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IBM BladeCenter HS22 Technical Introduction

The IBM® BladeCenter® HS22 is a two-socket blade server running the latest Intel® Xeon processors. It is ideal for infrastructure, virtualization and enterprise business applications and is compatible with the IBM BladeCenter H, E, S, and HT chassis.

This paper covers the following topics:

- ▶ “Model information” on page 3
- ▶ “Chassis support” on page 5
- ▶ “Processor” on page 8
- ▶ “Memory” on page 14
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- ▶ “I/O expansion” on page 30

Introduction

The HS22 supports up to two Intel Xeon® 5500 or 5600 series multi-core processors, 12 DIMMs modules, two hot-swap drives, two PCI Express connectors, and one internal USB connector. Figure 1 shows the HS22.

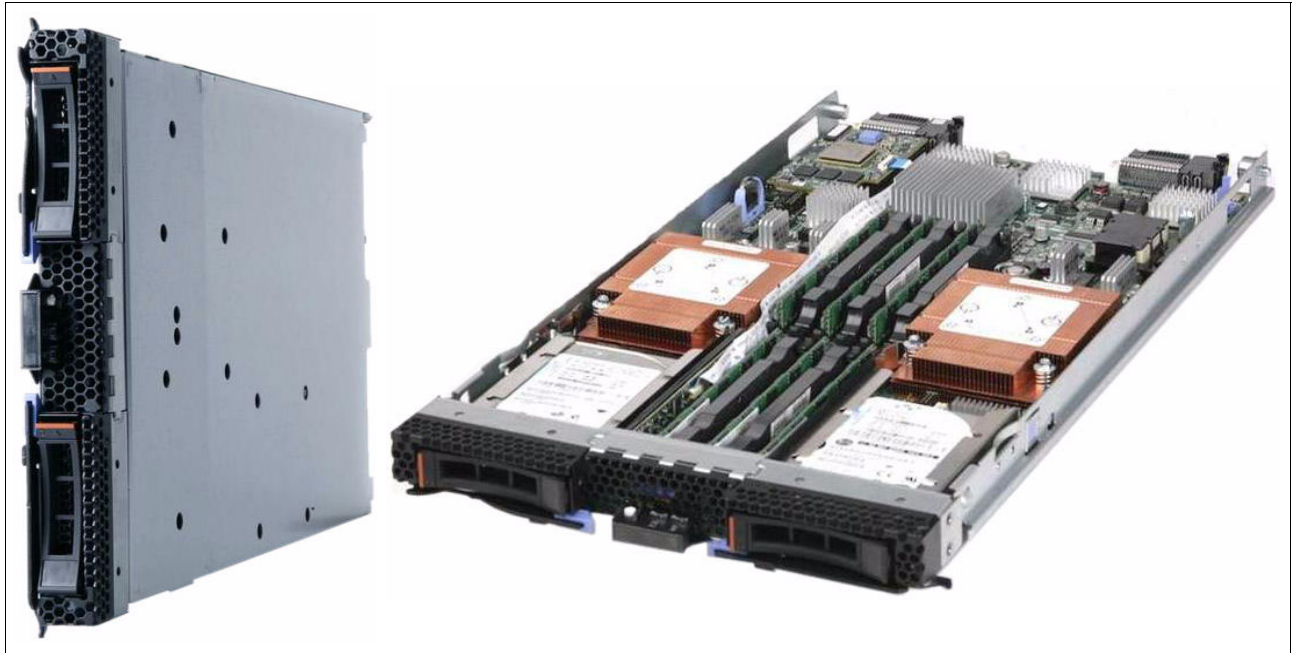


Figure 1 The HS22 type 7870

Table 1 lists the features of the HS22.

Table 1 Features of the HS22 type 7870

Feature	
Processor options	Intel Xeon 5600 Processor Series hex-core processors Intel Xeon 5600 Processor Series quad-core processors Intel Xeon 5500 Processor Series quad-core processors Intel Xeon 5500 Processor Series dual-core processors
Number of processors (std/max)	1 / 2
Memory Speed	800 MHz, 1033 MHz, or 1333 MHz (dependant on processor model)
Cache	4 MB, 8 MB, or 12 MB (shared between cores)
Memory slots	12 DIMM slots
Memory Maximums	Models with Intel Xeon 5600 series processors: 192 GB using 16GB DIMMs Models with Intel Xeon 5500 series processors: 96 GB using 8GB DIMMs

Feature	
Memory Types	DDR 3 ECC Very Low Profile (VLP) Registered DIMM DDR 3 ECC Very Low Profile (VLP) Low Power Registered DIMM
Hot Swap Disk Drives (std/max)	0 / 2 (SAS, SATA or SSD)
Maximum internal storage	Optional: Up to two 2.5" hot-swap SAS or SATA HDDs Optional: Up to two 2.5" hot-swap solid state drives
Network	Two ports, one Broadcom BCM5709S dual-port Gigabit Ethernet controller, TOE
I/O upgrade	Two PCI Express connectors (CFFh and CIOv form factors)

Figure 2 shows the components on the system board of the HS22.

