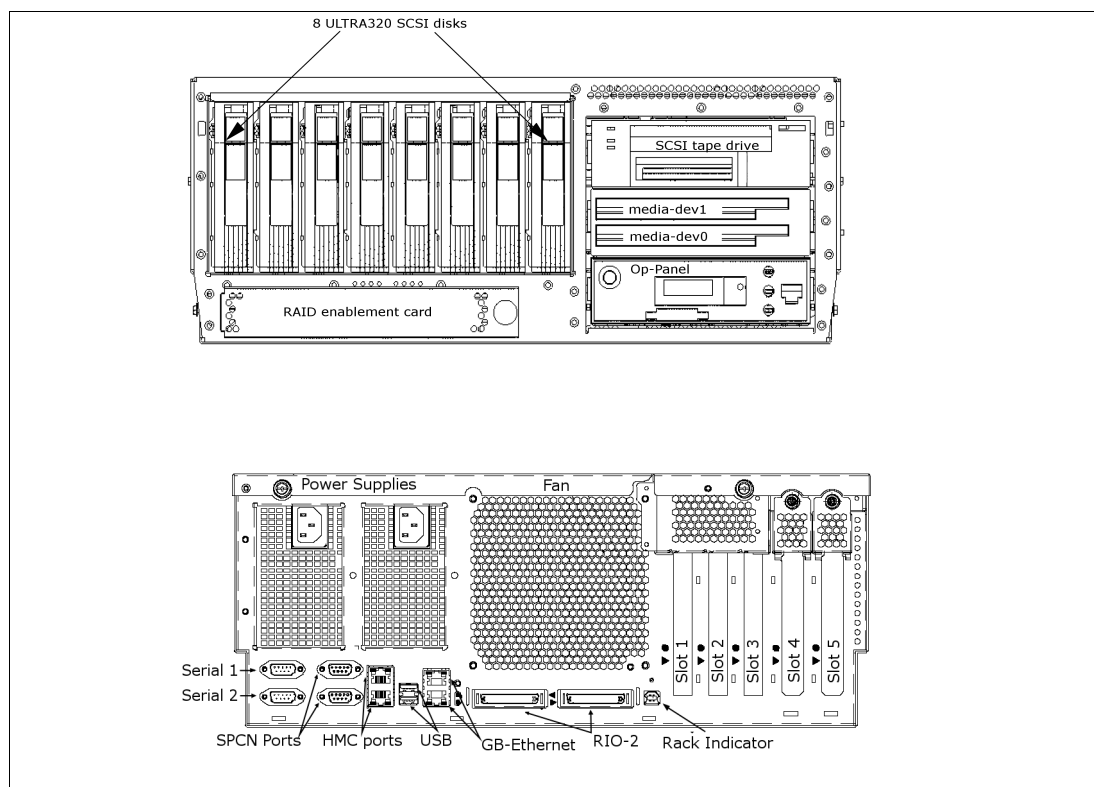


Figure 1-2 Detailed views of the p5-550 rack-mount system

1.3 Minimum and optional features

The p5-550 system is based on a flexible, modular design, and it features:

- ▶ Up to two processor books using the POWER5 chip, for a 1-way, 2-way, or 4-way configuration
- ▶ From 512 MB (1.5 GHz models) or 1 GB (1.65 GHz models) to 64 GB of total system memory capacity using DDR1 DIMM technology
- ▶ Four SCSI disk drives in a minimum configuration, eight SCSI disk drives with an optional second 4-pack enclosure for an internal storage capacity of 1.17 TB using 146.8 GB drives
- ▶ Four PCI-X slots and 1 GX+ slot or five PCI-X slots
- ▶ Two slim-line media bays for optional storage devices
- ▶ One half-high bay for an optional tape device

The p5-550, including the service processor (SP) described in 2.11.1, “Service processor base” on page 38, supports the following native ports:

- ▶ Two 10/100/1000 Ethernet ports
- ▶ Two serial ports
- ▶ Two USB 2.0 ports
- ▶ Two HMC ports
- ▶ Two remote I/O (RIO-2) ports
- ▶ Two SPCN ports

In addition, the p5-550 features one internal Ultra320 SCSI dual channel controller, redundant hot-swap power supply (optional), cooling fans, and up to two processor power regulators.

The system supports 32-bit and 64-bit applications.

1.3.1 Processor card features

The p5-550 accommodates 1-way or 2-way processor cards with state-of-the-art, 64-bit, copper-based, POWER5 microprocessors running at 1.5 GHz on 1 and 2-way cards and 1.65 GHz on 2-way cards share 1.9 MB of L2 on chip cache, 36 MB of L3 cache on 2-way cards, and eight slots for memory DIMMS using DDR1 technology. Processor card FC 5237 (1.65 GHz) and FC 5264 (1.5 GHz) are Capacity on Demand (CoD) processor cards, which means they provide the physical processor resources, but an additional activation is needed to use the processors. Different options for activating them are available; see Table 1-3 and Table 1-4.

An initial order must have at least one processor card. Only a single 1-way card may be present on any system, and cards with mixed clock rates cannot be installed on the same system.

The permanent activation options are *Permanent CUoD* (shipped from manufacturing as activated, or for later activation of available non-activated processors through the HMC) and *no-additional-charge CUoD* (one processor at no additional charge, if the initial order qualifies for the Value Pak options, see Table 1-8 on page 11). Temporary activations of processors are provided by *Reserve CoD* (prepaid 30 day reserve), and *On/Off CoD*. See 3.1, “Capacity on Demand” on page 48 for further details about CoD activation concepts. Table 1-4 contains all the available feature codes for processor cards, at the time of writing.

Table 1-3 Processor card and processor activation feature codes (1.5 GHz cards)

Processor card FC	Description
5264	Two processors, 0 activated, 1.5 GHz, eight DDR1 DIMM sockets
One processor activation	for base FC 5264
CUoD (permanent)	7603
No-additional charge CUoD (Value Pak)	8465
Reserve CoD (30 days)	7934
On/Off CoD activation (one day) billing	7608 (requires one FC 7930 to enable On/Off CoD)

Table 1-4 Processor card and processor activation feature codes (1.65 GHz 2-way cards)_

Processor card FC	Description
5237	Two processors, 0 activated, 1.65 GHz, eight DDR1 DIMM sockets
One processor activation	for base FC 5237
CUoD (permanent)	7871
No-additional charge CUoD (Value Pak)	8450
Reserve CoD (30 days)	7934
On/Off CoD activation (one day) billing	7931 (requires one FC 7930 to enable On/Off CoD)

1.3.2 Memory features

The processor cards used in the p5-550 system have eight sockets for memory DIMMs that are shipped in quads for all features except FC 4443, which is shipped as a pair. Each of the memory features available (at the time of writing) listed in Table 1-5, therefore, provides four DIMMs.

Table 1-5 Memory feature codes

Feature code	Description
4443	512 MB (2x 256 MB) DIMMs, DDR1 SDRAM
4444	1 GB (4x 256 MB) DIMMs, DDR1 SDRAM
4447	2 GB (4x 512 MB), DIMMs, DDR1
4445	4 GB (4x 1024 MB) DIMMs, DDR1
4450	8 GB (4x 2048 MB) DIMMs, DDR1
4449	16 GB (4x 4096 MB) DIMMs, DDR1

It is recommended that each processor card have an equal amount of memory installed. Balancing memory across the installed processor cards allows distributed memory accesses that provide optimal performance. The memory controller will detect a variety of memory configurations of mixed memory sized DIMMs and DIMMs installed in pairs.

1.3.3 Disk and media features

The minimum p5-550 configuration includes a 4-pack disk drive enclosure. A second 4-pack disk drive enclosure can be installed by ordering FC 6592 or FC 6593; therefore, the maximum internal storage capacity is 1.17 TB (using the disk drive features available at the time of writing). The p5-550 also features two slim-line media device bays and one half-height media bay. The minimum configuration requires at least one disk drive. Table 1-6 shows the disk drive feature codes that each bay can contain.

Table 1-6 Disk drive feature code description

Feature code	Description
3273	36.4 GB 10 K RPM Ultra3 SCSI disk drive assembly
3277	36.4 GB 15 K RPM Ultra3 SCSI disk drive assembly

Feature code	Description
3274	73.4 GB 10 K RPM Ultra3 SCSI disk drive assembly
3278	73.4 GB 15 K RPM Ultra3 SCSI disk drive assembly
3275	146.8 GB 10 K RPM Ultra3 SCSI disk drive assembly

Any combination of DVD-ROM and DVD-RAM drives of the following devices can be installed in the two slim-line bays:

- ▶ DVD-RAM drive, FC 5751
- ▶ DVD-ROM drive, FC 2640

A logical partition running a supported release of the Linux operating system requires a DVD-ROM drive or DVD-RAM drive to provide a way to boot hardware diagnostics from CD. Concurrent diagnostics, as provided by AIX, is not available on Linux at the time of writing.

Supplementary devices can be installed in the half-height media bay, such as:

- ▶ IBM 80/160 GB Internal Tape Drive with VXA Technology, FC 6120
- ▶ 60/150 GB 16-bit 8 mm Internal Tape Drive, FC 6134
- ▶ 36/72 GB 4 mm Internal Tape Drive, FC 6258

1.3.4 USB diskette drive

For today's administration tasks, an internal diskette drive is not state-of-the-art. In some situations, the external USB 1.44 MB diskette drive for p5-550 systems (FC 2591) is helpful. This super-slim-line and lightweight USB V2 attached diskette drive takes its power requirements from the USB port. A USB cable is provided. The drive can be attached to the integrated USB ports, or to a USB adapter (FC 2738). A maximum of one USB diskette drive is supported per integrated controller/adaptor. The same controller can share a USB mouse and keyboard.

1.3.5 I/O drawers

The p5-550 has five internal PCI-X slots, where four of them are long slots and one is a short slot. If more PCI-X slots are needed, especially well-suited to extend the number of LPARs and Micro-Partitions, up to eight Model 7311 Model D20 I/O drawers can be attached to the rack-mount p5-550 system. Up to four Model D20 drawers can be connected to the two RIO-2 ports on the rear of the system that are provided in a minimum configuration. An additional four Model D20s can be connected by ordering the Remote I/O expansion card (FC 1806). It provides two RIO-2 ports located on a interposer card that occupies the short PCI-X slot.

7311 Model D20 I/O drawer

The 7311 Model D20 I/O drawer is a 4U full-size drawer, which must be mounted in a rack. It features seven hot-pluggable PCI-X slots and optionally up to 12 hot-swappable disks arranged in two 6-packs. Redundant, concurrently maintainable power and cooling is an optional feature (FC 6268). The 7311 Model D20 I/O drawer offers a modular growth path for the p5-550 system with increasing I/O requirements. When a p5-550 is fully configured with eight attached 7311 Model D20 drawers, the combined system supports up to 61 PCI-X adapters (in a full configuration, Remote I/O expansion cards are required) and 104 hot-swappable SCSI disks.

PCI-X and PCI cards are inserted from the top of the I/O drawer down into the slot. The installed adapters are protected by plastic separators, designed to prevent grounding and damage when adding or removing adapters.

The drawer has the following attributes:

- ▶ 4U rack-mount enclosure assembly
- ▶ Seven PCI-X slots 3.3 volt, keyed, 133 MHz hot-pluggable
- ▶ Two 6-pack hot-swappable SCSI devices
- ▶ Optional redundant hot-plug power
- ▶ Two RIO-2 ports and two SPCN ports

Note: The 7311 Model D20 I/O drawer initial order, or an existing 7311 Model D20 I/O drawer that is migrated from another pSeries system, must have the RIO-2 ports available (FC 6417).

7311 Model D20 I/O drawer physical package

The I/O drawer has the following physical characteristics:

- ▶ Width: 482 mm (19.0 inches)
- ▶ Depth: 610 mm (24.0 inches)
- ▶ Height: 178 mm (7.0 inches)
- ▶ Weight: 45.9 kg (101 pounds)

Figure 1-3 shows the different views of the 7311-D20 I/O drawer.

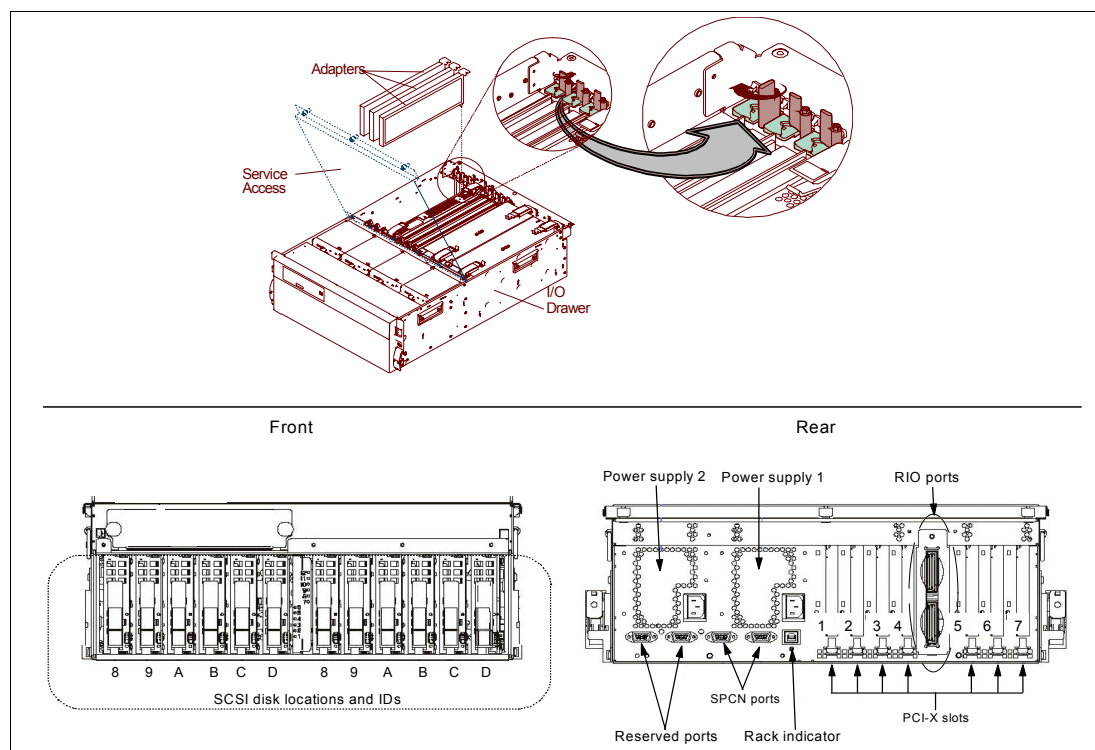


Figure 1-3 7311-D20 I/O drawer

Note: The 7311 Model D20 I/O drawer is designed to be installed by an IBM service representative.

I/O drawers and usable PCI slots

Only the 7311 Model D20 I/O drawer is supported on a p5-550 system. Depending on the p5-550 system configuration, the maximum number of I/O drawers supported is different. Table 1-7 summarizes the maximum number of I/O drawers supported and the total number of PCI-X slots available.

Table 1-7 Maximum number of I/O drawers supported and total number of PCI slots

p5-550	Max number of I/O drawers	Total number of PCI-X slots
Minimum configuration	4	28 + 5
Additional FC 1806	8	56 + 4 (excluding used slot)

1.3.6 Hardware Management Console models

The Hardware Management Console (HMC) provides a set of functions that is necessary to manage the p5-550 system when LPAR, Capacity on Demand without reboot, inventory and microcode management, and remote power control functions are needed. These functions include the handling of the partition profiles that define the processor, memory, and I/O resources allocated to an individual partition.

The 7310 Model CR2 or the 7310 Model C03 HMCs are specifically for POWER5 processor-based systems. However, an existing 7315 Model CR2 and the 7315 Model C03 (POWER4 processor-based systems HMC) can be converted for POWER5 processor-based systems use when it is loaded with the HMC software required for POWER5 processor-based systems (FC 0961).

POWER5 processor-based system HMCs require Ethernet connectivity. Ensure that sufficient Ethernet adapters are available to enable public and private networks if you need both. The 7310 Model C03 is a desktop model with only one native 10/100/1000 Ethernet port, but three additional PCI slots. The 7310 Model CR2 is a 1U, 19-inch rack mountable drawer that has two native Ethernet ports and two additional PCI slots.

When an HMC is connected to the p5-550, the p5-550 integrated serial ports are disabled. If you need serial connections, for example, non-Ethernet HACMP heartbeat, you need to provide an Async adapter.

Note: It is not possible to connect POWER4 and POWER5 processor-based systems simultaneously to the same HMC.

1.4 Value Paks

Value Paks are a new offering available on an initial order only. They provide a predefined configuration, designed to meet typical customer requirements. Special reduced pricing is available when a system order satisfies specific configuration requirements for memory, disk drives, and processors. When a Value Pak is ordered, it is still possible to select additional features.

If you order a p5-550, you can qualify for a processor activation at no additional charge. The number of processors, total memory, and quantity and size of disk are the only features that

determine if a customer is entitled to processor activations at no additional charge. You will also be entitled to a discounted AIX operating system license or you can choose to purchase the system with no operating system. All Value Paks consist of a standard configuration that must be part of the order. For each paid processor activation, the customer is entitled to one processor activation no additional charge if the following minimum requirements are met:

- ▶ The system must have at least two disk drives of 73.4 GB or greater each.
- ▶ There must be at least 2 GB of memory installed for each activated processor, as described in Table 1-8.

Note: Value Paks are available in an initial order only.

Table 1-8 Value Pak configurations

Value Paks	Processors, FCs	Memory (MB)	Disk
1.5 GHz	1-way, 1 x 5239 and 1 x 7601	2048, 1 x FC 4447	2 x 73.4 GB (FC 3274)
1.5 GHz	2-way, 1 x 5264 and 2 x 7603	4096, 2 x FC 4447	2 x 73.4 GB (FC 3274)
1.5 GHz	4-way, 2 x 5264 and 4 x 7603	8192, 4 x FC 4447	2 x 73.4 GB (FC 3274)
1.65 GHz	2-way, 1 x 5237 and 2 x 7871	4096, 2 x FC 4447	2 x 73.4 GB (FC 3274)
1.65 GHz	4-way, 2 x 5237 and 4 x 7871	8192, 4 x FC 4447	2 x 73.4 GB (FC 3274)

1.5 System racks

The Enterprise Rack Models T00 and T42 are 19-inch wide racks for general use with IBM *e*server p5, pSeries, and RS/6000 rack-based or rack drawer-based systems. The racks provide increased capacity, greater flexibility, and improved floor space utilization.