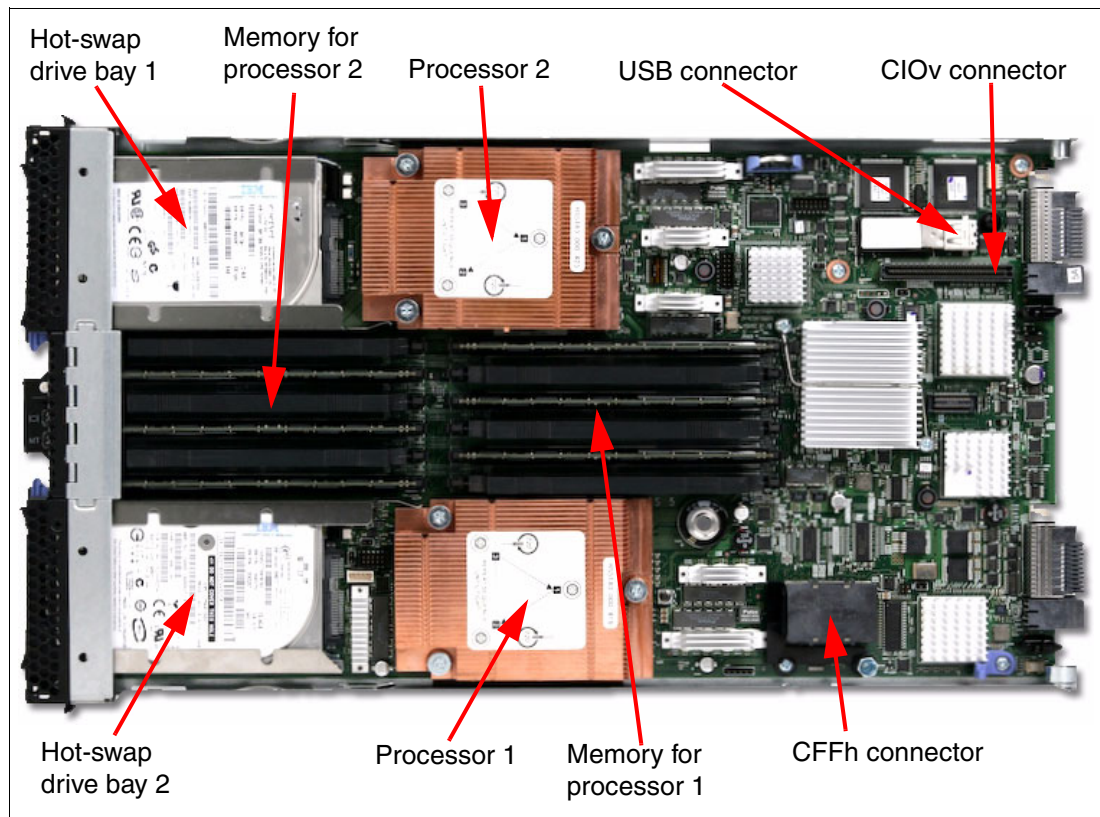


Figure 2 Layout of the HS22 system board

Model information

Table 2 on page 4 shows the current models.

Table 2 Models of the HS22 type 7870

Server models ^a	Processor model	Clock speed	Number of processors (std/max)	Number of cores	Shared cache size	Maximum memory speed	Memory (std/max ^b)
Intel Xeon 5600 series 6-core processors							
7870-N2x ^c	Intel Xeon L5640	2.26 GHz	1 / 2	6	12 MB	1066 MHz	3x 2 GB / 192 GB
7870-B6x	Intel Xeon E5649	2.53 GHz	1 / 2	6	12 MB	1333 MHz	3x 4 GB / 192 GB
7870-HAx ^d	Intel Xeon X5650	2.66 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 192 GB
7870-H2x	Intel Xeon X5650	2.66 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 192 GB
7870-H4x	Intel Xeon X5670	2.93 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 192 GB
7870-C6x	Intel Xeon X5675	3.06 GHz	1 / 2	6	12 MB	1333 MHz	3x 4 GB / 192 GB
7870-F2x	Intel Xeon X5680	3.33 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 192 GB
7870-C8x	Intel Xeon X5690	3.46 GHz	1 / 2	6	12 MB	1333 MHz	3x 4 GB / 192 GB
Intel Xeon 5600 series 4-core processors							
7870-A5x	Intel Xeon E5603	1.60 GHz	1 / 2	4	4 MB	1066 MHz	1x 4GB / 192 GB
7870-A7x	Intel Xeon E5607	2.26 GHz	1 / 2	4	8 MB	1066 MHz	1x 4GB / 192 GB
7870-G2x	Intel Xeon E5620	2.40 GHz	1 / 2	4	12 MB	1066 MHz	3x 2 GB / 192 GB
7870-G4x	Intel Xeon E5640	2.66 GHz	1 / 2	4	12 MB	1066 MHz	3x 2 GB / 192 GB
7870-GCx ^e	Intel Xeon E5640	2.66 GHz	1 / 2	4	12 MB	1066 MHz	3x 2 GB / 192 GB
7870-B5x	Intel Xeon X5647	2.93 GHz	1 / 2	4	12 MB	1066 MHz	3x 4 GB / 192 GB
7870-H5x	Intel Xeon X5667	3.06 GHz	1 / 2	4	12 MB	1333 MHz	3x 2 GB / 192 GB
7870-C5x	Intel Xeon X5672	3.20 GHz	1 / 2	4	12 MB	1333 MHz	3x 4 GB / 192 GB
7870-F3x	Intel Xeon X5677	3.46 GHz	1 / 2	4	12 MB	1333 MHz	3x 2 GB / 192 GB
7870-C7x	Intel Xeon X5687	3.60 GHz	1 / 2	4	12 MB	1333 MHz	3x 4 GB / 192 GB
Intel Xeon 5500 series 4-core processors							
7870-A4x	Intel Xeon E5507	2.26 GHz	1 / 2	4	4 MB	800 MHz	3x 1 GB / 96 GB
7870-M2x ^c	Intel Xeon L5518	2.13 GHz	1 / 2	4	8 MB	1066 MHz	2x 2 GB / 96 GB
Intel Xeon 5500 series 2-core processors							
7870-D3x	Intel Xeon E5503	2.00 GHz	1 / 2	2	4 MB	800 MHz	3x 1 GB / 96 GB

- a. Model numbers provided are worldwide generally available variant (GAV) model numbers which are not orderable as listed and need to be modified by country. The U.S. GAV model numbers use the following nomenclature: xxU. For example, the U.S. orderable part number for 7870-A2x is 7870-A2U. See the product-specific Official IBM announcement letter for other country-specific GAV model numbers.
- b. Maximum system memory capacity of 192 GB is based on using 12 x 16 GB memory DIMMs.
- c. Designated as a low-power (60 W) processor model.
- d. The HS22 7870-HAx model includes an Emulex Virtual Fabric Adapter (CFFh) I/O Expansion card.
- e. The HS22 7870-GCx model includes an Broadcom 10Gb Gen2 2-port (CFFh) I/O Expansion card.

Chassis support

The HS22 type 7870 is supported in the BladeCenter chassis (Table 3).

Table 3 HS22 chassis support

Blade	TDP ^a	BC S 8886	BC E 8677	BC T 8720	BC T 8730	BC H 8852	BC HT DC 8740	BC HT AC 8750
HS22	130 W	Yes ^b	No	No	No	Yes ^d	No	Yes ^e
HS22	Up to 95 W	Yes ^b	Yes ^c	No	No	Yes ^d	Yes ^e	Yes ^e

a. Thermal Design Power of the processor in the server. See Table 8 on page 10 to determine to which HS22 server models these apply.

b. See “BladeCenter S support” below.

c. See “BladeCenter E support” below.

d. See “BladeCenter H support” on page 7.

e. See “BladeCenter HT support” on page 8.

The specifics of the supported chassis depend on the models of the chassis and the power supplies and cooling modules (blowers) in the chassis.

BladeCenter S support

For HS22 servers with processors up to 95 W, a full complement of six servers can be installed. These can be mixed with other servers, except for the HX5 servers.

For HS22 servers with 130 W processors, up to five servers can be installed in the BladeCenter S. The one remaining bay must remain empty.

BladeCenter E support

When HS22 servers are to be installed in a BladeCenter E, the number of supported servers depends on the capacity of the power supplies installed in the chassis:

- ▶ 2000 W power supplies
- ▶ 2320 W power supplies

Restrictions: Note the following restrictions:

- ▶ The HS22 is not supported in BladeCenter E chassis with power supplies that have a capacity less than 2000 W.
- ▶ The HS22 with 130 W processors is not supported on the BladeCenter E at all.
- ▶ The HS22 always requires an advanced management module to be installed in the BladeCenter E.

There are restrictions regarding the number of HS22 blades that can be installed and in which bays when using a BladeCenter E chassis with 2000 W power supplies (Table 4).

In this Table 4:

- ▶ A green square (■) in a bay means that it can hold any blade server supported in the BladeCenter E *including* the HS22 and HS22V.
- ▶ A blue square (■) in a bay means that it can hold any supported blade server *except* an HS22 or HS22V.
- ▶ An E in a square means that the bay must remain empty.

Table 4 Placement of HS22 and other blades in a BladeCenter E with 2000 W power supplies

Power rating of HS22 CPU ^a	Max HS22s installable	Total blades installable	Power domain 1						Power domain 2						Total bays that must remain empty		
			Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10	Bay 11	Bay 12		Bay 13	Bay 14
130 W	0	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0
95 W	11	11	■	■	■	■	■	E	■	■	■	■	■	■	E	E	3
95 W	6	12	■	■	■	■	■	E	■	■	■	■	■	■	E	E	2
95 W	5	13	■	■	■	■	■	E	■	■	■	■	■	■	■	■	1
80 W	12	12	■	■	■	■	■	E	■	■	■	■	■	■	■	E	2
80 W	7	13	■	■	■	■	■	■	■	■	■	■	■	■	■	E	1
60 W	13	13	■	■	■	■	■	■	■	■	■	■	■	■	■	E	1
60 W	6	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0
40 W	14	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0

a. See Table 8 on page 10 to determine to which HS22 server models these apply.

For example, consider the second row of Table 4. If you want to install HS22 servers with 95 W CPUs, then you can install at most 11 of the servers into the chassis. Five of the servers must be installed in power domain 1 (bays 1 - 6), and six of the servers must be installed in power domain 2 (bays 7 - 12).

HS22 servers with 130 W processors are not supported at all in the BladeCenter E with 2000 W power supplies. This is shown in the first row of Table 4, where all cells are blue.

Tip: Within a power domain, it does not matter which bay is left unoccupied as required. Bays 6, 13, and 14 are used in the table for illustrative purposes only.

Table 5 shows the number of HS22 blades that are supported in the BladeCenter E with 2320 W power supplies installed. As you can see, the BladeCenter E with 95W or lower processors are fully supported with the 2320 W power supplies in the chassis. However, the 130 W processors are not supported at all in this chassis.

In Table 5:

- ▶ A green square (■) in a bay means that it can hold any blade server supported in the BladeCenter E *including* the HS22 and HS22V.
- ▶ A blue square (■) in a bay means that it can hold any supported blade server *except* an HS22 or HS22V.
- ▶ An E in a square means that the bay must remain empty.