The p5-550 uses a 4U rack-mounted server drawer.

If a p5-550 system is to be installed in a non-IBM rack or cabinet, you should ensure that the rack conforms to the EIA¹ standard EIA-310-D (see 1.5.6, “OEM rack” on page 15).

Note: It is the customer’s responsibility to ensure that the installation of the drawer in the preferred rack or cabinet results in a configuration that is stable, serviceable, safe, and compatible with the drawer requirements for power, cooling, cable management, weight, and rail security.

1.5.1 IBM RS/6000 7014 Model T00 Enterprise Rack

The 1.8-meter (71 inch) Model T00 is compatible with past and present p5, pSeries, and RS/6000 racks and is designed for use in all situations that have previously used the older rack models R00 and S00. The T00 rack has the following features:

- ▶ 36 EIA units (36U) of usable space.
- ▶ Optional removable side panels.
- ▶ Optional highly perforated front door.
- ▶ Optional side-to-side mounting hardware for joining multiple racks.

¹ Electronic Industries Alliance (EIA). Accredited by American National Standards Institute (ANSI), EIA provides a forum for industry to develop standards and publications throughout the electronics and high-tech industries.

- ▶ Standard black or optional white color in OEM format.
- ▶ Increased power distribution and weight capacity.
- ▶ An optional reinforced (ruggedized) rack feature (FC 6080) provides added earthquake protection with modular rear brace, concrete floor bolt-down hardware, and bolt-in steel front filler panels.
- ▶ Support for both AC and DC configurations.
- ▶ DC rack height is increased to 1926 mm (75.8 inches) if a power distribution panel is fixed to the top of the rack.
- ▶ Up to four Power Distribution Units (PDUs) can be mounted in the proper bays, but others can fit inside the rack. See 1.5.3, “AC Power Distribution Unit and rack content” on page 12.
- ▶ Optional rack status beacon (FC 4690). This beacon is designed to be placed on top of a rack and cabled to servers, such as a p5-550, and other components, such as a 7311 I/O drawer, inside the rack. Servers can be programmed to illuminate the beacon in response to a detected problem or changes in system status.
- ▶ A rack status beacon junction box (FC 4693) should be used to connect multiple servers and I/O drawers to the beacon. This feature provides six input connectors and one output connector for the rack. To connect the servers or other components to the junction box or the junction box to the rack, status beacon cables (FC 4691) are necessary. Multiple junction boxes can be linked together in a series using daisy chain cables (FC 4692).
- ▶ Weight:
 - T00 base empty rack: 244 kg (535 pounds)
 - T00 full rack: 816 kg (1795 pounds)

1.5.2 IBM RS/6000 7014 Model T42 Enterprise Rack

The 2.0-meter (79.3-inch) Model T42 is the rack that will address the special requirements of customers who want a tall enclosure to house the maximum amount of equipment in the smallest possible floor space. The features that differ in the Model T42 rack from the Model T00 include the following:

- ▶ 42 EIA units (42U) of usable space
- ▶ AC power support only
- ▶ Weight:
 - T42 base empty rack: 261 kg (575 pounds)
 - T42 full rack: 930 kg (2045 pounds)

1.5.3 AC Power Distribution Unit and rack content

For rack models T00 and T42 9-outlet PDUs are available.

PDUs with nine outlets (FC 9176, 9177, 9178, 7176, 7177, and 7178) are available. A T42 rack configured for the maximum number of power outlets would have six PDUs (two mounted horizontally requiring 2U of rack space), for a total of 54 power outlets.

The p5-550 can be connected to any PDU that is available for the 7014-T00 or 7014-T42 racks.

For detailed power cords requirements and power cord feature codes, see the publication *Site and Hardware Planning Information*, SA38-0508. An online copy can be found at:

http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base/

The first four PDUs ordered for a rack will be mounted vertically in the sides of the rack, occupying all the four PDU bays available. Any additional PDUs will be mounted horizontally in the rear of the rack and will occupy 1U of rack space.

Note: Each p5-550, or a system drawer to be mounted in the rack, requires two power cords, which are not included in the base system order.

The Universal PDU (FC 7188) and the optional Universal PDU to be mounted horizontally in the rack (FC 9188) will be available on December 31, 2004, supporting a wide range of country requirements and electrical power specifications. Each Universal PDU provides 12 C13 power outlets for use within a 7014-T00 or 7014-T42 rack, compared to nine C13 power outlets provided by FC 7176 or FC 7177 PDUs. Nine different power cord features can be used to connect the PDU to a wall power outlet. Each power cord provides the unique design characteristics for the different power requirements. To match new power requirements, these power cords can be requested with an initial order of the rack, or with a later upgrade of the rack features.

1.5.4 Rack-mounting rules for p5-p550

The primary rules that should be followed when mounting the p-550 into a rack are:

- ▶ The p5-550 is designed to be placed at any location in the rack. For rack stability, it is advisable to start filling a rack from the bottom.
- ▶ Any remaining space in the rack can be used to install other systems or peripherals, provided that the maximum permissible weight of the rack is not exceeded and the installation rules for these devices are followed.
- ▶ Before placing a p5-550 into the service position, it is essential that the rack manufacturer's safety instructions have been followed regarding rack stability.

Depending on the current implementation and future enhancements of additional 7311 Model D20 drawers connected to the p5-550 or single installed p5-550 systems, Table 1-9 shows examples of the minimum and maximum configurations for different combinations of p5-550s and attached 7311 Model D20 I/O drawers.

Table 1-9 Minimum and maximum configurations for p550s and 7311-D20s

	Only p5-550s	One p5-550, one 7311-D20	One p5-550, four 7311-D20s	One p5-550, eight 7311-D20s
7014-T00 rack	9	4	1	1
7014-T42 rack	10	5	2	1

1.5.5 Additional options for rack

The intention of this section is to highlight some solutions available to provide a single point of management for environments composed of multiple p5-550 servers or other IBM @server p5, pSeries, and RS/6000 systems.

IBM 7212 Model 102 IBM TotalStorage Storage device enclosure

The IBM 7212 Model 102 is designed to provide efficient and convenient storage expansion capabilities for select IBM eServer p5, pSeries, and RS/6000 servers. The IBM 7212 Model 102 is a 1U rack-mountable option to be installed in a standard 19-inch rack using an optional rack-mount hardware feature kit. The 7212 Model 102 has two bays that can accommodate any of the following storage drive features:

- ▶ Digital Data Storage (DDS) Gen 5 DAT72 Tape Drive provides physical storage capacity of 36 GB (72 GB with 2:1 compression) per data cartridge.
- ▶ VXA-2 Tape Drive provides a media capacity of up to 80 GB (160 GB with 2:1 compression) physical data storage capacity per cartridge.
- ▶ DDS-4 tape drive with 20 GB native data capacity per tape cartridge and a native physical data transfer rate of up to 3 MB/sec, using 2:1 compression so that a single tape cartridge can store up to 40 GB of data.
- ▶ DVD-ROM drive is a 5 1/4-inch, half-high device. It can read 640 MB CD-ROM and 4.7 GB DVD-RAM media. It can be used for Alternate IPL (IBM-distributed CD-ROM media only) and program distribution.
- ▶ DVD-RAM drive with up to 2.7 MB/sec throughput. Using 3:1 compression, a single disk can store up to 28 GB of data. Supported DVD disk native capacities on a single DVD-RAM disk are as follows: up to 2.6 GB, 4.7 GB, 5.2 GB, and 9.4 GB.

Flat panel display options

The IBM 7316-TF3 Flat Panel Console Kit may be installed in the system rack. This 1U console uses a 15-inch thin film transistor (TFT) LCD with a viewable area of 304.1 mm x 228.1 mm and a 1024 x 768 picture elements (pels) resolution. The 7316-TF3 Flat Panel Console Kit has the following attributes:

- ▶ Flat panel color monitor.
- ▶ Rack tray for keyboard, monitor, and optional VGA switch with mounting brackets.
- ▶ IBM Space Saver 2, 14.5-inch keyboard that mounts in the Rack Keyboard Tray and is available as a feature in 16 language configurations (the track point mouse is integrated into the keyboard).

Note: It is recommended that you have the 7316-TF3 installed between EIA 20 to 25 of the rack for ease of use. The 7316-TF3 or any other graphics monitor requires a POWER GXT135P graphics accelerator (FC 2848 or FC 2849) to be installed in the server, or other graphic accelerator, if supported.

Hardware Management Console 7310 Model CR2

The 7310 Model CR2 is a 1U, 19-inch rack mountable drawer supported in the 7014 Model T00 and T42 racks. The 7310 Model CR2 provides one serial port, two integrated Ethernet ports, and two additional PCI slots. The HMC 7310 Model CR2 has USB ports to connect USB keyboard and mouse devices.

Note: The HMC serial port can be used for external modem attachment if the Service Agent call-home function is implemented, and the Ethernet ports are used to communicate to the service processor in p5-550 systems. An Ethernet cable (FC 7801 or 7802) is required to attach the HMC to the p5-550 system it controls.

1.5.6 OEM rack

The p5-550 can be installed in a suitable OEM rack, provided that the rack conforms to the EIA-310-D standard. This standard is published by the Electrical Industries Alliance, and a summary of this standard is available in the publication *Site and Hardware Planning Information*, SA38-0508.

The key points mentioned in this standard are as follows:

- ▶ Any rack used must be capable of supporting 15.9 kg (35 pounds) per EIA unit (44.5 mm [1.75 inches] of rack height).
- ▶ To ensure proper rail alignment, the rack must have mounting flanges that are at least 494 mm (19.45 inches) across the width of the rack and 719 mm (28.3 inches) between the front and rear rack flanges.
- ▶ It might be necessary to supply additional hardware, such as fasteners, for use in some manufacturer's racks.

Figure 1-4 shows the drawing specifications for OEM racks.

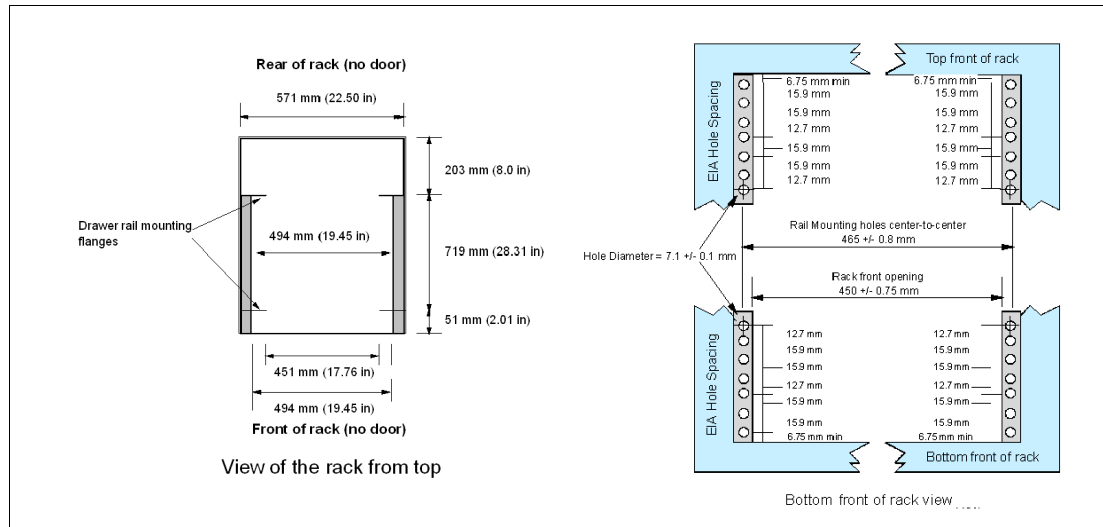


Figure 1-4 Reference drawing for OEM rack specifications

Architecture and technical overview

This chapter discusses the overall system architecture represented by Figure 2-1. The major components of this diagram are described in the following sections. The bandwidths provided throughout this section are theoretical maximums provided for reference. It is always recommended to obtain real-world performance measurements using production workloads.

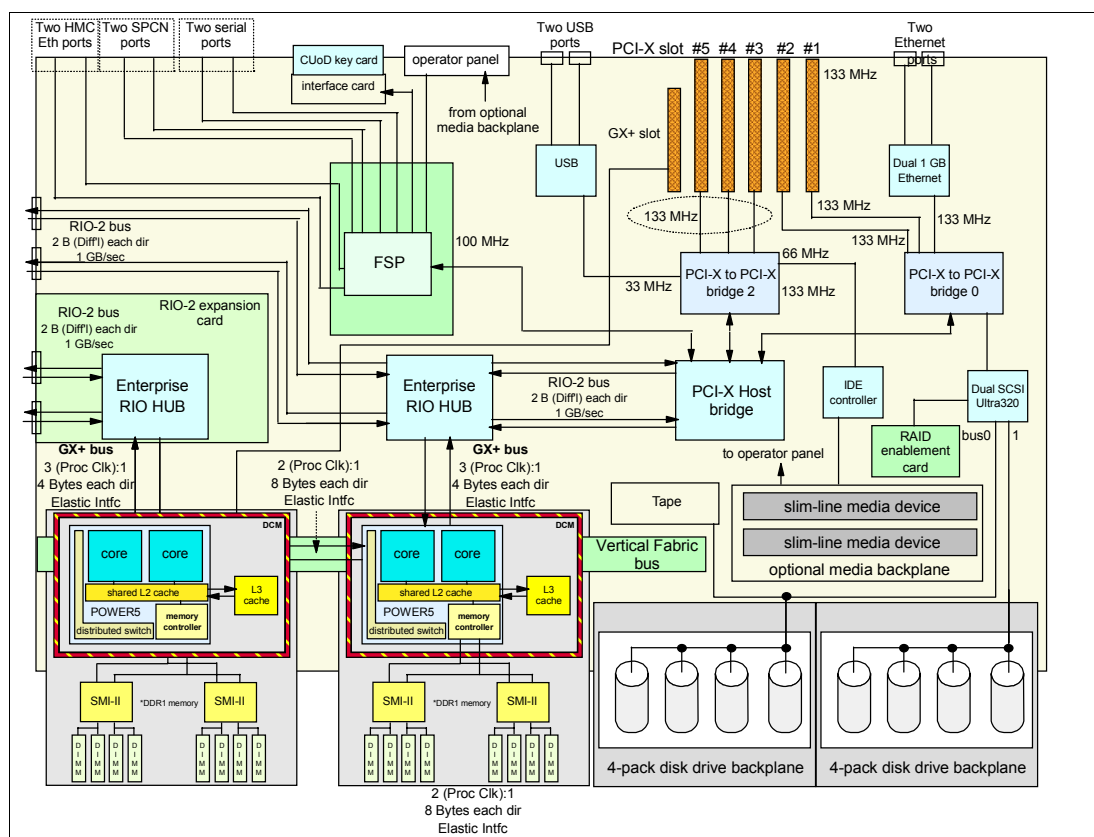


Figure 2-1 p5-550 logic data flow

2.1 The POWER5 chip

The POWER5 chip features single-threaded and multi-threaded execution, providing higher performance in the single-threaded mode than its POWER4 predecessor at equivalent frequencies provides. POWER5 maintains both binary and architectural compatibility with existing POWER4 systems to ensure that binaries continue executing properly and all application optimizations carry forward to newer systems. The POWER5 provides additional enhancements such as virtualization, reliability, availability, and serviceability at both chip and system levels, and it has been designed to support speeds up to 3 GHz.

Figure 2-2 shows the high-level structures of POWER4 and POWER5 processor-based systems. The POWER4 scales up to a 32-way symmetric multiprocessor. Going beyond 32 processors increases interprocessor communication, resulting in high traffic on the interconnection fabric bus. This contention negatively affects system scalability.

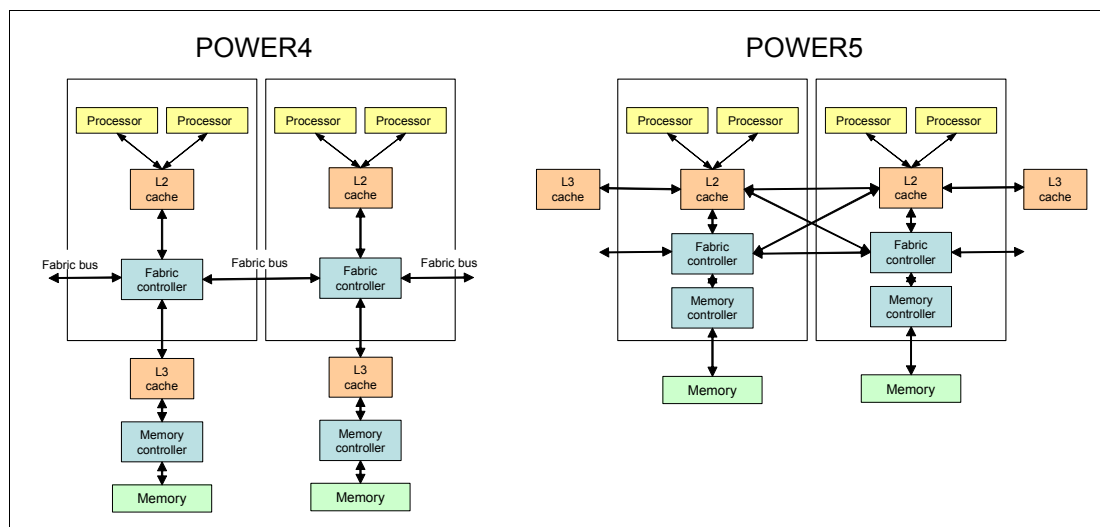


Figure 2-2 POWER4 and POWER5 system structures

Moving the L3 cache (2-way processor cards only) provides significantly more cache on the processor side than previously available, thus reducing traffic on the fabric bus and allowing POWER5 processor-based systems to scale to higher levels of symmetric multiprocessing. The POWER5 supports a 1.9 MB on-chip L2 cache, implemented as three identical slices with separate controllers for each. Either processor core can independently access each L2 controller. The L3 cache, with a capacity of 36 MB, operates as a backdoor with separate buses for reads and writes that operate at half processor speed.

Because of the higher transistor density of the POWER5 0.13- μ m technology, it was possible to move the memory controller on chip and eliminate a chip previously needed for the memory controller function. These changes in the POWER5 also have the significant side benefits of reducing latency to the L3 cache and main memory and reducing the number of chips necessary to build a system.

The POWER5 processor supports the 64-bit PowerPC architecture. A single die contains two identical processor cores, each supporting two logical threads. This architecture makes the chip appear as a 4-way symmetric multiprocessor to the operating system. The POWER5 processor core has been designed to support both enhanced simultaneous multi-threading and single threaded (ST) operation modes.