Table 5 Placement of HS22 and other blades in a BladeCenter E with 2320 W power supplies

Power rating of HS22 CPU ^a	Max HS22s installable	Total blades installable	Power domain 1						Power domain 2						Total bays that must remain empty		
			Bay 1	Bay 2	Bay 3	Bay 4	Bay 5	Bay 6	Bay 7	Bay 8	Bay 9	Bay 10	Bay 11	Bay 12		Bay 13	Bay 14
130 W	0	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0
95 W	14	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0
80 W	14	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0
60 W	14	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0
40 W	14	14	■	■	■	■	■	■	■	■	■	■	■	■	■	■	0

a. See Table 8 on page 10 to determine to which HS22 server models these apply.

BladeCenter H support

With the exception of servers with 130 W processors, the BladeCenter H fully supports installation of up to 14 HS22 servers.

With HS22 servers with 130 W, the number of servers supported depends on the capacity of the power supplies and the cooling modules installed in the chassis:

- ▶ 2900 W power supplies
- ▶ 2980 W power supplies
- ▶ BladeCenter H standard blowers
- ▶ BladeCenter H Enhanced Cooling Modules (enhanced blowers)

These power supplies and blowers are standard on particular models of the BladeCenter H.

Table 6 on page 8 lists the number of HS22 servers that are supported in models of the BladeCenter H chassis.

In the Table 6:

- ▶ A green square (■) in a cell means that the chassis can be filled with HS22 blade servers up to the maximum number of blade bays in the chassis (14 blades in the BladeCenter H).
- ▶ A yellow square (■) in a cell means that the maximum number of HS22 blades that the chassis can hold is fewer than the total available blade bays. *All other bays must remain*

empty. Empty bays must be distributed evenly between the two power domains of the chassis (bays 1 - 6 and bays 7 - 14).

Table 6 HS22 support in the BladeCenter H

Power rating of HS22 CPU ^a	Maximum number of servers supported in each chassis				
	BC-H (models other than 4Tx)				BC-H (8852-4Tx)
	2900 W supplies		2980 W supplies ^b		2980 W supplies
	Standard blower	Enhanced blower ^c	Standard blower	Enhanced blower ^c	Enhanced blower ^c
130 W	None	12	None	14	14
95 W	14	14	14	14	14
80 W	14	14	14	14	14
60 W	14	14	14	14	14
40 W	14	14	14	14	14

a. See Table 8 on page 10 to determine to which HS22 server models these apply.

b. IBM BladeCenter H 2980W AC Power Modules, 68Y6601 (standard in 4Tx, optional with all other BC-H chassis models).

c. IBM BladeCenter H Enhanced Cooling Modules, 68Y6650 (standard in 4Tx, optional with all other BC-H chassis models).

BladeCenter HT support

For non-NEBS support (AC model 8750 only):

- ▶ For HS22 servers with processors up to 95 W, a full complement of 12 servers can be installed. These can be mixed with other servers except for the HX5 servers.
- ▶ For HS22 servers with 130 W processors, up to 10 servers can be installed in the BladeCenter HT. The two remaining bays must remain empty, one in each power domain.

For NEBS support, HS22 servers that have been tested for NEBS Level 3 and ETSI compliance for use in a central office environment are by processor model. See Table 8 on page 10 to determine to which HS22 server models these apply to:

- ▶ Intel Xeon E5540 (80W/4c)
- ▶ Intel Xeon L5518 (60W/4c)
- ▶ Intel Xeon L5508 (38W/2c)
- ▶ Intel Xeon E5620 (80W/4c) (planned for 4Q/2010)
- ▶ Intel Xeon E5645 (80W/6c) (planned for 4Q/2010)
- ▶ Intel Xeon L5638 (60W/6c) (planned for 4Q/2010)
- ▶ Intel Xeon L5618 (40W/4c) (planned for 4Q/2010)

For further information see the *IBM BladeCenter Interoperability Guide*:

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073016>

Processor

The HS22 type 7870 features the Intel Xeon 5500 and 5600 series processors. The Xeon 5500 series processor has models with either two or four cores per processor. The new Xeon

5600 series processor has models with either four or six cores per processor. With the Xeon 5500 and 5600 series processors, the memory controller is built into the processor. The memory is directly connected to the processor via three memory controller buses.

The two Xeon processors in the HS22 are connected through a serial coherency link called QuickPath Interconnect (QPI), as shown in Figure 3. The QPI link is capable of up to 6.4 Giga-transfers per second (GTps), depending on the processor model. The *Tylersburg* I/O hub chip is also connected to each processor via another QPI link.

Figure 3 shows the major components of the HS22 system.

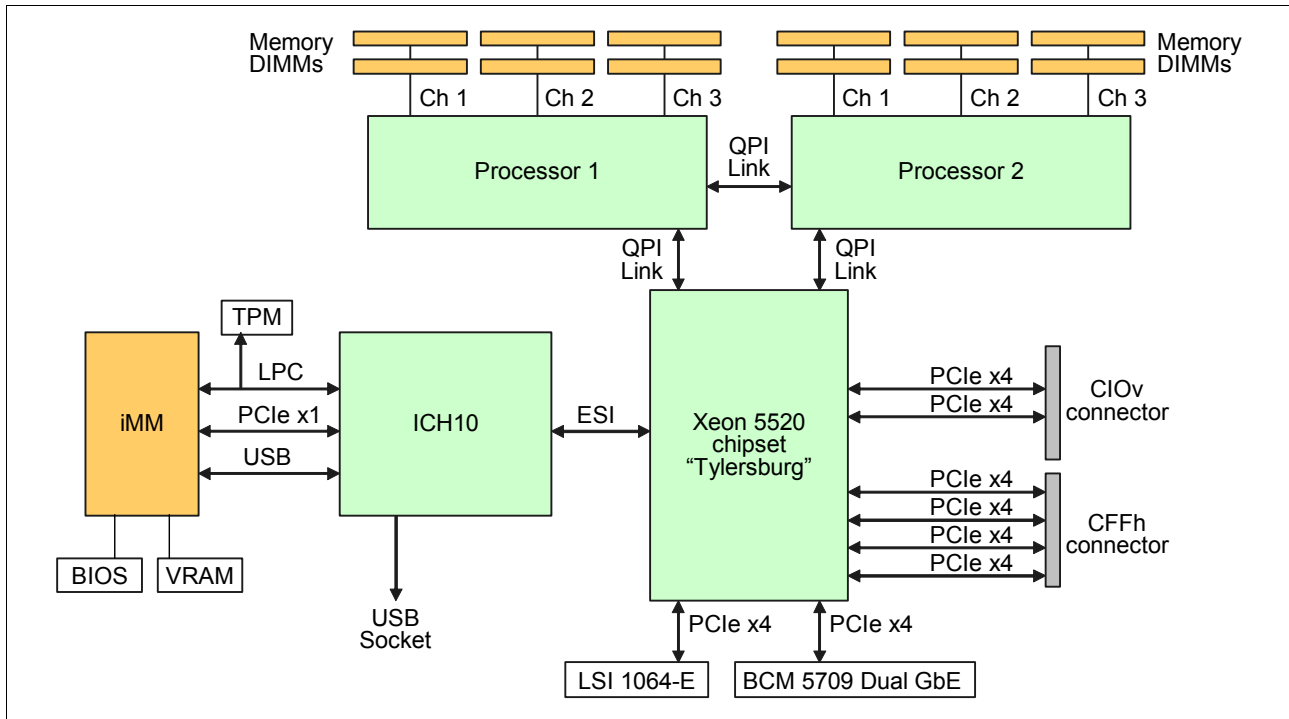


Figure 3 HS22 processor board block diagram

The blade server HS22 type 7870 supports either:

- ▶ Up to two Intel Xeon Processor 5600 Series (Westmere-EP) hex-core processors
- ▶ Up to two Intel Xeon Processor 5600 Series (Westmere-EP) quad-core processors
- ▶ Up to two Intel Xeon Processor 5500 Series (Nehalem-EP) quad-core processors
- ▶ Up to two Intel Xeon Processor 5500 Series (Nehalem-EP) dual-core processors

In a two-socket configuration, both processors must be identical.

The Intel Xeon 5500 and 5600 series processors are available in various clock speeds and have standard and low-power offerings. The processors support the following Intel technologies:

- ▶ QuickPath Technology
- ▶ Intel Turbo Boost Technology
- ▶ Intel Hyper-Threading Technology
- ▶ Intel Virtualization Technology
- ▶ Intelligent Power Capability
- ▶ Intel 64 Technology

Table 7 and Table 8 identify the features of the processor models available for the HS22.

Table 7 Intel Xeon 5600 Series processor features

Processor number	Processor frequency	Turbo	HT	L3 cache	Cores	Power	QPI Link speed ^a	Max DDR3 speed	Supports 2DPC/1333 ^b
Advanced									
Xeon X5690	3.46	Yes	Yes	12 MB	6	130 W	6.4 GT/s	1333 MHz	Yes
Xeon X5687	3.60 GHz	Yes	Yes	12 MB	4	130 W	6.4 GT/s	1333 MHz	Yes
Xeon X5680	3.33 GHz	Yes	Yes	12 MB	6	130 W	6.4 GT/s	1333 MHz	Yes
Xeon X5677	3.46 GHz	Yes	Yes	12 MB	4	130 W	6.4 GT/s	1333 MHz	Yes
Xeon X5675	3.06 GHz	Yes	Yes	12 MB	6	95 W	6.4 GT/s	1333 MHz	Yes
Xeon X5672	3.20 GHz	Yes	Yes	12 MB	4	95 W	6.4 GT/s	1333 MHz	Yes
Xeon X5670	2.93 GHz	Yes	Yes	12 MB	6	95 W	6.4 GT/s	1333 MHz	Yes
Xeon X5667	3.06 GHz	Yes	Yes	12 MB	4	95 W	6.4 GT/s	1333 MHz	Yes
Xeon X5660	2.80 GHz	Yes	Yes	12 MB	6	95 W	6.4 GT/s	1333 MHz	Yes
Xeon X5650	2.66 GHz	Yes	Yes	12 MB	6	95 W	6.4 GT/s	1333 MHz	Yes
Xeon X5647	2.93 GHz	Yes	Yes	12 MB	4	130 W	5.86 GT/s	1066 MHz	No
Standard									
Xeon E5649	2.53 GHz	Yes	Yes	12 MB	6	80 W	5.86 GT/s	1333 MHz	No
Xeon E5640	2.66 GHz	Yes	Yes	12 MB	4	80 W	5.86 GT/s	1066 MHz	No
Xeon E5630	2.53 GHz	Yes	Yes	12 MB	4	80 W	5.86 GT/s	1066 MHz	No
Xeon E5620	2.40 GHz	Yes	Yes	12 MB	4	80 W	5.86 GT/s	1066 MHz	No
Xeon E5607	2.26 GHz	No	No	8 MB	4	80 W	4.8 GT/s	1066 MHz	No
Xeon E5603	1.60 GHz	No	No	4 MB	4	80 W	4.8 GT/s	1066 MHz	No
Low power									
Xeon L5640	2.26 GHz	Yes	Yes	12 MB	6	60 W	5.86 GT/s	1066 MHz	No

a. GT/s = giga transfers per second.

b. Whether the processor supports the ability to run two DIMMs per channel at 1333 MHz. See “Memory” on page 14, for details.