2.1.1 Simultaneous multi-threading

As a permanent requirement for performance improvements at the application level, simultaneous multi-threading functionality is embedded in the POWER5 chip technology. Developers are familiar with process-level parallelism (multi-tasking) and thread-level parallelism (multi-threads). Simultaneous multi-threading is the next stage of processor saturation for throughput-oriented applications to introduce the method of instruction-level parallelism to support multiple pipelines to the processor.

By default, simultaneous multi-threading is activated. On a 2-way POWER5 processor-based system, the operating system views the available processors as a 4-way system. To achieve a higher performance level, simultaneous multi-threading is also applicable in Micro-Partitioning, capped or uncapped, and dedicated partition environments.

Simultaneous multi-threading is supported on POWER5 systems running AIX 5L Version 5.3 or Linux operating system-based at a required 2.6 kernel. AIX provides the `smtctl` command that turns simultaneous multi-threading on and off without a subsequent reboot. For Linux, an additional boot option must be set to activate simultaneous multi-threading after a reboot.

The simultaneous multi-threading mode maximizes the usage of the execution units. In the POWER5 chip, more rename registers have been introduced (for floating-point operation, rename registers increased to 120) that are essential for out of order execution and then vital for the simultaneous multi-threading.

Enhanced simultaneous multi-threading features

To improve simultaneous multi-threading performance for various workload mixes and provide robust quality of service, POWER5 provides two features:

- ▶ Dynamic resource balancing
 - The objective of dynamic resource balancing is to ensure that the two threads executing on the same processor flow smoothly through the system.
 - Depending on the situation, the POWER5 processor resource balancing logic has different thread throttling mechanisms.
- ▶ Adjustable thread priority
 - Adjustable thread priority lets software determine when one thread should have a greater (or lesser) share of execution resources.
 - POWER5 supports eight software-controlled priority levels for each thread.

ST operation

Not all applications benefit from simultaneous multi-threading. Having threads executing on the same processor will not increase the performance of applications with execution unit limited performance or applications that consume all the chip's memory bandwidth. For this reason, the POWER5 supports the ST execution mode. In this mode, the POWER5 processor gives all the physical resources to the active thread, allowing it to achieve higher performance than a POWER4 processor-based system at equivalent frequencies. Highly optimized scientific codes are one example where ST operation is ideal.

2.1.2 Dynamic power management

In current Complimentary Metal Oxide Semiconductor (CMOS) technologies, chip power is one of the most important design parameters. With the introduction of simultaneous multi-threading, more instructions execute per cycle per processor core, thus increasing the core's and the chip's total switching power. To reduce switching power, POWER5 chips use a

fine-grained, dynamic clock gating mechanism extensively. This mechanism gates off clocks to a local clock buffer if dynamic power management logic knows the set of latches driven by the buffer will not be used in the next cycle. This allows substantial power saving with no performance impact. In every cycle, the dynamic power management logic determines whether a local clock buffer that drives a set of latches can be clock gated in the next cycle.

In addition to the switching power, leakage power has become a performance limiter. To reduce leakage power, the POWER5 chip uses transistors with low threshold voltage only in critical paths. The POWER5 chip also has a low-power mode, enabled when the system software instructs the hardware to execute both threads at the lowest available priority. In low power mode, instructions dispatch once every 32 cycles at most, further reducing switching power. The POWER5 chip uses this mode only when there is no ready task to run on either thread.

2.1.3 POWER chip evolution

The p5-550 system complies with the RS/6000 platform architecture, which is an evolution of the PowerPC Common Hardware Reference Platform (CHRP) specifications. Figure 2-3 shows the POWER evolution.

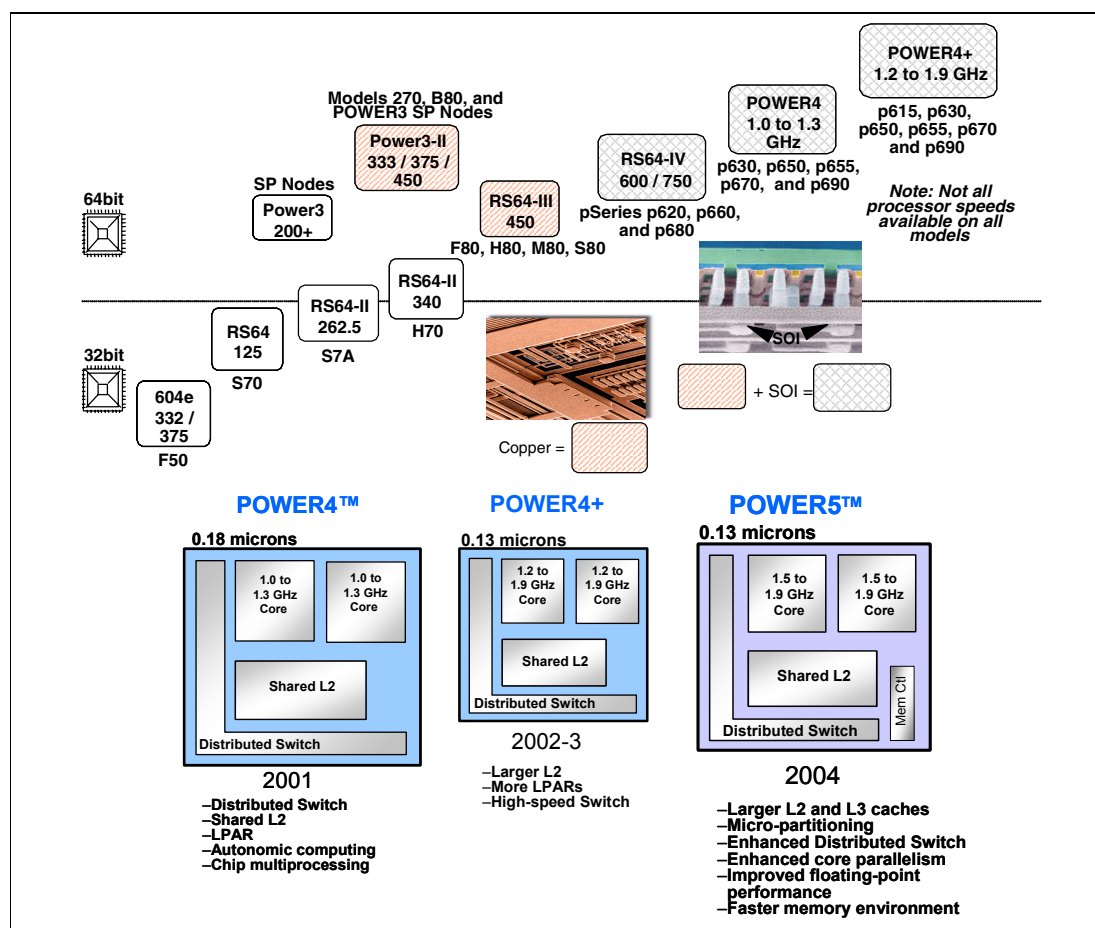


Figure 2-3 POWER chip evolution

2.1.4 CMOS, copper, and SOI technology

The POWER5 processor design is a result of a close collaboration between *IBM Systems and Technology Group* and *IBM Microelectronics Technologies* that enables IBM *@server p5* systems to give customers improved performance, reduced power consumption, and decreased IT footprint size through logical partitioning. The POWER5 processor chip takes advantage of IBM leadership technology. It is made using IBM 0.13- μ m-lithography CMOS technology. The POWER5 processor also uses copper and silicon-on-insulator (SOI) technology to allow a higher operating frequency for improved performance yet with reduced power consumption and improved reliability compared to processors not using this technology.

2.2 Processor cards

In the p5-550 system, the POWER5 chip has been packaged with the L3 cache chip (on 2-way cards) into a cost-effective Dual Chip Module (DCM) package. The storage structure for the POWER5 chip is a distributed memory architecture, which provides high memory bandwidth. Each processor can address all memory and sees a single shared memory resource. As such, a single DCM and its optional L3 cache and memory are packaged on a single processor card. Access to memory behind another processor is accomplished through the fabric buses. The p5-550 supports up to two 2-way processor cards (only a single 1-way). Each processor card has a single DCM containing a POWER5 processor chip and a 36 MB L3 module. I/O connects to the Central Electronic Complex (CEC) subsystem through the GX+ bus. Each DCM provides a single GX+ bus for a total system capability of two GX+ buses. The GX+ bus provides an interface to a single device such as the RIO-2 buses, as shown in Figure 2-4.

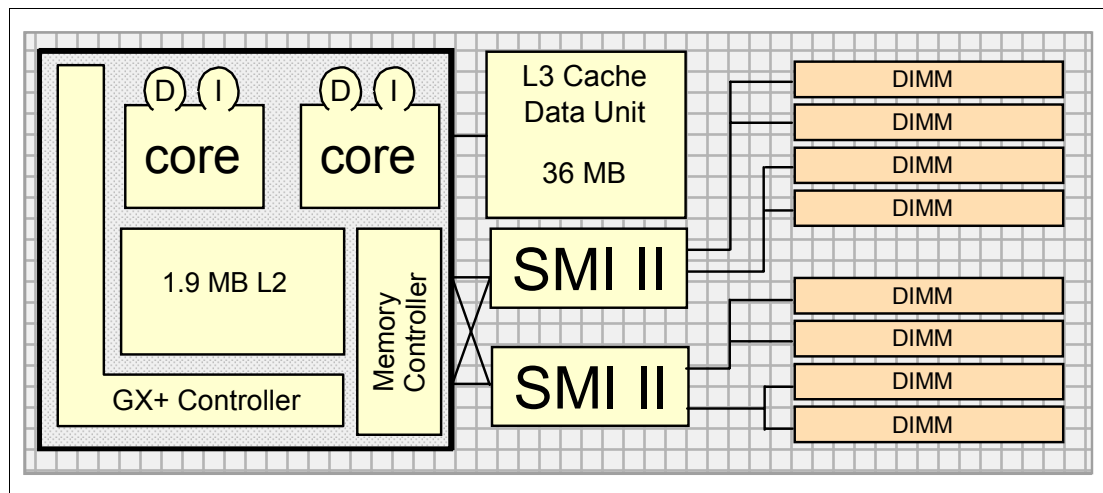


Figure 2-4 p5-550 DCM diagram

Each processor card contains a single DCM and the local memory storage subsystem for that DCM. The processor card also contains LEDs for each FRU¹ on the CPU card including the CPU card itself. See Figure 2-5 for a processor card layout view.

¹ Field Replacement Unit

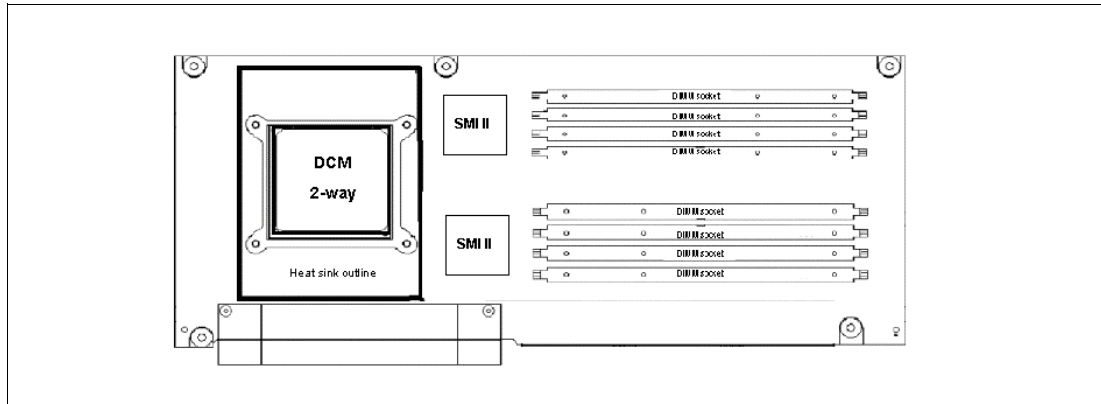


Figure 2-5 Processor card with DDR1 memory socket layout view

2.2.1 Available processor speeds

The p5-550 operates with a processor clock rate of 1.5 GHz or 1.65 GHz for 2-way and 4-way systems and 1.5 GHz for 1-way systems.

To determine the processor characteristics on a running system, use one of the following commands:

lsattr -El procX Where X is the number of the processor, for example, proc0 is the first processor in the system. The output from the command² would be similar to the following (False, as used in this output, signifies that the value cannot be changed through an AIX command interface):

```
type powerPC_POWER5      Processor type      False
frequency 165600000      Processor Speed    False
smt_enabled true         Processor SMT enabled False
smt_threads 2            Processor SMT threads False
state enable             Processor state      False
```

pmcycles -m

This command (in AIX 5L) uses the performance monitor cycle counter and the processor real-time clock to measure the actual processor clock speed in MHz. The following is the output of a 2-way p5-550 running at 1.65 GHz system with simultaneous multi-threading enabled:

```
Cpu 0 runs at 1656 MHz
Cpu 1 runs at 1656 MHz
Cpu 2 runs at 1656 MHz
Cpu 3 runs at 1656 MHz
```

Note: The **pmcycles** command is part of the **bos.pmapi** fileset. First check whether that component is installed using the **lspp -l bos.pmapi** command.

2.3 Memory subsystem

The p5-550 system offers pluggable DIMMs for memory. Each processor card contains eight slots for up to eight pluggable DIMMs. The minimum memory for a p5-550 processor-based system is 1 GB and 64 GB as a maximum installable memory option. The p5-550 memory

² The output of the **lsattr** command has been expanded with AIX 5L to include the processor clock rate.

capacity is dependant on the number of processors ordered for the system and on the type of memory and functionality required. Figure 2-6 shows the offerings and memory slot availability.

2.3.1 Memory placement rules

The memory features available at the time of writing for the p5-550 are listed in 1.3.2, “Memory features” on page 7.

Each memory feature consists of four DIMMs and must be installed according to Figure 2-6. With quad-based memory features, the first quad slots are J0A, J1A, J0C, and J1C, and for the second quad, the slots are J0B, J1B, J0D, and J1D. The 512 MB memory feature must be installed in J0A and J1A.

Note: A quad must consist of a single feature (that is made of four identical DIMMs). Mixed DIMM capacities in a quad will result in reduced RAS.

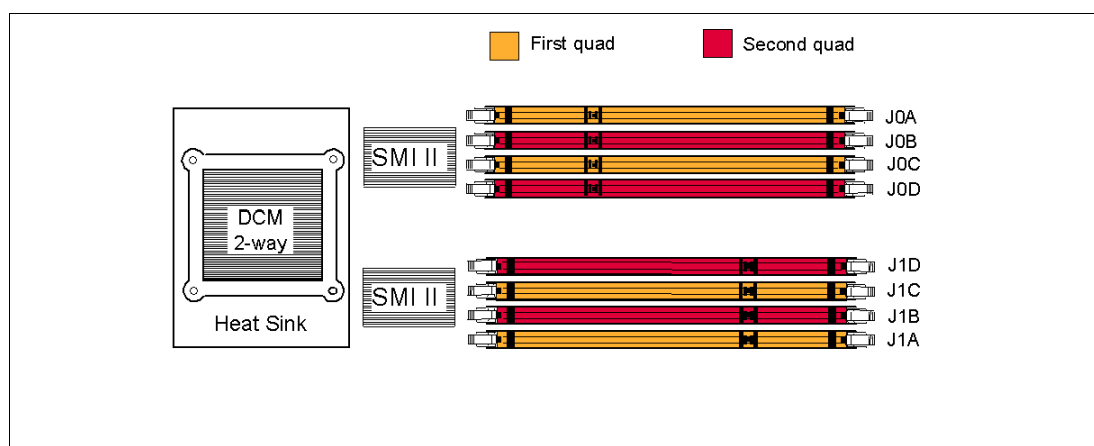


Figure 2-6 Memory placement for the p5-550

2.3.2 Memory restriction

The p5-550 does not officially support OEM memory, and there is no exception to this rule. OEM memory is never certified for the use in pSeries and the new p5 servers. If the p5-550 is populated with OEM memory, you could experience unexpected and unpredictable behavior.

All IBM memory is identified by an IBM logo and a white label printed with a barcode on top and an alphanumeric string on the bottom, created according to the rule reported in Figure 2-7.

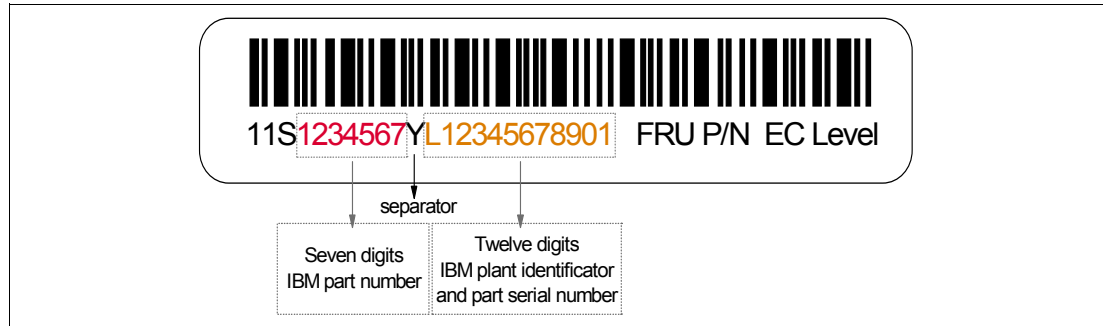


Figure 2-7 IBM memory certification label

Sometimes OEM vendors put a label reporting the IBM memory part number but not the barcode or the alphanumeric string, or both on their DIMMs.

In case of system failure caused by OEM memory installed in the system, the first thing to do is to replace the suspected memory with IBM memory and check whether the problem is corrected. Contact your IBM representative for further assistance if needed.

2.3.3 Memory throughput

The memory subsystem throughput is based on the speed of the memory, not the speed of the processor. An elastic interface, contained in the POWER5 chip, buffers reads and writes to and from memory and the processor. There are two SMIs, each with a single 8 byte read and 2 byte write DDR bus to the processor on each processor card. A DDR bus allows double reads or writes per clock cycle. If 266 MHz memory is installed (operating at 266.5 MHz), the throughput is $(16 \times 2 \times 266.5) + (4 \times 2 \times 266.5)$ or 10660 MB/second or 10.41 GB/second per processor card between the SMIs and the processor. For a system with two processor cards, this value is doubled, or 20.82 GB/second. These values are maximum theoretical throughputs for comparison purposes only.