Table 8 Intel Xeon 5500 Series processor features

Processor number	Processor frequency	Turbo	HT	L3 cache	Cores	Power	QPI Link speed ^a	Max DDR3 speed	Supports 2DPC/1333 ^b
Advanced									
Xeon X5570	2.93 GHz	Yes	Yes	8 MB	4	95 W	6.4 GT/s	1333 MHz	No
Xeon X5560	2.80 GHz	Yes	Yes	8 MB	4	95 W	6.4 GT/s	1333 MHz	No
Xeon X5550	2.66 GHz	Yes	Yes	8 MB	4	95 W	6.4 GT/s	1333 MHz	No

Processor number	Processor frequency	Turbo	HT	L3 cache	Cores	Power	QPI Link speed ^a	Max DDR3 speed	Supports 2DPC/1333 ^b
Standard									
Xeon E5540	2.53 GHz	Yes	Yes	8 MB	4	80 W	5.86 GT/s	1066 MHz	No
Xeon E5530	2.40 GHz	Yes	Yes	8 MB	4	80 W	5.86 GT/s	1066 MHz	No
Xeon E5520	2.26 GHz	Yes	Yes	8 MB	4	80 W	5.86 GT/s	1066 MHz	No
Basic									
Xeon E5507	2.26 GHz	No	No	4 MB	4	80 W	4.8 GT/s	800 MHz	No
Xeon E5506	2.13 GHz	No	No	4 MB	4	80 W	4.8 GT/s	800 MHz	No
Xeon E5504	2.00 GHz	No	No	4 MB	4	80 W	4.8 GT/s	800 MHz	No
Xeon E5503	2.00 GHz	No	No	4 MB	2	80 W	4.8 GT/s	800 MHz	No
Xeon E5502	1.86 GHz	No	No	4 MB	2	80 W	4.8 GT/s	800 MHz	No
Low power									
Xeon L5530	2.40 GHz	Yes	Yes	8 MB	4	60 W	5.86 GT/s	1066 MHz	No
Xeon L5520	2.26 GHz	Yes	Yes	8 MB	4	60 W	5.86 GT/s	1066 MHz	No
Xeon L5506	2.13 GHz	No	No	4 MB	4	60 W	4.8 GT/s	800 MHz	No

a. GT/s = giga transfers per second.

b. Whether the processor supports the ability to run two DIMMs per channel at 1333 MHz. See “Memory” on page 14 for details.

The Xeon 5500 and 5600 series of processors have a number of features as described in the following sections.

► Nehalem architecture

Intel's latest-generation microarchitecture represents the next step in faster, multi-core technology that intelligently maximizes performance to match your workload. It is designed to take advantage of Intel's 45nm (for the 5500 series) and 32nm (for the 5600 series) high-k metal gate silicon technology. The architecture uses parallel processing enabled by an integrated memory controller and Intel QuickPath Technology providing high-speed interconnects between independent processing cores.

► QuickPath Technology

Intel QuickPath Technology is a platform architecture that provides high-speed (up to 25.6 GBps), point-to-point connections between processors, and between processors and the I/O hub. Each processor has its own dedicated memory that it accesses directly through an Integrated Memory Controller. In cases where a processor needs to access the dedicated memory of another processor, it can do so through a high-speed QuickPath Interconnect (QPI) that links all the processors.

► Intel Turbo Boost Technology

Intel Turbo Boost Technology dynamically turns off unused processor cores and increases the clock speed of the cores in use. It will increase the frequency in steps of 133 MHz (to a maximum of three steps or 400 MHz) as long as the processor's predetermined thermal and electrical requirements are still met.

For example, with three cores active, a 2.26 GHz processor can run the cores at 2.4 GHz. With only one or two cores active, the same processor can run those cores at 2.53 GHz. Similarly, a 2.93 GHz processor can run at 3.06 GHz or even 3.33 GHz. When the cores are needed again, they are dynamically turned back on and the processor frequency is adjusted accordingly. This feature can be enabled or disabled in the UEFI BIOS.

For more information about Intel Turbo Boost Technology, see the following URL:

<http://www.intel.com/technology/turboboost/>

► Intel Hyper-Threading Technology

Intel Hyper-Threading Technology boosts performance for parallel, multi-threaded applications. It enables simultaneous multi-threading within each processor core, up to two threads per core or eight threads per quad-core processor. Hyperthreading reduces computational latency, making optimal use of every clock cycle. This feature can be enabled or disabled in the UEFI BIOS.

► Intelligent Power Capability

Intelligent Power Capability powers individual processor elements on and off as needed, to reduce power draw.

► Intel Virtualization Technology

Improvements to Intel Virtualization Technology (Intel VT-x) provide hardware-assisted page-table management, allowing the guest operating system more direct access to the hardware and reducing compute-intensive software translation from the VMM. Intel VT-x also includes Intel VT FlexMigration and Intel VT Flex-Priority, which are capabilities for flexible workload migration and performance optimization across the full range of 32-bit and 64-bit operating environments.