There are four 8 Byte paths to the memory DIMMs from the SMIs, therefore the throughput is 8.32 GB/s per processor card or 16.65 GB/s for a 4-way system.

The POWER5 processor's integrated memory controller further reduces latency over the previous outboard controller on POWER4 systems to the SMI chips by requiring fewer cycles in order to set up memory addressing in the hardware.

2.4 System buses

The following sections provide additional information related to the internal buses.

2.4.1 RIO buses and GX card

Each DCM provides a GX+ bus that is used to connect to an I/O subsystem. In a fully populated p5-550, there are two GX+ buses, one from each processor card. Each p5-550 has one GX+ slot with a single GX+ bus. The GX+ slot is not active unless the second processor card is installed. It is not required for CUoD processor cards to be activated in order for the associated GX+ bus to be active. The GX+ cards are hot-pluggable. The p5-550 provides two external RIO-2 ports that can operate up to 1 GHz. An add-in GX adapter card (Remote I/O expansion card, FC 1806) when plugged into the GX+ slot adds two more RIO-2 ports. The RIO-2 ports are used for I/O expansion to external I/O drawers. The supported I/O drawer is 7311 Model D20.

2.5 Internal I/O subsystem

The internal I/O subsystem resides on the system planar, and the SP is packaged on a separate service processor card. Each card is a separate FRU. There is an internal RIO-2 bus imbedded in the system planar. The system planar contains both the Enterprise RIO-2 hub and the PCI-X Host bridge chip to connect to the integrated I/O packaged on the system planar. Two RIO-2 ports of the Enterprise hub chip are used for the integrated I/O, and the remaining two ports are routed to external connectors.

The system planar provides five PCI-X slots and several integrated PCI devices that interface to two EADS-X chips that function as PCI-X to PCI-X bridges to the primary PCI-X buses on the PCI-X Host bridge chip.

PCI-X slot 5 can accept a short PCI-X or PCI card and its space is shared with the Remote I/O expansion card. The remaining PCI-X slots are full length cards. The dual 10/100/1000 Mbps Ethernet adapter is integrated on the system planar.

2.5.1 PCI-X slots and adapters

PCI-X, where the X stands for extended, is an enhanced PCI bus, delivering a bandwidth of up to 1 GB/sec, running a 64-bit bus at 133 MHz. PCI-X is backward compatible, so the p5-550 systems can support existing 3.3 volt PCI adapters.

The PCI-X slots in the p5-550 system support hot-plug and Extended Error Handling (EEH). In the unlikely event of a problem, EEH-enabled adapters respond to a special data packet generated from the affected PCI-X slot hardware by calling system firmware, which will examine the affected bus, allow the device driver to reset it, and continue without a system reboot.

64-bit and 32-bit adapters

IBM offers 64-bit adapter options for the p5-550, as well as 32-bit adapters. Higher-speed adapters use 64-bit slots because they can transfer 64 bits of data for each data transfer phase. Generally, 32-bit adapters can function in 64-bit PCI-X slots; however, some 64-bit adapters cannot be used in 32-bit slots. For a full list of the adapters that are supported on the p5-550 systems, and for important information regarding adapter placement, see the *IBM @server. Hardware Information Center*. You can find it at:

http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base/

2.5.2 LAN adapters

To connect a p5-550 to a local area network (LAN), the dual port internal 10/100/1000 Mbps RJ-45 Ethernet controller, integrated on the system planar can be used.

See the Table 2-1 for the list of additional LAN adapters available at the time of writing. IBM supports an installation with NIM using Ethernet and token-ring adapters (CHRP³ is the platform type).

Table 2-1 Available LAN adapters

Feature code	Adapter description	Slot	Size	Max
4959	4/16 Token Ring	32 or 64	short	4

³ CHRP stands for Common Hardware Reference Platform, a specification for PowerPC-based systems that can run multiple operating systems.

Feature code	Adapter description	Slot	Size	Max
4962	10/100 Ethernet	32 or 64	short	5
5700	Gigabit Ethernet	64	short	5
5701	10/100/1000 Ethernet	64	short	5
5706	2-port 10/100/1000 Ethernet	64	short	5
5707	2-port Gigabit Ethernet - SX	64	short	5
5718	10 Gigabit Ethernet PCI-X	64	short	1

2.5.3 Graphic accelerators

The p5-550 supports up to two enhanced POWER GXT135P (FC 2849) 2D graphic accelerators. The POWER GXT135P is a low-priced 2D graphics accelerator for pSeries and p5 servers. It can be configured to operate in either 8-bit or 24-bit color modes running at 60 Hz to 85 Hz. This adapter supports both analog and digital monitors. The adapter requires one short 32-bit or 64-bit PCI-X slot.

2.5.4 SCSI adapters

To connect to external SCSI devices, the following adapters provided in Table 2-2 are available, at the time of writing, to be used in p5-550 system.

Table 2-2 Available SCSI adapters

Feature code	Adapter description	Slot	Size	Max
5703	Ultra320 SCSI RAID, bootable	64	long	4
5712	Ultra320 SCSI	64	short	5
6204	Ultra SCSI Differential	32	short	2

There is also the option to make the internal Ultra320 SCSI channel externally accessible on the rear side of the system by installing FC 4273. No additional SCSI adapter is required in this case. If FC 4273 is installed, a second 4-pack disk enclosure (FC 6592 or FC 6593) cannot be installed, which limits the maximum number of internal disks to four. FC 4273 also requires one PCI-X slot.

For more information about the internal SCSI system, see 2.7, “Internal storage” on page 27.

2.6 Internal serial ports

The serial ports S1 and S2, at the rear of the system, are only available if the system is not managed using a Hardware Management Console (HMC). In this case, the S1 and S2 ports support the attachment of serial console and modem.

If an HMC is connected, a *virtual serial console* is provided by the HMC (logical device vsa0 under AIX) and also a modem can be connected to the HMC. The S1 and S2 ports are not usable in this case.

If additional serial port functionality is needed, optional PCI adapters are available (PCI 8-port adapter FC 2943 or PCI 128-port adapter FC 2944).

2.7 Internal storage

There is one dual channel Ultra320 SCSI controller managed by the EADS-X chips, integrated into the system planar, that is used to drive the internal disk drives. The eight internal drives plug into the disk drive backplane, which has two separate SCSI buses with four disk drives per bus.

The internal disk drive can be used in two different modes based on whether the SCSI RAID Enablement Card (FC 5709) is installed (see 2.7.3, “RAID options” on page 29).

The p5-550 supports a split 8-pack disk drive backplane that is designed for hot-pluggable disk drives. The disk drive backplane docks directly to the system planar. The virtual SCSI Enclosure Services (VSES) hot-plug control functions are provided by the Ultra320 SCSI controllers.

2.7.1 Internal media devices

The p5-550 provides two slim-line media bays for an optional DVD-ROM (FC 2640) and optional DVD-RAM (FC 5751), and one media bay for a tape drive. These features are summarized in Table 2-3.

Table 2-3 Available tape drives

Feature code	Description
6258	4-mm 36/72 GB tape (LVD)
6134	8-mm 60/150 GB tape (LVD)
6120	VXA 80/160 GB tape (LVD)

2.7.2 Internal hot swappable SCSI disks

The p5-550 can have up to eight hot-swappable disk drives plugged in the two 4-pack disk drives backplanes. The hot-swap process is controlled by the SCSI enclosure service (SES), which is located in the 4-pack disk drives backplane (AIX assigns the name ses0 to the first 4-pack, and ses1 to the second, if present). The two hot-swappable 4-pack disk drives backplanes can accommodate the devices listed in Table 2-4.

Table 2-4 Hot-swappable disk drive options

Feature code	Description
3273	36.4 GB 10,000 RPM Ultra3 SCSI hot-swappable disk drive
3277	36.4 GB 15,000 RPM Ultra3 SCSI hot-swappable disk drive
3274	73.4 GB 10,000 RPM Ultra3 SCSI hot-swappable disk drive
3278	73.4 GB 15,000 RPM Ultra3 SCSI hot-swappable disk drive
3275	146.8 GB 10,000 RPM Ultra3 SCSI hot-swappable disk drive

At the time of writing, if a new order is placed with two 4-pack DASD backplanes (FC 6592) and more than one disk, the system configuration shipped from manufacturing will balance the total number of SCSI disks between the two 4-pack SCSI backplanes. This is for manufacturing test purposes, and not because of any limitation. Having the disks balanced between the two 4-pack DASD backplanes allows the manufacturing process to systematically test the SCSI paths and devices related to them.

Prior to the hot-swap of a disk in the hot-swappable capable bay, all necessary operating system actions must be undertaken to ensure that the disk is capable of being deconfigured. After the disk drive has been deconfigured, the SCSI enclosure device will power-off the slot, enabling safe removal of the disk. You should ensure that the appropriate planning has been given to any operating-system-related disk layout, such as the AIX Logical Volume Manager, when using disk hot-swap capabilities. For more information, see *Problem Solving and Troubleshooting in AIX 5L*, SG24-5496.

Note: We recommend that you follow this procedure, after the disk has been deconfigured, when removing a hot-swappable disk:

1. Release the tray handle on the disk.
2. Pull out the disk assembly a little bit from the original position.
3. Wait up to 20 seconds until the internal disk stops spinning.
4. Now you can safely remove the disk from the 4-pack DASD backplane.

After the SCSI disk hot-swap procedure, you can expect to find SCSI_ERR10 logged in the AIX error log, with the second word of the sense data equal to 0017. It is generated from a SCSI bus reset issued by the SES to reset all processes when a drive is inserted, and it is not an issue.

Hot-swap disks and Linux

Linux does not support the hot-swap of any disk drive at the time of writing; therefore, the Linux operating system does not support these hot-swappable procedures. A p5-550 system running Linux must be shut down and powered off before you replace any disk drives.

2.7.3 RAID options

Internal hardware RAID is available on the p5-550. Three options are available:

- ▶ Install the Dual Channel SCSI RAID Enablement Card (FC 5709). Install four disk drives in the first 4-pack DASD backplane (FC 6592). This will allow RAID 0, 5, or 10 capabilities within a single 4-pack of DASD with one RAID controller.
- ▶ Install FC 5709. Install a second FC 6592. Install four additional disk drives in the second 4-pack DASD backplane. This will allow RAID 0, 5, or 10 capabilities across two 4-packs of DASD with one RAID controller.
- ▶ Install feature number 5709. Install the Ultra320 SCSI 4-Pack Enclosure for Disk Mirroring (FC 6593). Install the PCI-X Dual Channel Ultra320 SCSI RAID Adapter (FC 5703). Install the SCSI Cable which connects the PCI Adapter to the second 4-pack DASD backplane (FC 4267). This will allow RAID 0, 5, or 10 capabilities within each 4-pack of DASD with two RAID controllers.

Note: Because the p5-550 has eight disk drive slots, customers performing upgrades must perform appropriate planning to ensure the correct handling of their RAID arrays.

2.8 External I/O subsystem

This section describes the external I/O subsystem, the 7311 Model D20 I/O drawer that is supported on the p5-550 system.

2.8.1 I/O drawers

As described in Chapter 1, “General description” on page 1, the p5-550 system has five internal PCI-X slots, which is enough for average customer configurations. If more PCI-X slots are needed to dedicate more adapters to a partition or to increase the bandwidth of network adapters, up to eight 7311 model D20 I/O drawers can be added to the p5-550 system.

The p5-550 system contains a RIO-2 bus to connect the internal PCI-X slots through the PCI-X to PCI-X bridges and support up to four external I/O drawers. To support more I/O

drawers in one p5-550, a RIO-2 expansion card FC 1806 is needed occupying PCI-X slot 5. The RIO-2 expansion card supports up to four additional I/O drawers.

2.8.2 7311 Model D20 I/O drawer

The 7311 Model D20 I/O drawer must have the RIO-2 loop adapter (FC 6417) to be connected to the p5-550 system. The PCI-X host bridge inside the I/O drawer provides two primary 64-bit PCI-X buses running at 133 MHz. Therefore, a maximum bandwidth of 1 GB/sec is provided by each of the buses. To avoid overloading an I/O drawer, the recommendation in the *IBM @server Hardware Information Center* should be followed. You can find it at:

http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base/

Figure 2-8 on page 30 shows a conceptual diagram of the 7311 Model D20 I/O drawer subsystem.

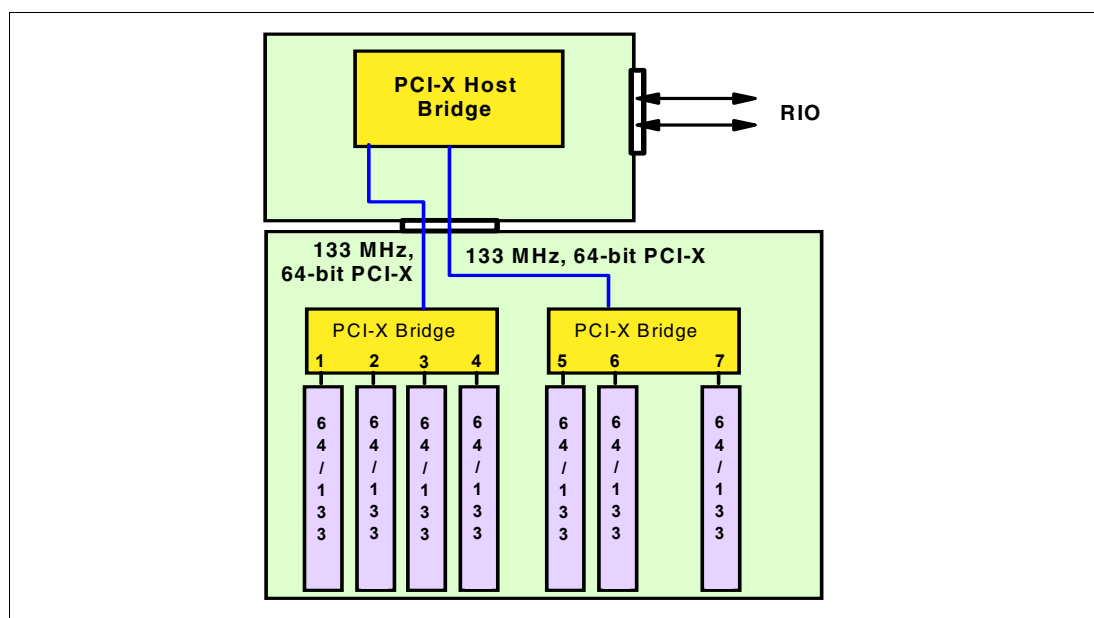


Figure 2-8 Conceptual diagram of the 7311-D20 I/O drawer

7311 Model D20 internal SCSI cabling

A 7311 Model D20 supports hot-swappable disks using two 6-pack disk bays for a total of 12 disks. Additionally, the SCSI cables (FC 4257) are used to connect a SCSI adapter (that can have various features) in slot 7 to each of the 6-packs, or two SCSI adapters, one in slot 4 and one in slot 7 (see Figure 2-9 on page 31).

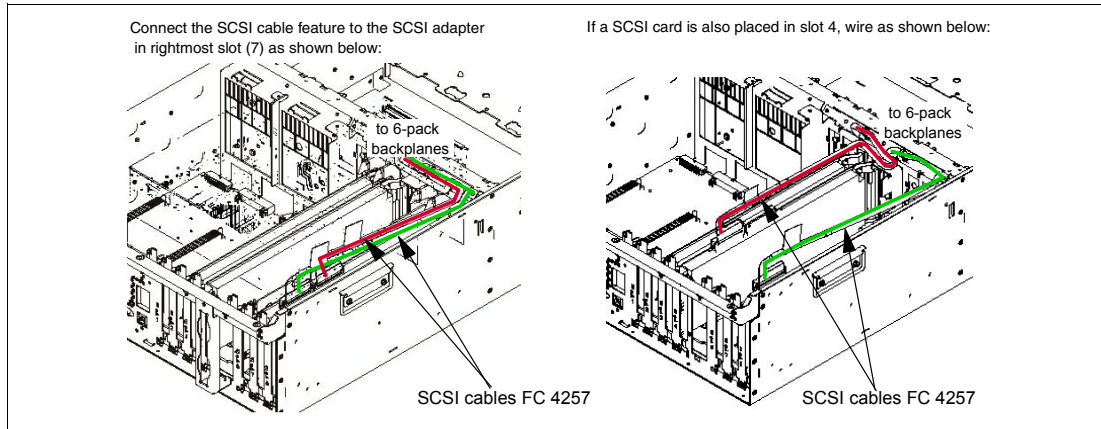


Figure 2-9 7311 Model D20 internal SCSI cabling

Note: Any 6-pack and the related SCSI adapter can be assigned to a single partition. If one SCSI adapter is connected to both 6-packs, both 6-packs can be assigned only to the same partition.

2.8.3 7311 I/O drawer's RIO-2 cabling

As described in the 2.8, "External I/O subsystem" on page 29, you can connect up to four I/O drawers in the same loop and up to eight I/O drawers to the p5-550 system.

Each RIO-2 port can operate at 1 GHz in bidirectional mode and is capable of passing data in each direction on each cycle of the port. Therefore, the maximum data rate is 4 GB/s per I/O drawer in double barrel mode.

There is one default primary RIO-2 loop in any p5-550 system. This feature provides two remote I/O ports for attaching up to four 7311 Model D20 I/O drawers to the system in a single loop. The optional RIO-2 expansion card can be used to increase the number of I/O drawers connected to one p5-550 system, and the same rules of the default RIO-2 loop must be considered. Figure 2-10 shows how you could logically connect four I/O drawers to one p5-550 system. Actual cables should be routed according to installation instructions.

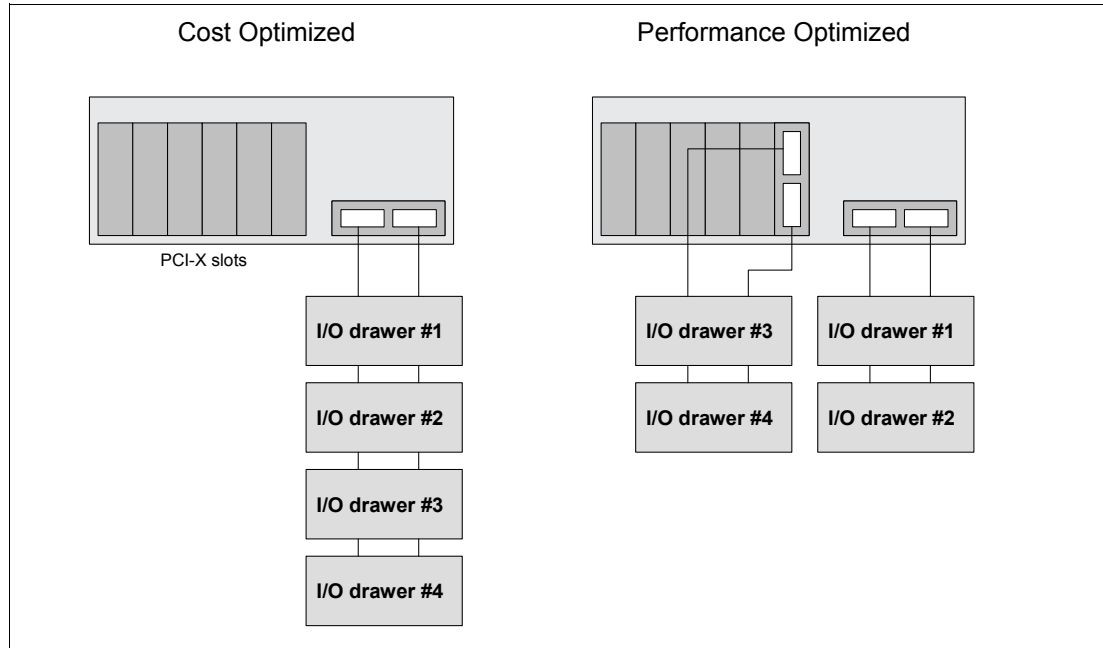


Figure 2-10 RIO-2 connections

The RIO-2 cables used have different lengths to satisfy the different connection requirements:

- Remote I/O cable, 3.5 m (FC 3147)
- Remote I/O cable, 10 m (FC 3148)

2.8.4 7311 Model D20 I/O drawer SPCN cabling

SPCN is used to control and monitor the status of power and cooling within the I/O drawer. The SPCN is a loop (Figure 2-11 on page 33), the cabling starts from SPCN port 0 on the p5-550 system to SPCN port 0 on the first I/O drawer. The loop is closed connecting the SPCN port 1 of the I/O drawer back to the port 1 of p5-550 system. If you have more than one I/O drawer, you continue the loop connecting the following drawer (or drawers) with the same rule.

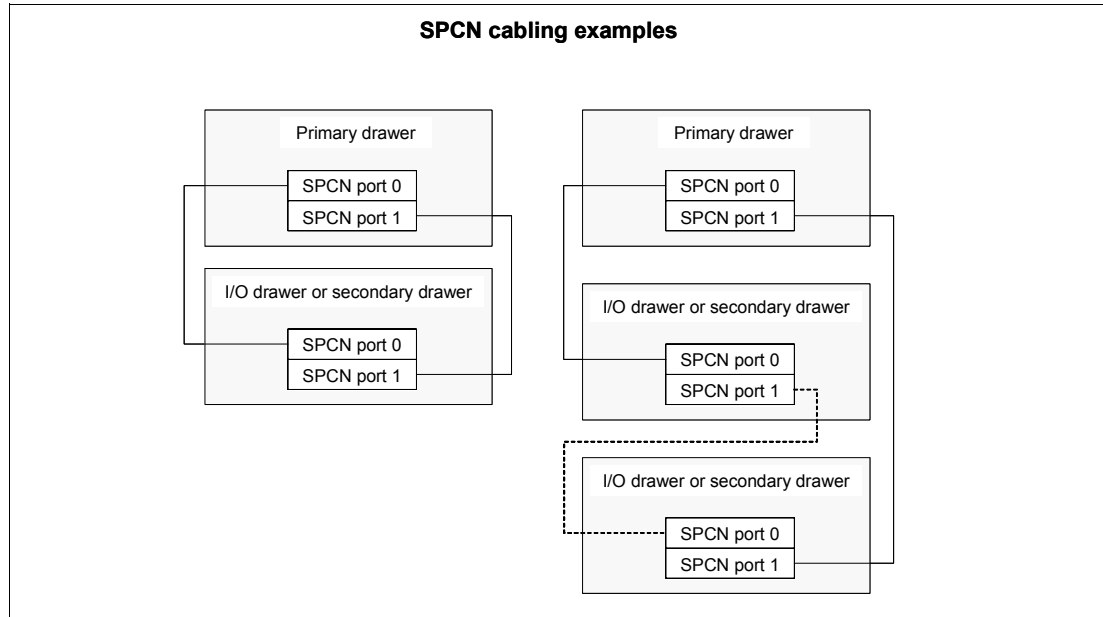


Figure 2-11 SPCN cabling examples

There are different SPCN cables to satisfy different length requirements:

- ▶ SPCN cable drawer to drawer, 2 m (FC 6001)
- ▶ SPCN cable drawer to drawer, 3 m (FC 6006)
- ▶ SPCN cable rack to rack, 6 m (FC 6008)
- ▶ SPCN cable rack to rack, 15 m (FC 6007)

2.8.5 External disk subsystems

The p5-550 system has internal hot-swappable drives. Internal disks are usually used for the AIX rootvg and paging space. The two 4-pack backplanes can be split when the SCSI RAID Enablement Card is not part of the p5-550 configuration, but specific customer requirements can be satisfied with the several external disks possibilities that the p5-550 supports.

IBM 2104 Expandable Storage Plus

The IBM 2104 Expandable Storage Plus Model DS4 is a low-cost 3U disk subsystem that supports up to 14 Ultra320 SCSI disks from 18.2 GB up to 146.8 GB, at the time this publication was written. This subsystem can be used in splitbus mode, meaning the bus with 14 disks could be split into two buses with seven disks each. In this configuration, two additional LPARs (using dedicated devices) could be provided with up to seven disks for rootvg by using one Ultra3 SCSI adapter (FC 5712) for each LPAR.

For further information about the IBM 2104 Expandable Storage Plus subsystem, visit the following Web site:

<http://www.storage.ibm.com/hardsoft/products/expplus/expplus.htm>

IBM TotalStorage FAStT Storage servers

The IBM TotalStorage FAStT Storage server family consists of five models: Model 100, 600, 700, and 900. The Model 100 is the smallest model, which scales up to 14 TB, and Model 900 is the largest, which scales up to 32 TB of disk storage, at the time this publication was written. Model 600 provides up to 16 bootable partitions that are attached with the Gigabit

Fibre Channel adapter (FC 5716). Model 700 provides up to 64 bootable partitions. In most cases, both the FAStT Storage server and the p5-550 or the 7311 Model D20 I/O drawers are connected to a storage area network (SAN). If only space for the rootvg is needed, the FAStT Model 100 is a good solution.

For support of additional features and for further information about the FAStT family, refer to the following Web site:

<http://www.storage.ibm.com/hardsoft/disk/fastt/index.html>

IBM TotalStorage Enterprise Storage Server

The IBM TotalStorage Enterprise Storage Server (ESS) is the high-end premier storage solution for use in storage area networks. The 2105 Model 800 provides from 582 GB up to 55.9 TB of usable disk capacity. An ESS system can also be used to provide disk space for booting LPARs or partitions using Micro-Partitioning technology. An ESS is usually connected to a SAN to which the p5-550 is also connected by using Gigabit Fibre Channel adapters (FC 5716).

For further information about ESS, refer to the following Web site:

<http://www.storage.ibm.com/hardsoft/products/ess/index.html>

2.9 Dynamic logical partitioning

Introduced with the POWER4 processor product line and the AIX 5L Version 5.1 operating system, the logical partition (LPAR) became available. The technology offered the capability to divide a pSeries system into separate systems, where each LPAR runs an operating environment on dedicated attached devices, such as processors, memory, and I/O components. When the customer requested system flexibility to change the system topology on demand, it was achieved by modifying the system layout on the required HMC.

Later, dynamic LPAR increased the flexibility, allowing selected system resources, such as processors, memory, and I/O components to be added and deleted from dedicated partitions while they are executing. Therefore, AIX 5L Version 5.2 with all the necessary enhancements to enable dynamic LPAR was introduced in 2002. This requires an attached HMC, with the proper level of software, to control the system resources and an updated system firmware level to electronically isolate systems resources. The ability to reconfigure dynamic LPARs encourages system administrators to dynamically redefine all available system resources to reach the optimum capacity for each defined dynamic LPAR.

Dynamic logical partitioning is supported by AIX 5L for POWER V5.2, or later. Dynamic logical partitioning is planned to be supported by SUSE LINUX Enterprise Server 9, or later, but with reduced functionality (changing memory attributes dynamically is not supported at the time of writing). Dynamic logical partitioning is not supported by current version of Red Hat Enterprise Linux AS for POWER Version 3.

USB resources are considered a single group, as are slimline devices. Groups can only be allocated to a single partition at a time. In a base configuration, each 4-pack is connected to one of the two ports on the integrated SCSI controller. To an LPAR, the entire SCSI controller (including all disks attached to both ports) will be seen as P1-T10, and therefore can only be assigned to one active LPAR at a time. To provide additional internal drives for a second LPAR, either virtual I/O or an optional SCSI PCI adapter feature should be used. If a PCI SCSI adapter is featured, it will be connected to one of the 4-packs allowing it to be assigned to a partition independent of the 4-pack attached to the integrated SCSI adapter.

2.10 Virtualization

On the p5-550 server, logical partitions requiring dedicated resources may now be able to take advantage of a new technology that allows resources to be virtualized, allowing for a better overall balance of global system resources and their effective utilization.

2.10.1 Virtual Ethernet

To enhance intercommunication between partitions, either dedicated partitions or partitions using Micro-Partitioning technology, Virtual Ethernet allows in-memory connections at a high bandwidth from partition to partition. Virtual Ethernet working on LAN technology allows a transmission speed in the range of 1 to 3 GB/sec depending on the MTU⁴ size. Virtual Ethernet connections (up to 256) are supported in a partition, where a single Virtual Ethernet resource can be connected to another Virtual Ethernet, a real network adapter, or both in a partition.

2.10.2 Advanced POWER Virtualization feature

The Advanced POWER Virtualization feature is an optional additional cost hardware feature that is available on all IBM *eServer* POWER5 processor-based systems. Each system has a unique feature code for this feature. For the p5-550 server, select FC 7941 to order the Advanced Virtualization feature.

The Advanced POWER Virtualization feature includes:

- ▶ Firmware enablement for Micro-Partitions
- ▶ Installation image for the Virtual I/O server software that supports:
 - Ethernet adapter sharing
 - Virtual SCSI server
- ▶ Partition Load Manager
 - Automated CPU and memory reconfiguration
 - Real-time partition configuration and load statistics
 - Graphical user interface

Micro-Partitioning technology

Based on the partitioning concepts of a stable and well-known mainframe technology and existing LPAR/dynamic LPAR implementation on POWER4 and POWER4+ servers, The POWER5 systems introduce an enhanced partitioning model available as a hardware feature.

The Micro-Partitioning model offers a virtualization method of system resources. In POWER5 processor-based systems, physical resources are abstracted into virtual resources that are available to partitions. This sharing method is the primary feature of this new partitioning concept and it happens automatically after a initial system setup.

POWER5 Micro-Partitioning specifies processor capacity in processing units. One processing unit represents 1% of one physical processor. A partition defined with 220 processing units is equivalent to the power of 2.2 physical processors. Creating a partition using Micro-Partitioning technology, the minimum capacity is 10 processing units, or 1/10 of a physical processor. A maximum of 10 partitions using Micro-Partitioning technology for each physical processor can be defined, but on a loaded system the practical limit is less.

⁴ Maximum Transmission Unit

Partitions using Micro-Partitioning technology can also be defined with the capped and uncapped attributes. A capped partition is not allowed to exceed the defined share, while an uncapped partition is allowed to consume additional capacity with fewer restrictions. Uncapped partitions can be configured to the total idle capacity of the server or a percentage of it. Configuration through the HMC menus sets the allowed share and the capped or uncapped attribute.

The POWER5 processor-based systems use the POWER Hypervisor, which is the new active Hypervisor to support Micro-Partitioning technology. The Hypervisor of existing POWER4 processor-based systems is working on a demand basis, as the result of machine interrupts and callbacks to the operating system.

The Advanced POWER Virtualization Feature (Virtual I/O Server) described in 2.10.2, “Advanced POWER Virtualization feature” on page 35, facilitates the understanding of all the POWER5 and POWER Hypervisor enhancements to reach the highest level of granularity of installed system resources.

Figure 2-12 shows the Micro-Partitioning LPAR concept.

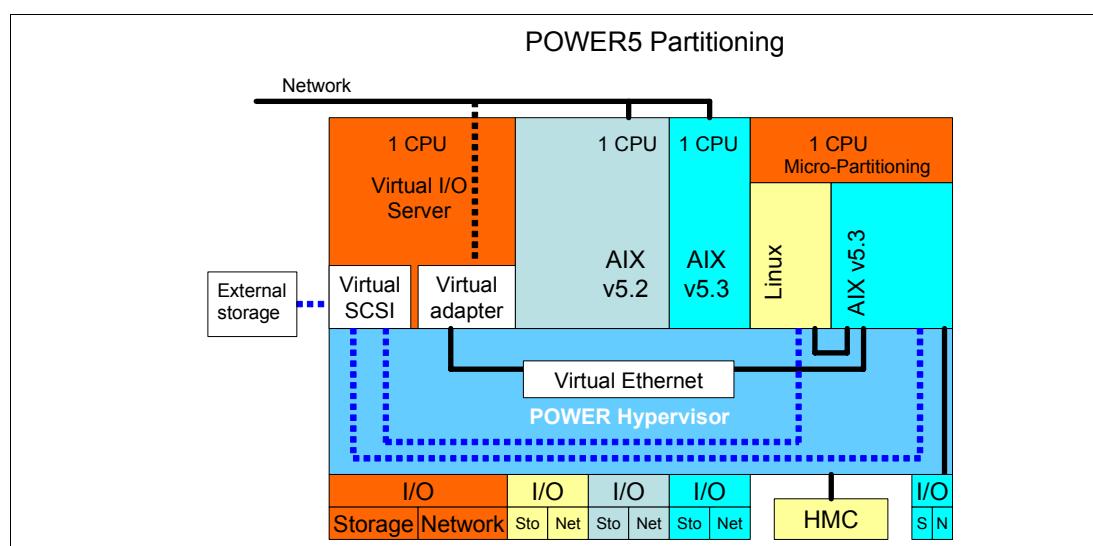


Figure 2-12 LPARs using Micro-Partitioning technology

Virtual I/O server

The Virtual I/O server is a special purpose partition to provide virtual I/O resources to client partitions. The Virtual I/O server owns the real resources that will be shared with the other clients. The Virtual I/O technology allows a physical adapter assigned to a partition to be shared by one or more partitions, enabling clients to minimize their number of physical adapters. Virtual I/O will be used to reduce costs by eliminating the requirement that each partition has a dedicated network adapter, disk adapter, and disk drive.

It is preferred that you use the Virtual I/O server in a partition with dedicated resources to help ensure stable performance.

Two major functions are provided from the Virtual I/O Server, as described in the following sections.

Shared Ethernet adapter

The Shared Ethernet adapter is a new service that acts as a layer 2 network switch to route network traffic from a Virtual Ethernet to a real network adapter. The Shared Ethernet Adapter must run in a Virtual I/O Server partition.

The advantages of the virtual Ethernet services is that partitions to communicate outside the system without having a physical network adapter attached to the partition. At the time of writing, up to 16 Virtual Ethernet x 18 VLANs can be shared on a single network interface. The amount of network traffic will limit the number of client partitions served through a single network interface.

Virtual SCSI

Access to real storage devices is implemented through the Virtual SCSI services, a part of the Virtual I/O Server partition. Logical volumes created and exported on the Virtual I/O Server partition will be shown at the Virtual Storage Client partition as a SCSI disk. All current storage device types, such as SAN, SCSI, and RAID, are supported. iSCSI and SSA are not supported.

The Virtual I/O server supports logical mirroring, and RAID configurations. Logical volumes created on RAID or JBOD configurations are bootable, and the number of logical volumes is limited to the amount of storage available and architectural limits of the LVM.

Note: The Shared Ethernet adapter and Virtual SCSI server function is provided in the Virtual I/O Server that is included in the optional Advanced POWER Virtualization feature.

Partition Load Manager

The Partition Load Manager (PLM) provides automated processor and memory distribution between dynamic LPAR and Micro-Partitioning capable logical partition running AIX 5L. The PLM application is based on a client/server model to share system information, such as processor or memory events, across the concurrent present logical partitions.

To improve the overall resource utilization of a partitioned system, PLM uses user-defined resource management policies to determine the additional resources, such as processors and memory, for each requesting partition.

PLM uses the Resource Monitoring and Control (RMC) subsystem for network communication, which provides several events on every managed partition node. The following events are registered on all managed nodes:

- ▶ Memory-pages-steal high thresholds and low thresholds
- ▶ Memory-usage-high thresholds and low thresholds
- ▶ Processor-load-average high threshold and low threshold

To ensure a secure communication between managed partition nodes, OpenSSH and Kerberos V5 are supported in PLM to have a secure communication and an authentication mechanism for administrators. If Kerberos is not installed, PLM uses the next configured authentication method, such as AIX authentication.

2.11 Service processor

The service processor (SP) is an embedded controller based on a PowerPC 405GP processor (PPC405) implementation running the SP internal operating system. The SP

operating system contains specific programs and device drivers for the SP hardware (Figure 2-13 on page 38).

The p5-550 uses the SP implementation. The key components include a FSP-Base (FSP-B) and an Extender chipset (FSP-E). FSP-B and FSP-E are implemented on a dedicated card.