For more information about Intel Virtualization Technology, see the following URL:

<http://www.intel.com/technology/virtualization/technology.htm>

The Xeon 5600 series of processors have an additional feature: Advanced Encryption Standard New Instructions (AES-NI). These are new instructions that allow the processor to perform hardware-accelerated encryption for the AES algorithm. By significantly accelerating encryption, Intel Advanced Encryption Standard (AES- NI) enables more secure systems. Increased speed means that longer encryption keys can be used, strengthening the protection of data. More network traffic can be encrypted with less impact on server performance. Database and storage encryption can be more widely and be cost effectively deployed.

Table 9 lists the processor options for the HS22.

Table 9 Processors for the HS22 type 7870

Description	Part number	Feature code	Supported model
Intel Xeon 5600 series processors			
Intel Xeon X5690 6C 3.46GHz 12MB 1333MHz 130w	81Y9331	A16C	C8x
Intel Xeon X5687 4C 3.60GHz 12MB 1333MHz 130w	81Y9330	A16D	C7x
Intel Xeon X5680 HC 3.33 GHz 12 MB Cache 1333 MHz	59Y5713	7751	F2x
Intel Xeon X5677 QC 3.46 GHz 12 MB Cache 1333 MHz	59Y5714	7750	F3x
Intel Xeon X5675 6C 3.06GHz 12MB 1333MHz 95w	81Y9329	A16E	C6x
Intel Xeon X5672 4C 3.20GHz 12MB 1333MHz 95w	81Y9328	A16F	C5x

Description	Part number	Feature code	Supported model
Intel Xeon X5670 HC 2.93 GHz 12 MB Cache 1333 MHz	59Y5711	7753	H4x
Intel Xeon X5667 QC 3.06 GHz 12 MB Cache 1333 MHz	59Y5712	7752	H5x
Intel Xeon X5660 HC 2.80 GHz 12 MB Cache 1333 MHz	59Y5710	7754	CTO
Intel Xeon X5650 HC 2.66 GHz 12 MB Cache 1333 MHz	59Y5709	7755	H2x, HAx
Intel Xeon E5649 6C 2.53GHz 12MB 1333MHz 80w	81Y9327	A16G	B6x
Intel Xeon X5647 4C 2.93GHz 12MB 1066MHz 130w	81Y9326	A16H	B5x
Intel Xeon E5645 HC 2.40 GHz 12 MB Cache 1333 MHz	68Y8125	7668	CTO
Intel Xeon E5640 QC 2.53 GHz 12 MB Cache 1066 MHz	59Y5708	7756	G4x, GCx
Intel Xeon L5638 HC 2.0 GHz 12 MB Cache 1333 MHz	68Y8124	7669	CTO
Intel Xeon E5630 QC 2.40 GHz 12 MB Cache 1066 MHz	59Y5707	7757	CTO
Intel Xeon E5620 QC 2.26 GHz 12 MB Cache 1066 MHz	59Y5705	7758	G2x
Intel Xeon L5640 HC 2.26 GHz 12 MB Cache 1333 MHz	59Y5706	7759	N2x
Intel Xeon L5630 QC 2.13 GHz 4 MB Cache 800 MHz	59Y5704	7760	CTO
Intel Xeon L5609 QC 1.60 GHz 12 MB Cache 1066 MHz	49Y5184	7761	CTO
Intel Xeon E5607 4C 2.26GHz 8MB 1066MHz 80w	81Y9325	A16J	A7x
Intel Xeon E5603 4C 1.60GHz 4MB 1066MHz 80w	81Y9323	A16L	A5x
Intel Xeon 5500 series processors			
Intel Xeon X5570 QC 2.93 GHz 8 MB Cache 1333 MHz	44T1887	1033	C4x
Intel Xeon X5560 QC 2.80 GHz 8 MB Cache 1333 MHz	44T1886	1032	C3x
Intel Xeon X5550 QC 2.66 GHz 8 MB Cache 1333 MHz	44T1885	1031	CTO
Intel Xeon E5540 QC 2.53 GHz 8 MB Cache 1066 MHz	44T1884	1030	B4x
Intel Xeon E5530 QC 2.40 GHz 8 MB Cache 1066 MHz	44T1883	1029	B3x
Intel Xeon L5530 QC 2.40GHz 8MB Cache 1066MHz	59Y5575	7749	L3x
Intel Xeon E5520 QC 2.26 GHz 8 MB Cache 1066 MHz	44T1736	1028	CTO
Intel Xeon L5520 QC 2.26 GHz 8 MB Cache 1066 MHz	46M0697	7793	L2x
Intel Xeon L5518 QC 2.13GHz 8MB Cache 1066MHz	49Y5052	7748	M2x
Intel Xeon E5507 QC 2.26 GHz 4 MB Cache 800 MHz	59Y5695	7762	A4x
Intel Xeon E5506 QC 2.13 GHz 4 MB Cache 800 MHz	43W5987	1027	CTO
Intel Xeon E5504 QC 2.00 GHz 4 MB Cache 800 MHz	44T1712	1026	A2x, CCx
Intel Xeon E5503 QC 2.00 GHz 4 MB Cache 800 MHz	59Y5692	7763	D3x
Intel Xeon E5502 DC 1.86 GHz 4 MB Cache 800 MHz	43W5986	5369	D2x

For more information about the Intel Xeon 5500 and 5600 series processors see the following URL:

http://www.intel.com/p/en_US/products/server/processor/xeon5000

Memory

The HS22 has six DIMM sockets per processor (12 DIMMs in total). The HS22 with the Xeon 5600 series processor can support up to 192 GB of memory in total when using 16 GB DIMMs and with both processors installed. The HS22 with the Xeon 5500 series processor can support up to 96 GB of memory in total when using 8 GB DIMMs and with both processors installed. The HS22 uses Double Data Rate-3 (DDR-3) very-low-profile (VLP) registered DIMMs.