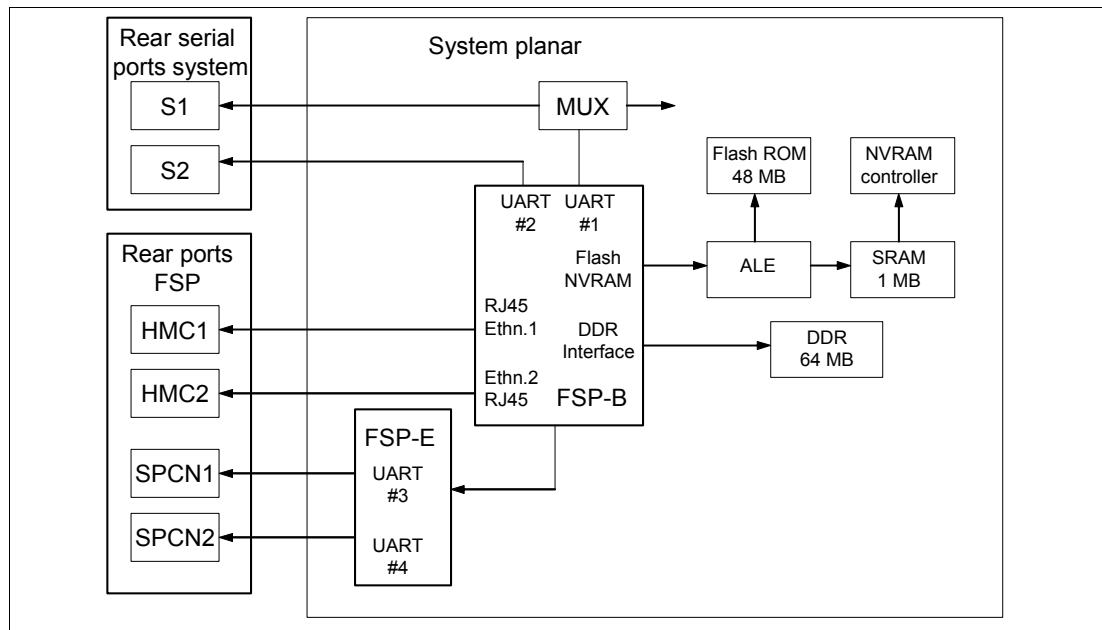


Figure 2-13 Service processor logical diagram

2.11.1 Service processor base

The PPC405 core is 5-stage pipeline instruction processor and contains 32-bit general purpose registers. The Flash ROM contains a compressed image of a software load.

The SP base unit offers the following connections:

- ▶ Two Ethernet Media Access Controller3 (MAC3) cores, which is a generic implementation of the Ethernet Media Access (MAC) protocol compliant with ANSI/IEEE 802.3, IEEE 802.3u, ISO/IEC 8802.3 CSMA/CD standard. The Ethernet MAC3 supports both half duplex (CSMA/CD) and full duplex operation at 10/100 Mbps. Both Ethernet port are visible only to the service processor.
- ▶ Two serial interfaces, accessible only though the serial ports of p5-550 on the rear side. At the time of writing, the System Management Interface (SMI) is usable if a connection is established to serial port 1. Terminals connected to serial port 2 receive only boot sequence information without manual interaction. When the HMC is connected to the SP, the serial ports are disabled and do not provide any external connection.

2.11.2 Service processor extender

The SP extender unit offers two system power control network (SPCN) ports that are used to control the power of the attached I/O subsystems. The SPCN control software and the service processor software are run on the same PPC405 processor.

2.12 Boot process

From the earlier RS/6000 systems, through the previous pSeries systems, the boot process passed through several enhancements. With the implementation of the POWER5 chip technology in the pSeries platform, the boot process is enhanced for the flexibility that the POWER5 processor-based hardware features. Depending on the customer configuration, a system may or may not require the use of an HMC to manage the system. The boot process, based on the Initial Program Load (IPL) setup, will depend on the hardware setup and on the way we will use the features that POWER5 processor-based systems provide.

The IPL process starts when power is connected to the system. Immediately after, the SP starts an internal self test based on integrated diagnostic programs (Built-In-Self-Test, BIST). Only if all the test units have been successfully passed, the system status changes to standby.

2.12.1 IPL flow without an HMC attached to the system

When the system status is standby, the SP provides a System Management Interface (SMI) that can be accessed by pressing any key on an attached serial console keyboard, or the Advanced System Management Interface (ASMI) using a Web browser⁵ on a client system that is connected to the SP on an Ethernet network.

The SP and the ASMI are standard on all POWER5 processor-based hardware. Both system management interfaces require you to enter the general or admin ID password and allow you to set flags that affect the operation of the system, according to the provided password, such as auto power restart, to view information about the system (such as the error log and VPD), network environment access setup, and to control the system power.

You can start and shut down the system in addition to setting IPL options. This server has a permanent firmware boot side, or A side, and a temporary firmware boot side, or B side. New levels of firmware should be installed on the temporary side first in order to test the update's compatibility with your applications. When the new level of firmware has been approved, it can be copied to the permanent side.

In the SMI and ASMI, you can view and change the following IPL settings:

- ▶ System boot speed.
Fast or Slow. Fast boot results in skipped diagnostic tests and shorter memory tests during the boot.
- ▶ Firmware boot side for next boot.
Permanent or Temporary. Firmware updates should be tested by booting from the temporary side before being copied into the permanent side.
- ▶ System operating mode.
Manual or Normal. Manual mode overrides various automatic power-on functions, such as auto-power restart, and enables the power switch button.
- ▶ AIX/Linux partition mode boot, available only if the system is not managed by the HMC.
 - Service mode boot from saved list. This is the preferred way to run concurrent AIX diagnostics.
 - Service mode boot from default list. This is the preferred way to run stand-alone AIX diagnostics.

⁵ Supported browsers are Netscape (Version 7.1), Microsoft Internet Explorer (version 6.0), and Opera (Version 7.23). At the time of writing, previous versions of these browsers are not supported. JavaScript™ and cookies must be enabled.

- Boot to open firmware prompt.
- Boot to System Management Service (SMS) to further select the boot devices or network boot options.
- ▶ Boot to server firmware:
 - Select the state for the server firmware: Standby or Running.
 - When the server is in the server firmware standby state, partitions can be set up and activated

2.12.2 Hardware Management Console

Depending on the model, the HMC provides a number of native serial ports and Ethernet port. One serial port can be used to attach a modem for the Service Agent. The Service Agent Connection Manager can be used instead if the HMC has a TCP/IP port 80 connection to the Internet. The HMC provides an Ethernet port (or ports) to connect to partitions on its POWER5 processor-based managed systems. The network connection is mandatory for the HMC to p5 systems, and highly recommended between the HMC and partitions. It supports the following functions:

- ▶ Logical partition configuration and management
- ▶ Dynamic logical partitioning
- ▶ Capacity and resource management
- ▶ System status
- ▶ HMC management
- ▶ Service functions (for example, Microcode Updates and Service Focal Point)
- ▶ Remote HMC interface

Note: The same HMC cannot be attached to POWER4 and POWER5 processor-based systems simultaneously, but for redundancy purposes, one POWER5 processor-based server can be attached to two HMCs.

All the managed servers must be authenticated from the HMC. If a new attached system is discovered, the HMC will prompt you to set two passwords using the HMC interface:

- ▶ Advanced System Management general user ID password
- ▶ Advanced System Management admin ID password
- ▶ HMC access password

2.12.3 IPL flow with an HMC attached to the system

When the system status is in standby, you can use the HMC to open a virtual terminal and access the SMI, or launch a Web browser to access the ASMI.

Using the SMI or the ASMI, you can view or modify the proper IPL settings in order to set the boot mode to partition standby and then turn the system on. However, the HMC can be also used to power on the managed system (and is highly recommended). Using the HMC to turn the system on requires you to select one of the following choices:

- ▶ Partition Standby

- The Partition Standby power-on mode allows you to create and activate logical partitions.
- When the Partition Standby power-on is completed, the operator panel on the managed system displays *LPAR...*, indicating the managed system is ready for you to use the HMC to partition its resources and, possibly, activate them.
- When a partition is activated, the HMC requires you to select the boot mode of the single partition.
- ▶ **System Profile**
The System Profile option powers on the system according to a predefined set of profiles. The profiles are activated in the order in which they are shown in the system profile.
- ▶ **Partition autostart**
This option powers on the managed system to partition standby mode and then activates all partitions that have been designated autostart.

After the system boots with any of the above choices, the HMC can be used to manage the system, such as continuing to boot from the operating system or manage the logical partitions. See 2.12.2, “Hardware Management Console” on page 40.

2.12.4 Definitions of partitions

Describing the detailed process to work with the HMC and the management tasks to create and manage a logical partition (LPAR or dynamic LPAR) is not the intention of this documentation. The following section describes the additional functionality used to create partitions that are using fractional elements of available system resources, namely Micro-Partitioning.

For a better understanding of the partitioning concept, this section contains an overview of common terminology. There are two important components:

- ▶ Managed systems,
- ▶ profiles

Managed systems

Managed systems are physical systems that are managed by the HMC, whereby one HMC can manage more managed systems at a time.

Profiles

A profile defines the configuration of a logical partition or managed system. There are three types of profiles that can be used to create multiple profiles for each logical partition or managed system:

- ▶ **Partition profile**
 - A partition profile includes the collection of resource specifications, such as processing units, memory, and I/O resources, because a logical partition is not aware of a resource until it is activated.
 - A logical partition can have more than one partition profile, but at least one is a minimum requirement.
- ▶ **All resources dedicated partition profile**
A partition profile that contains the entire resource list of the machine, using all physical resources working as one system.
- ▶ **System profile**

- A system profile is an ordered list of partition profiles. When you activate a system profile, the managed system will attempt to activate the partition profiles in the defined order.
- To enhance the flexibility to use the system within several different logical configuration, a system profile can be defined to collect more than one partition profile to provide the requested system behavior.

2.12.5 Hardware requirements for partitioning

To implement Micro-Partitioning technology on a POWER5 processor-based system, resource planning is important to have a base configuration and enough flexibility to make desirable changes to the running logical partitions. To configure a partition, the minimum requirements needed are processors, memory, and possibly an expansion unit to define more partitions than possible in a single system.

Processors

Within POWER5 technology, and depending on performance requirements, a logical partition can be created by using a shared processor pool or a dedicated processor.

Shared processors can be defined by a fractional number of 1/10 as minimum requirement of a real processor. To calculate the required processor power, a real processor is divided in 100 processing units, and 1/10 of a processor is equal to 10 processing units.

Dedicated processors are entire processors that can be assigned to a single logical partition without the capability to share free capacity with other logical partitions.

Memory

Depending on given application and performance requirements, a logical partition requests memory to execute the installed operating system and application. To create partitions, the minimum memory requirement is 128 MB per logical partition and dynamically increased by increments of 16 MB from the overall memory available in the system.

Expansion unit

Expansion units extend the flexibility of the server system to enlarge the number of possible logical partitions by adding additional hardware, such as storage or network devices.

2.12.6 Specific partition definitions used for Micro-Partitioning

In addition to the base definitions for a partition, new parameters must be defined to receive more flexibility and capacity usage of logical partitions included in POWER5 technology.

Capped and uncapped partitions

A capped partition indicates that the local partition will never exceed its assigned capacity. A partition using the uncapped mode indicates that if the maximum capacity is reached, the shared pool of processing power is used for more resources if available.

To manipulate the behavior of uncapped partitions, the parameter uncapped weight, in the range from 0 through 255, must be defined. To prevent an uncapped partition from receiving extra capacity, the uncapped weight parameter should be 0.

The default uncapped weight is 128.

2.12.7 System Management Service

Either booting up a full partition system or a logical partition to System Management Services (SMS), the ASCII⁶ interface or the GUI are identical in contents and functionality.

The p5-550 (or the logical partition) must be equipped with either a graphic adapter connected to a graphics display, keyboard, and mouse device, or an ASCII display terminal connected to one of the native serial ports, or the attached HMC to use the SMS menus. It is possible to view information about the system (or the single logical partition) and perform tasks such as setting a password, changing the boot list, and setting the network parameters.

If the system or the partition has been activated without flagging the option to stop to the SMS, there is the option to press the 1 key on the terminal, or in the graphic window, after the word keyboard appears and before the word speaker appears. In the terminal, or in the GUI, the system or the partitions will require you to enter the password defined for admin or general access. After the text-based SMS starts (either for terminal or graphic window), a screen similar to the one shown in Figure 2-14 opens.

```
Version SF220_004
SMS 1.5 (c) Copyright IBM Corp. 2000,2003 All right reserved
-----
Main Menu
 1. Select Language
 2. Setup Remote IPL (Initial Program Load)
 3. Change SCSI Settings
 4. Select Console
 5. Select Boot Options

-----

Navigation Keys:

                                     X = eXit System Management Services
-----
Type the number of the menu item and press Enter or select Navigation Key:
```

Figure 2-14 System Management Services main menu

Note: The version of system firmware currently installed in your system is displayed at the top of each screen. Processor and other device upgrades might require a specific version of firmware to be installed in your system.

On each menu screen, you are given the option of choosing a menu item and pressing Enter (if applicable), or selecting a navigation key. You can use the different options to review or set the boot list information, or to set up the network environment parameters if you want the system to boot from a NIM server.

⁶ American Standard Code for Information Interchange: This is the world-wide standard for the code numbers used by computers to represent all the uppercase and lowercase Latin letters, numbers, punctuation and so forth.

2.12.8 Boot options

The p5-550 handles the boot process in a way that is similar to other pSeries servers.

The initial stage of the boot process is to establish that the machine has powered up correctly and the memory and CPUs are functioning correctly. After the machine or the logical partition reaches the SMS menus, all of the necessary tests have been performed and the machine is scanning the bus for a boot source.

Most system backplanes are designed such that the drive in the first slot spins up immediately after power-on, and other drives will wait for the operating system to send a command before spinning up. Disk drive bays 1 and 5 are hardwired to spin-up immediately. The left-most and accordingly bottom-most slot of the 4-pack disk backplanes (SCSI ID 8, boot, autostart) is set to spin up immediately after power-on. The power-on delay sequence is performed to prevent power supply overloading. This behavior makes the disk in the first slot of the first 4-pack DASD backplane the preferred boot device. See Figure 2-15 to locate all of the disk bays.

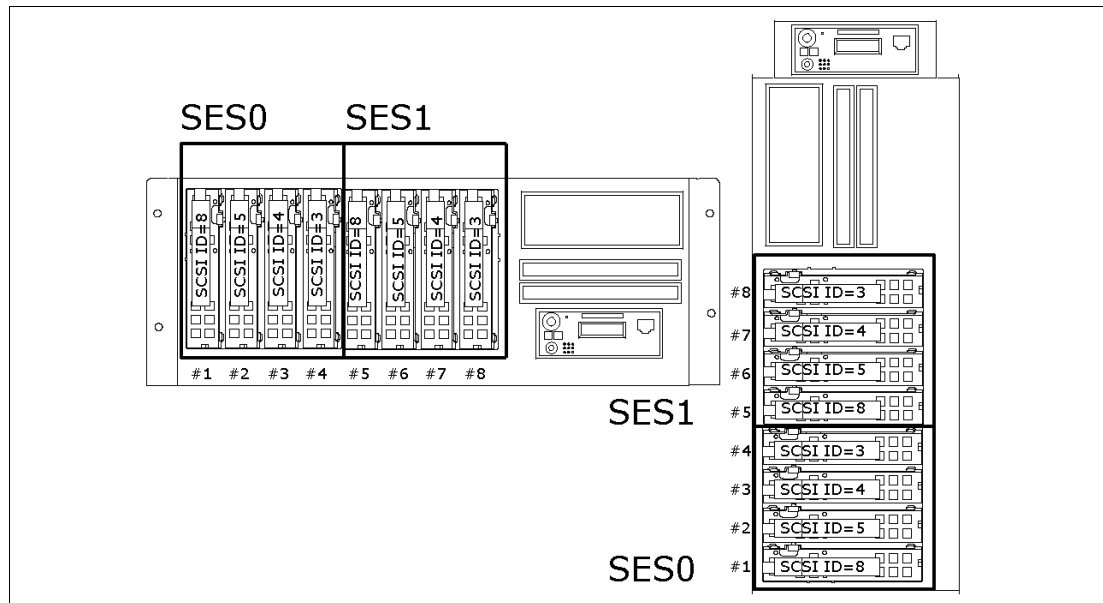


Figure 2-15 Disk bays and SCSI addresses within a p5-550

When SMS menus are available, the Select Boot Options menu can be used to view and set various options regarding the installation devices and boot devices:

1. Select Install or Boot a Device

Enables you to select a device to boot from or install the operating system from. This selection is for the current boot only.

2. Select Boot Devices

Enables you to set the boot list.

3. Multiboot Startup

Toggles the multiboot startup flag, which controls whether the multiboot menu is invoked automatically on startup.

2.12.9 Additional boot options

Instead of booting from the preferred boot device, or from any other internal disks, there are a number of other possibilities:

DVD-ROM, DVD-RAM

These devices can be used to boot the system, or a logical partition (if the resource is available to the specific partition), so that a system can be loaded, system maintenance performed, or stand-alone diagnostics performed.

Internal or external tape drives

The media bay tape drive or any externally attached tape drive can be used to boot the system, or a logical partition (if the resource is available to the specific partition) using `mksysb`, for example.

SCSI disk, and Virtual SCSI disk

The more common method of booting the system is to use a disk situated in one of the hot-swap bays in the front of the machine. However, any external SCSI-attached disk could be used if required. As described in previous sections, Virtual SCSI devices are also available to a logical partition.

SAN boot

It is possible to boot the p5-550 system from a SAN using a 2 GB Fibre Channel Adapter (FC 6239), or it is possible to boot one partition using the dedicated 2 GB Fibre Channel Adapter or the Virtual SCSI device related to this adapter. The IBM 2105 Enterprise Storage Server (ESS) is an example of a SAN-attached device that can provide a boot medium.

LAN boot

Network boot and NIM installs can be used if required. Logical partitions can use both a dedicated Ethernet adapter or Virtual Ethernet to accomplish that.

2.12.10 Security

The p5-550 system allows you to set two different types of passwords to limit the access to these systems. These are defined in the ASMI menus. This password is usually used by the system administrator. The *general ID password* provides limited access to the system functions and is usually available to all users who are allowed to power on the server, especially remotely.

2.13 Operating system requirements

All new POWER5 servers are capable of running IBM AIX 5L for POWER and support appropriate versions of Linux. AIX 5L has been specifically developed and enhanced to exploit and support the extensive RAS features on IBM @server pSeries systems.

2.13.1 AIX 5L

The p5-550 requires AIX 5L Version 5.3 or AIX 5L Version 5.2 Maintenance Package 5200-04 (IY56722) or later.

The system requires the following media:

- AIX 5L for POWER Version 5.2 5765-E62, dated 08/2004 (CD# LCD4-1133-04) or later

- ▶ AIX 5L for POWER Version 5.3 5765-G03, initial CD set (CD# LCD4-7463-00) or later

IBM periodically releases maintenance packages for the AIX 5L operating system. These packages are available on CD-ROM (FC 0907), or they can be downloaded from the Internet at:

<http://techsupport.services.ibm.com/server/fixes>

You can also get individual operating system fixes and information about obtaining AIX 5L service at this site. In AIX 5L Version 5.3, there is also the **suma** command available that helps the administrator to automate the task of checking and downloading operating system downloads. For more information about **suma** command see 3.3.4, “Service Update Management Assistant” on page 57.

If you have problems downloading the latest maintenance level, ask your IBM Business Partner or IBM representative for assistance.

The Advanced POWER Virtualization feature is not supported on AIX 5L Version 5.2.

2.13.2 Linux

For the p5-550, Linux distributions are available through SUSE and Red Hat at the time this publication was written. The p5-550 requires the following version of Linux distributions:

- ▶ SUSE LINUX Enterprise Server 9 for POWER systems, or later
- ▶ Red Hat Enterprise Linux AS for POWER Version 3

The Advanced POWER Virtualization feature, DLPAR, and other features require SUSE SLES 9. Red Hat Enterprise Linux supports the Advanced POWER Virtualization feature.

In Japan, Turbolinux is also available. In the Latin America sales region, Conectiva is also available. For related information and an overview, see:

<http://www.ibm.com/servers/eserver/pseries/linux>

To find full information about Red Hat Enterprise Linux AS for POWER Version 3 at:

<http://www.redhat.com/software/rhel/as/>

To find full information about SUSE LINUX Enterprise Server 9 for POWER, see:

http://www.suse.com/us/business/products/server/sles/i_pseries.html

For information about UnitedLinux for pSeries from Turbolinux, see:

<http://www.turbolinux.co.jp>

For the latest in IBM Linux news, subscribe to the Linux Line. See:

<https://www6.software.ibm.com/reg/linux/linuxline-i>

Many of the features described in this document are operating system dependant and may not be available on Linux. For more information, check:

http://www.ibm.com/servers/eserver/pseries/linux/whitepapers/linux_pseries.html

Linux support

IBM only supports the Linux systems of customers with a SupportLine contract covering Linux. Otherwise, the Linux distributor should be contacted for support.



Capacity on Demand, RAS, and manageability

The following sections provide more detailed information about IBM @server p5 design features that will help lower the total cost of ownership (TCO). This chapter includes several features based on the benefits available when using AIX 5L. Support of these features using Linux can vary.

3.1 Capacity on Demand

The p5-550 systems can be shipped with non-activated processor resources, which can be added as they are needed. Processors can be brought online to meet increasing workload demands, without affecting system operations.

The following sections outline the different methods available, namely the processor:

- ▶ Permanent Capacity Upgrade on Demand
- ▶ Reserve Capacity on Demand
- ▶ Dynamic processor sparing
- ▶ Trial Capacity on Demand for processors and memory

The base 2-way 1.65 GHz POWER5 (FC 5237) processor card supports CUoD. It features two processors, but zero active, and eight DDR1 Memory DIMM sockets. Processors are activated in increments of one processor either permanently or for a given amount of time.

Processor Upgrade On Demand and Dynamic Processor Sparing are supported by AIX 5L Version 5.2 ML4 and AIX 5L Version 5.3. Dynamic Processor Sparing requires that the CPU guard attribute is set to enable.

3.1.1 Processor Capacity Upgrade on Demand methods

This section describes the different IBM @server Capacity Upgrade on Demand methods available for the processors, at this time of writing.

Permanent Capacity Upgrade on Demand

Capacity Upgrade on Demand (CUoD) is a method where processors are shipped to customers installed in the p5-550 and later can be activated in increments of one processor. Additional options deliver the possibility to use temporarily processors resources installed in the server.

All processor cards are 2-ways, with 0-way active. In an initial order of the p5-550 system, at least two processors must be activated by ordering the appropriate activation features.

On/Off Capacity on Demand

After an On/Off Processor Enablement feature is ordered and the associated enablement code is entered into the system, the customer must report On/Off usage to IBM at least monthly. This information, used to compute the billing data, is then provided to the sales channel. The sales channel will place an order for a quantity of On/Off Processor Day Billing features.

Reserve Capacity on Demand

The Reserve Capacity option activation is a reserve capacity for 30 processor-days of prepaid reserve. To establish processor capacity on the server, select a quantity of inactive processors to be placed in the server's shared processor pool as reserve processors. After the server recognizes that non-reserve processors (permanently activated processors) assigned or available or both to the uncapped partitions have been 100% used, use of additional processors will cause processor days (good for a 24-hour period) to be subtracted from the prepaid number of processor-days.

The 30-days Reserve Capacity Processors option is activated with FC 7956. This requires the purchase of the Advanced POWER Virtualization feature.

Dynamic Processor Sparing

When you have non-activated CUoD processors, a feature called Dynamic Processor Sparing is automatically provided. Non-activated CUoD processors are processors that are physically installed in the system, but not activated. Dynamic Processor Sparing allows the system to disable a failing processor and enable a non-activated CUoD available processor.

Trial Capacity on Demand

Customers with CUoD featured systems must purchase the activation codes from IBM before the non-activated CUoD resources can be activated to meet the increased workload. However with the Trial Capacity on Demand feature, customers can activate the required non-activated CUoD resources immediately and after that, proceed to purchase those resources from IBM or not. In the HMC, this feature is named *Activate Immediate*. A one-time, no-cost activation for a maximum period of 30 consecutive days is available as a complementary service when access to CUoD resources is required immediately.

The following basic rules apply for the p5-550 system:

- ▶ After the CUoD resources are activated, the customer must either buy part or all of the activated CUoD resources from IBM or return the activated CUoD resources back to the system within 30 days.
- ▶ The Trial CUoD can only be used once.

There are several advantages of using this feature:

- ▶ Improve the response time to meet an unpredictable increase in workload.
- ▶ The customer can monitor the performance of the system after activating the CUoD resources before placing the order for activation codes.
- ▶ It is useful when a CUoD permanent activation purchase is pending.

3.1.2 How to report temporary activation resources

There are three methods for reporting information about the usage of On/Off Capacity on Demand to IBM (contact your areas IBM representative for the numbers and addresses):

- ▶ Using Electronic Service Agent
 - Monthly reporting of temporary capacity billing information can be sent to IBM electronically using the Electronic Service Agent, which is part of the Hardware Management Console and is designed to monitor events and to transmit server inventory information to IBM on a periodic, customer-definable timetable.
- ▶ Using fax
 - Fax information about billing information for On/Off Capacity on Demand can be sent to IBM.
- ▶ Using e-mail
 - E-mail information about billing information for On/Off Capacity on Demand can be sent to IBM.

3.2 Reliability, availability, and serviceability

Excellent quality and reliability are inherent in all aspects of the IBM *@server* p5 design and manufacturing. The fundamental objective of the design approach is to minimize outages. The RAS features help to ensure that the system operates when required, performs reliably, and efficiently handles any failures that might occur. This is achieved using capabilities provided by both the hardware and the operating system AIX 5L.

The p5-550 as a POWER5 server enhances the RAS capabilities implemented in POWER4-based systems. RAS enhancements available on POWER5 servers are:

- ▶ Most firmware updates allow the system to remain operational.
- ▶ The ECC has been extended to inter-chip connections for the fabric and processor bus.
- ▶ Partial L2 cache deallocation is possible.
- ▶ The number of L3 cache line deletes improved from 2 to 10 for better self-healing capability.

The following sections describe the concepts that form the basis of leadership RAS features of IBM *@server* p5 systems in more detail.

3.2.1 Fault avoidance

The p5 systems are built on a quality-based design to keep errors from ever happening. This design includes the following features:

- ▶ Reduced power consumption, cooler operating temperatures for increased reliability, enabled by copper chip circuitry, silicon-on-insulator, and dynamic-clock-gating
- ▶ Mainframe-inspired components and technologies

3.2.2 First Failure Data Capture

If a problem should occur, the ability to correctly diagnose it is a fundamental requirement upon which improved availability is based. The p5-550 incorporates advanced capability in start-up diagnostics and in run-time First Failure Data Capture (FDDC) based on strategic error checkers built into the chips.

Any errors detected by the pervasive error checkers are captured into Fault Isolation Registers (FIRs), which can be interrogated by the service processor (SP). The SP in the p5-550 has the capability to access system components using special purpose service processor ports or by access to the error registers (Figure 3-1).

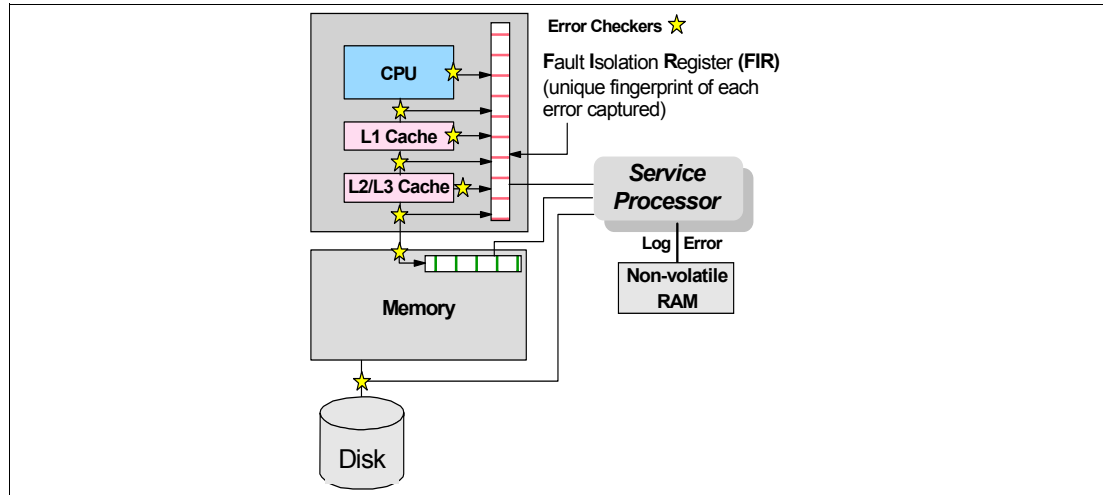


Figure 3-1 Schematic of Fault Isolation Register implementation

The FIRs are important because they enable an error to be uniquely identified, thus enabling the appropriate action to be taken. Appropriate actions might include such things as a bus retry, ECC correction, or system firmware recovery routines. Recovery routines can include dynamic deallocation of potentially failing components.

Errors are logged into the system non-volatile random access memory (NVRAM) and the SP event history log, along with a notification of the event to AIX for capture in the operating system error log. Diagnostic Error Log Analysis (*diagela*) routines analyze the error log entries and invoke a suitable action such as issuing a warning message. If the error can be recovered, or after suitable maintenance, the service processor resets the FIRs so that they can accurately record any future errors.

The ability to correctly diagnose any pending or firm errors is a key requirement before any dynamic or persistent component deallocation or any other reconfiguration can take place. For more information, see “Dynamic or persistent deallocation” on page 53.

3.2.3 Permanent monitoring

The SP included in the p5-550 provides a means to monitor the system even when the main processor is inoperable. See the following subsections for a more detailed description of monitoring functions in p5-550.

Mutual surveillance

The SP can monitor the operation of the firmware during the boot process, and it can monitor the operating system for loss of control. This allows the service processor to take appropriate action, including calling for service, when it detects that the firmware or the operating system has lost control. Mutual surveillance also allows the operating system to monitor for service processor activity and can request a service processor repair action if necessary.

Environmental monitoring

Environmental monitoring related to power, fans, and temperature is done by the System Power Control Network (SPCN). Environmental critical and non-critical conditions generate Early Power-Off Warning (EPOW) events. Critical events (for example, Class 5 AC power loss) trigger appropriate signals from hardware to impacted components so as to prevent any data loss without the operating system or firmware involvement. Non-critical environmental events are logged and reported through Event Scan.

The operating system cannot program or access the temperature threshold using the SP.

EPOW events can, for example, trigger the following actions:

- ▶ Temperature monitoring, which increases the fans speed rotation when ambient temperature is above a preset operating range.
- ▶ Temperature monitoring warns the system administrator of potential environmental-related problems. It also performs an orderly system shutdown when the operating temperature exceeds a critical level.
- ▶ Voltage monitoring provides warning and an orderly system shutdown when the voltage is out of the operational specification.

3.2.4 Self-healing

For a system to be self-healing, it must be able to recover from a failing component by first detecting and isolating the failed component, taking it off line, fixing or isolating it, and reintroducing the fixed or replacement component into service without any application disruption. Examples include:

- ▶ *Bit steering* to redundant memory in the event of a failed memory module to keep the server operational.
- ▶ *Bit-scattering*, thus allowing for error correction and continued operation in the presence of a complete chip failure (*Chipkill recovery*).
- ▶ Single bit error correction using ECC without reaching error thresholds for main, L2, and L3 cache memory.
- ▶ L3 cache line deletes extended from 2 to 10 for additional self-healing.
- ▶ ECC extended to inter-chip connections on fabric and processor bus.
- ▶ *Memory scrubbing* to help prevent soft-error memory faults.
- ▶ *Dynamic processor deallocation*, a deallocated processor can be replaced by an unused Capacity on Demand processor to keep the system operational.

Memory reliability, fault tolerance, and integrity

The p5-550 uses Error Checking and Correcting (ECC) circuitry for system memory to correct single-bit and to detect double-bit memory failures. Detection of double-bit memory failures helps maintain data integrity. Furthermore, the memory chips are organized such that the failure of any specific memory module only affects a single bit within a four-bit ECC word (*bit-scattering*), thus allowing for error correction and continued operation in the presence of a complete chip failure (*Chipkill recovery*). The memory DIMMs also use *memory scrubbing* and thresholding to determine when spare memory modules within each bank of memory should be used to replace ones that have exceeded their threshold of error count (*dynamic bit-steering*). Memory scrubbing is the process of reading the contents of the memory during idle time and checking and correcting any single-bit errors that have accumulated by passing the data through the ECC logic. This function is a hardware function on the memory controller chip and does not influence normal system memory performance.

3.2.5 N+1 redundancy

The use of redundant parts allows the p5-550 to remain operational with full resources:

- ▶ Redundant spare memory bits in L1, L2, L3, and main memory
- ▶ Redundant fans
- ▶ Redundant power supplies (optional)

3.2.6 Fault masking

If corrections and retries succeed and do not exceed threshold limits, the system remains operational with full resources, and no client or IBM customer engineer intervention is required. This technology is used in the following faults:

- ▶ CEC bus retry and recovery
- ▶ PCI-X bus recovery
- ▶ ECC Chipkill soft error

3.2.7 Resource deallocation

If recoverable errors exceed threshold limits, resources can be deallocated with system remaining operational, allowing deferred maintenance at a convenient time.

Dynamic or persistent deallocation

Dynamic deallocation of potentially failing components is non-disruptive, allowing the system to continue to run. Persistent deallocation occurs when a failed component is detected, which is then deactivated at a subsequent reboot.

Dynamic deallocation functions include:

- ▶ Processor
- ▶ L3 cache line delete
- ▶ Partial L2 cache deallocation
- ▶ PCI-X bus and slots

For dynamic processor deallocation, the service processor performs a predictive failure analysis based on any recoverable processor errors that have been recorded. If these transient errors exceed a defined threshold, the event is logged and the processor is deallocated from the system while the operating system continues to run. This feature (named *CPU Guard*) enables maintenance to be deferred until a suitable time. Processor deallocation can only occur if there are sufficient functional processors (at least two).

To verify whether CPU Guard has been enabled, run the following command:

```
lsattr -El sys0 | grep cpuguard
```

If enabled, the output will be similar to the following:

```
cpuguard      enable      CPU Guard      True
```

If the output shows CPU Guard as disabled, enter the following command to enable it:

```
chdev -l sys0 -a cpuguard='enable'
```

Cache or cache-line deallocation is aimed at performing dynamic reconfiguration to bypass potentially failing components. This capability is provided for both L2 and L3 caches. Dynamic run-time deconfiguration is provided if a threshold of L1 or L2 recovered errors is exceeded.

In the case of an L3 cache run-time array single-bit solid error, the spare chip resources are used to perform a line delete on the failing line.

PCI hot-plug slot fault tracking helps prevent slot errors from causing a system machine check interrupt and subsequent reboot. This provides superior fault isolation, and the error affects only the single adapter. Run-time errors on the PCI bus caused by failing adapters will result in recovery action. If this is unsuccessful, the PCI device will be gracefully shut down.

Parity errors on the PCI bus itself will result in bus retry, and if uncorrected, the bus and any I/O adapters or devices on that bus will be deconfigured.

The p5-550 supports PCI Extended Error Handling (EEH) if it is supported by the PCI-X adapter. In the past, PCI bus parity errors caused a global machine check interrupt, which eventually required a system reboot in order to continue. In the p5-550 system, hardware, system firmware, and AIX interaction have been designed to allow transparent recovery of intermittent PCI bus parity errors and graceful transition to the I/O device available state in the case of a permanent parity error in the PCI bus.

EEH-enabled adapters respond to a special data packet generated from the affected PCI slot hardware by calling system firmware, which will examine the affected bus, allow the device driver to reset it, and continue without a system reboot.

Persistent deallocation functions include:

- ▶ Processor
- ▶ Memory
- ▶ Deconfigure or bypass failing I/O adapters
- ▶ L3 cache

Following a hardware error that has been flagged by the service processor, the subsequent reboot of the system will invoke extended diagnostics. If a processor or L3 cache has been marked for deconfiguration by persistent processor deallocation, the boot process will attempt to proceed to completion with the faulty device automatically deconfigured. Failing I/O adapters will be deconfigured or bypassed during the boot process.

Note: The auto-restart (reboot) option, when enabled, can reboot the system automatically following an unrecoverable software error, software hang, hardware failure, or environmentally induced failure (such as loss of power supply)

3.2.8 Serviceability

Increasing service productivity means the system is up and running for a longer time. p5-550 improves service productivity by providing the functions described in the following subsections:

Error indication and LED indicators

The p5-550 is designed for customer setup of the machine and for the subsequent addition of most hardware features. The p5-550 also allows customers to replace service parts (Customer Replaceable Unit). To accomplish this, the p5-550 provides internal LED diagnostics that will identify parts that require service. Attenuation of the error is provided through a series of light attention signals, starting on the exterior of the system (System Attention LED) located on the front of the system, and ending with an LED near the failing Field Replaceable Unit.

For more information about Customer Replaceable Units, including videos, see:

<http://publib.boulder.ibm.com/eserver>

System Attention LED

The attention indicator is represented externally by an amber LED on the operator panel and the back of the system unit. It is used to indicate that the system is in one of the following states:

- ▶ Normal state, LED is off.

- ▶ Fault state, LED is on solid.
- ▶ Identify state, LED is blinking.

Additional LEDs on I/O components such as PCI-X slots and disk drives provide status information such as power, hot-swap, and need for service.

Concurrent Maintenance

Concurrent Maintenance provides replacement of the following parts while the system remains running:

- ▶ Disk drives
- ▶ Cooling fans
- ▶ Power subsystems
- ▶ PCI-X adapter cards

3.3 Manageability

The functions and tools provided for IBM *@server* p5 systems are described in the next sections.

3.3.1 Service processor

With system in power standby mode, or with an operating system in control of the machine, or controlling the related partition, the SP is working and checking the system for errors, ensuring the connection to the HMC for manageability purposes. With system up and running, the SP provides the possibility to view and change the Power-On settings, using the Advanced System Management Interface (ASMI). Also, the surveillance function of the SP is monitoring the operating system to check that it is still running and has not stalled.

See Figure 3-2 for an example of the Advanced System Management Interface accessed from a Web browser.

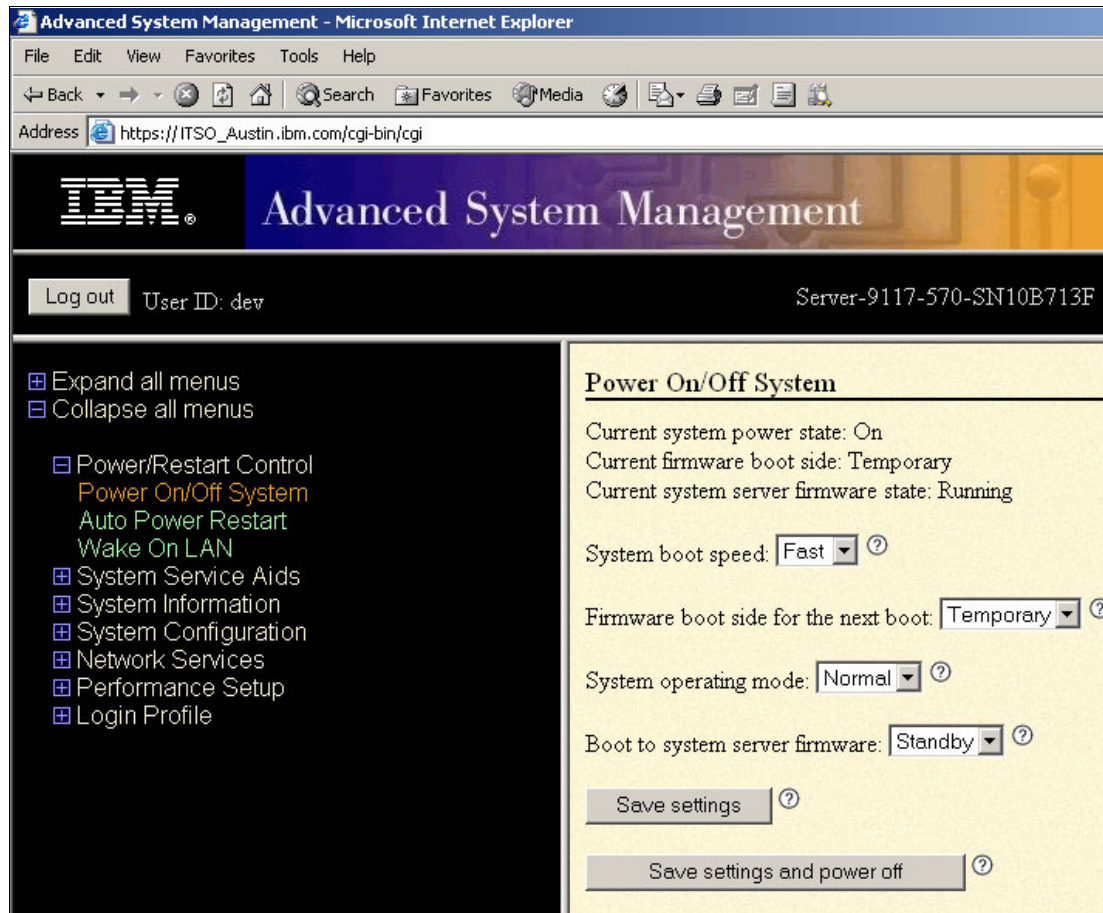


Figure 3-2 Advanced System Management main menu

3.3.2 Service Agent

Service Agent is an application program that operates on a p5, pSeries or IBM RS/6000 computer and monitors them for hardware errors. It reports detected errors, assuming they meet certain criteria for criticality, to IBM for service with no customer intervention. It is an enhanced version of Service Director with a graphical user interface.

Key things you can accomplish using Service Agent for p5, pSeries, and RS/6000 include:

- ▶ Automatic problem analysis
- ▶ Problem-definable threshold levels for error reporting
- ▶ Automatic problem reporting; service calls placed to IBM without intervention
- ▶ Automatic customer notification

In addition:

- ▶ Commonly viewed hardware errors. You can view hardware event logs for any monitored machine on the network from any Service Agent host user interface.
- ▶ High-availability cluster multiprocessing (HACMP) support for full fallback. Includes high-availability cluster workstation (HACWS) for 9076.
- ▶ Network environment support with minimum telephone lines for modems.

- VPD data can be sent to IBM using Performance Management.

Machines are defined by using the Service Agent user interface. After the machines are defined, they are registered with the IBM Service Agent Server (SAS). During the registration process, an electronic key is created that becomes part of your resident Service Agent program. This key is used each time the Service Agent places a call for service. The IBM Service Agent Server checks the current customer service status from the IBM entitlement database; if this reveals that you are not on Warranty or MA, the service call is refused and posted back through an e-mail notification.

Service Focal Point

Service Focal Point is used by service technicians to start and end their service calls. It provides service representatives with event, Vital Product Data (VPD), and diagnostic information. The HMC can also notify service representatives of hardware failures automatically by using the Service Agent features. You can configure the HMC to use the Service Agent call-home feature to send IBM event information. This information is stored, analyzed, and then acted upon by the service representative. Some parts of Service Focal Point need to be configured so that the proper information is sent to IBM.

You can download the latest version of Service Agent at:

ftp://ftp.software.ibm.com/aix/service_agent_code

3.3.3 p5 Customer-Managed Microcode

The pSeries and RS/6000 Customer-Managed Microcode is a methodology that enables you to manage and install microcode updates on p5, pSeries and RS/6000 systems and associated I/O adapters. The IBM pSeries Microcode Update Web site can be found at:

<http://techsupport.services.ibm.com/server/mdownload>

IBM provides service tools that can assist you in determining microcode levels and updating systems with the latest available microcode. To determine which tool to use in a specific environment, visit:

<http://techsupport.services.ibm.com/server/mdownload/mcodetools.html>

3.3.4 Service Update Management Assistant

The Service Update Management Assistant (SUMA) helps system administrators retrieve maintenance updates from the Web. SUMA offers flexible options that let customers set up policies to automate the download of fixes to their systems. SUMA policies can be scheduled to periodically check the availability of specific new fixes (APAR, PTF, or fileset), critical or security fixes, or an entire maintenance level. A notification e-mail can be sent detailing updates that are needed when comparing available fixes to installed software, a fix repository, or a maintenance level.

Benefits provided by SUMA:

- Moves administrators away from the task of manually retrieving maintenance updates from the Web.
- Policy can be scheduled to run periodically, for example, to download the latest critical fixes weekly.
- Can compare fixes needed against software inventory, fix repository, or a maintenance level.
- Receive mail notification after a fileset preview or download operation.

- ▶ Allows for FTP, HTTP, or secure HTTPS transfers.
- ▶ Provides the same requisite checking as the IBM fix distribution Web site.
- ▶ Available through SMIT menus (smitty suma) or a command line interface.

3.4 Cluster 1600

Today's IT infrastructure requires that systems meet increasing demands, while offering the flexibility and manageability to rapidly develop and deploy new services. IBM clustering hardware and software provide the server, with availability, scalability, security, and single-point-of-management control, to satisfy these needs.

IBM *e*server Cluster 1600 is a POWER-based AIX 5L and Linux Cluster targeting scientific and technical computing, large-scale databases, and workload consolidation

IBM Cluster Systems Management (CSM) is designed to provide a robust, powerful, and centralized way to manage a large number of POWER5-based systems all from one single point of control. CSM can help lower the overall cost of IT ownership by helping to simplify the tasks of installing, operating, and maintaining clusters of servers. CSM can provide one consistent interface for managing both AIX and Linux nodes (physical systems or logical partitions), with capabilities for remote parallel network install, remote hardware control, and distributed command execution.

The p5-550 is supported with the Cluster 1600 running CSM for AIX, V1.3.1. To attach a p5-550 to a Cluster 1600, an HMC is required. One HMC can also control several p5-550s that are part of the cluster. If a p5-550 configured in partition mode (with physical or virtual resources) is part of the cluster, all partitions must be part of the cluster.

It is not possible to use selected partitions as part of the cluster and use others for non-cluster use. The HMC uses a dedicated connection to the p5-550 to provide the functions needed to control the server, such as powering the system on and off. The HMC must have an Ethernet connection to the Control Work Station (CWS). Each partition in p5-550 must have an Ethernet adapter to connect to the CWS *trusted* LAN.

Information regarding HMC control, cluster building block servers, and cluster software available at:

<http://www.ibm.com/servers/eserver/clusters/>

The benefits of a clustered environment based on logical partitions

The evolution of processor and storage technologies has a great impact on the architecture of IT infrastructures. This was the most significant challenge for the infrastructure in the past and will also be in the future. During the first half of the 1990s, one single central instance of an application per node was suitable, moreover, most productive systems needed additionally associated nodes, so-called application servers.

Increasing performance and reliability by simply replicating application server nodes led to complex environments that often resulted in poor system management. The reason for these complex constructions was the limited computing power of a single node. This limitation was softened during the second half of the 1990s.

Big symmetric multiprocessor (SMP) nodes with higher clock rates and increased memory provided the possibility to install more than one system on a node. This had some side effects regarding systems operations: Release planning processes had to pay attention to different databases or application versions, or both, to avoid unresolved conflicts.

In 2000, Workload Manager for AIX (WLM) was announced. Multiple application instance installations became more and more popular because of the permanently increasing number of systems dedicated to applications at customer sites. The general availability of this functionality of AIX to separate the workloads of dedicated systems eliminated the last obstacle for consolidating several systems in one node.

Some customers expanded the usage of their dedicated systems and consequently model more business processes. This often caused an increased number of dedicated systems used and a stronger demand on flexibility. In addition, the life cycle of these systems differed extremely. Renaming, removal, or deletion became more and more common system administration tasks.

In 2001, the pSeries hardware technology with logical partitioning was generally available. Logical partitioning creates the possibility to define the logical partitions (LPARs) that are adapted to customer needs regarding the number of processors, assigned memory, and I/O adapters. The p5-550 offers the flexibility to increase the usage of the resources even more, and reduce the total cost of ownership (TCO).

Partitions with associated physical resources or virtual resources are not different from a collection of stand-alone nodes.

Today, server consolidation is a must for many IT sites. Minimized TCO and complexity, with the maximum amount of flexibility, is a crucial goal of nearly all customers. LPARs allow a flexible distribution of resources with LPAR boundaries. Each logical partition can be configured according to the specific needs of the occupant application. LPARs provide a protection boundary between the systems. More test and development systems can exist on the same server in separate partitions.

The CSM value points

The CSM allows the management of different hardware platforms from one single point of control and it has consistent interfaces to manage systems and logical partitions running both AIX and Linux. The management is achieved across multiple switch and interconnect topologies. PSSP forced system administrators to do some things a certain way (such as NIM, and SP user management). The CSM provides assistance on setting these things up, but allows the system administrator to tailor their system to their own needs, and it has the ability to manage systems across different geographical sites.

Monitoring is much easier to use and the system administrator can monitor all the network interfaces, not just the switch and administrative interfaces. The management server pushes information out to the nodes, which allows the management server to not have to trust the node. In addition, the nodes do not have to be network connected to each other either. This means that giving root access on one node does not mean giving root access on all the nodes. The base security setup is all done automatically at install time.

The CSM ships with AIX itself (a 60-day Try and Buy license is shipped with AIX). The CSM client side is automatically installed and ready when you install AIX, so each system or logical partition is cluster-ready.

CSM Version 1.4 on AIX and Linux (planned 4Q04)

The CSM V1.4 on AIX and Linux introduces an optional IBM CSM High Availability Management Server feature, designed to allow automated failover of the CSM management server to a backup management server. In addition, sample scripts for setting up NTP¹, and

¹ Network Time Protocol

network tuning (AIX ONLY) configurations, and the capability to copy files across nodes or node groups in the cluster can improve cluster ease of use and site customization.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this Redpaper.

IBM Redbooks

For information about ordering these publications, see “How to get IBM Redbooks” on page 63. Note that some of the documents referenced here may be available in softcopy only.

- ▶ *BM @server pSeries 670 and pSeries 690 System Handbook*, SG24-7040
- ▶ *The Complete Partitioning Guide for IBM pSeries Servers*, SG24-7039
- ▶ *Managing AIX Server Farms*, SG24-6606
- ▶ *Practical Guide for SAN with pSeries*, SG24-6050
- ▶ *Problem Solving and Troubleshooting in AIX 5L*, SG24-5496
- ▶ *Understanding IBM @server pSeries Performance and Sizing*, SG24-4810

Other publications

These publications are also relevant as further information sources:

- ▶ *7014 Series Model T00 and T42 Rack Installation and Service Guide*, SA38-0577, contains information regarding the 7014 Model T00 and T42 Rack, in which this server can be installed.
- ▶ *7316-TF3 17-Inch Flat Panel Rack-Mounted Monitor and Keyboard Installation and Maintenance Guide*, SA38-0643, contains information regarding the 7316-TF3 Flat Panel Display, which can be installed in your rack to manage your system units.
- ▶ *IBM @server Hardware Management Console for pSeries Installation and Operations Guide*, SA38-0590, provides information to operators and system administrators on how to use a IBM Hardware Management Console for pSeries (HMC) to manage a system. It also discusses the issues associated with logical partitioning planning and implementation.
- ▶ *Planning for Partitioned-System Operations*, SA38-0626, provides information to planners, system administrators, and operators about how to plan for installing and using a partitioned server. It also discusses some issues associated with the planning and implementing of partitioning.
- ▶ *RS/6000 and @server pSeries Adapters, Devices, and Cable Information for Multiple Bus Systems*, SA38-0516, contains information about adapters, devices, and cables for your system. This manual is intended to supplement the service information found in the *Diagnostic Information for Multiple Bus Systems* documentation.
- ▶ *RS/6000 and @server pSeries Diagnostics Information for Multiple Bus Systems*, SA38-0509, contains diagnostic information, service request numbers (SRNs), and failing function codes (FFCs).
- ▶ *RS/6000 and pSeries PCI Adapter Placement Reference*, SA38-0538, contains information regarding slot restrictions for adapters that can be used in this system.

- ▶ *System Unit Safety Information*, SA23-2652, contains translations of safety information used throughout the system documentation.

Online resources

These Web sites and URLs are also relevant as further information sources:

- ▶ AIX 5L operating system maintenance packages downloads
<http://www.ibm.com/servers/eserver/support/pseries/aixfixes.html>
- ▶ Autonomic computing on IBM @server pSeries servers
<http://www.ibm.com/autonomic/index.shtml>
- ▶ Ceramic Column Grid Array (CCGA), see IBM Chip Packaging
<http://www.ibm.com/chips/micronews>
- ▶ Copper circuitry
<http://www.ibm.com/chips/technology/technologies/copper/>
- ▶ Frequently asked SSA-related questions
<http://www.storage.ibm.com/hardsoft/products/ssa/faq.html>
- ▶ Hardware documentation
http://publib16.boulder.ibm.com/pseries/en_US/infocenter/base/
- ▶ IBM @server Information Center
<http://publib.boulder.ibm.com/eserver/>
- ▶ IBM @server pSeries and RS/6000 microcode update
<http://techsupport.services.ibm.com/server/mdownload2/download.html>
- ▶ IBM @server pSeries support
<http://www.ibm.com/servers/eserver/support/pseries/index.html>
- ▶ IBM @server support: Tips for AIX administrators
<http://techsupport.services.ibm.com/server/aix.srchBroker>
- ▶ IBM Linux news: Subscribe to the Linux Line
<https://www6.software.ibm.com/reg/linux/linuxline-i>
- ▶ Information about UnitedLinux for pSeries from Turbolinux
<http://www.turbolinux.co.jp>
- ▶ IBM online sales manual
<http://www.ibm.link.ibm.com>
- ▶ Linux for IBM @server pSeries
<http://www.ibm.com/servers/eserver/pseries/linux/>
- ▶ Microcode Discovery Service
<http://techsupport.services.ibm.com/server/aix.invsoutMDS>
- ▶ POWER4 system micro architecture, comprehensively described in the *IBM Journal of Research and Development*, Vol 46 No.1 January 2002
<http://www.research.ibm.com/journal/rd46-1.html>
- ▶ SCSI T10 Technical Committee
<http://www.t10.org>

- ▶ Silicon-on-insulator (SOI) technology
<http://www.ibm.com/chips/technology/technologies/soi/>
- ▶ SSA boot FAQ
<http://www.storage.ibm.com/hardsoft/products/ssa/faq.html#microcode>
- ▶ SUSE LINUX Enterprise Server 8 for pSeries information
http://www.suse.de/us/business/products/server/sles/i_pseries.html
- ▶ The LVT is a PC based tool intended assist you in logical partitioning
<http://www-1.ibm.com/servers/eserver/series/lpar/systemdesign.htm>

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IBM *@*server p5 550

Technical Overview and Introduction



**Finer system
granulation using
Micro-Partitioning
technology to help
lower TCO**

**Outstanding
performance based
on POWER5 processor
technology**

**From Web servers to
integrated cluster
solutions**

This document is a comprehensive guide covering the IBM *@*server p5 550 UNIX servers. We introduce major hardware offerings and discuss their prominent functions. Professionals wishing to acquire a better understanding of IBM *@*server p5 products should consider reading this document. The intended audience includes:

- ▶ Customers
- ▶ Sales and marketing professionals
- ▶ Technical support professionals
- ▶ IBM Business Partners
- ▶ Independent software vendors

This document expands the current set of IBM *@*server documentation by providing a desktop reference that offers a detailed technical description of the p5-550 system. This publication does not replace the latest pSeries marketing materials and tools. It is intended as an additional source of information that, together with existing sources, can be used to enhance your knowledge of IBM server solutions.

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