Figure 4 shows the location of the 12 memory DIMM sockets.

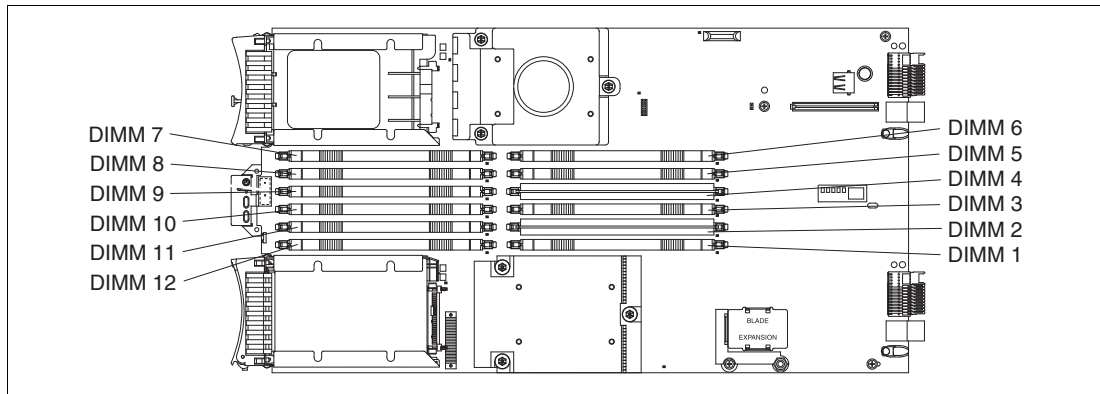


Figure 4 DIMM layout on the HS22 system board

Unlike previous generations of Intel Xeon processors, the Xeon 5500 and 5600 series processors have an integrated memory controller. The memory DIMMs connect directly to one of the processors. With one processor installed, only six DIMMs can be accessed. To access memory in the other six DIMM connectors, the second processor must be installed.

Table 10 shows which memory DIMM connectors are connected to each processor.

Table 10 Memory channel configuration

Processor	Memory channel	DIMM connector
1	Channel 0	DIMM connector 1 and 2
	Channel 1	DIMM connector 5 and 6
	Channel 2	DIMM connector 3 and 4
2	Channel 3	DIMM connector 7 and 8
	Channel 4	DIMM connector 11 and 12
	Channel 5	DIMM connector 9 and 10

Topics in this section:

- ▶ “Memory DIMM installation recommendations” on page 15
- ▶ “Memory modes” on page 16

- ▶ “Memory for HS22 servers with Xeon 5500 series processors” on page 17
- ▶ “Memory for HS22 servers with Xeon 5600 series processors” on page 20
- ▶ “Memory performance” on page 23

Memory DIMM installation recommendations

The HS22 will boot with one memory DIMM installed. However, the suggested memory configuration is to balance the memory across all the memory channels on each processor to utilize the available memory bandwidth. This means that the suggested memory configuration is either of the following:

- ▶ Three or six memory DIMMs in a single processor HS22 blade server
- ▶ Six or 12 memory DIMMs in a dual processor HS22 blade server

This suggested sequence spreads the DIMMs across as many memory channels as possible. For best performance, install the DIMMs in the sockets as shown in:

- ▶ Table 11 if you have one processor installed
- ▶ Table 12 if you have two processors installed

Table 11 Suggested DIMM installation for the HS22 with one processor installed

Number of processors	Number of DIMMs	Processor 1						Processor 2					
		Channel		Channel		Channel		Channel		Channel		Channel	
		DIMM 1	DIMM 2	DIMM 3	DIMM 4	DIMM 5	DIMM 6	DIMM 7	DIMM 8	DIMM 9	DIMM 10	DIMM 11	DIMM 12
1	1		x										
1	2		x		x								
1	3		x		x		x						
1	4	x	x		x		x						
1	5	x	x	x	x		x						
1	6	x	x	x	x	x	x						

Table 12 Suggested DIMM installation for the HS22 with two processors installed

Number of processors	Number of DIMMs	Processor 1						Processor 2					
		Channel		Channel		Channel		Channel		Channel		Channel	
		DIMM 1	DIMM 2	DIMM 3	DIMM 4	DIMM 5	DIMM 6	DIMM 7	DIMM 8	DIMM 9	DIMM 10	DIMM 11	DIMM 12
2	2		x						x				
2	3		x		x				x				
2	4		x		x				x		x		
2	5		x		x		x		x		x		
2	6		x		x		x		x		x		x

Number of processors	Number of DIMMs	Processor 1						Processor 2					
		Channel		Channel		Channel		Channel		Channel		Channel	
		DIMM 1	DIMM 2	DIMM 3	DIMM 4	DIMM 5	DIMM 6	DIMM 7	DIMM 8	DIMM 9	DIMM 10	DIMM 11	DIMM 12
2	7	x	x		x		x		x		x		x
2	8	x	x		x		x	x	x		x		x
2	9	x	x	x	x		x	x	x		x		x
2	10	x	x	x	x		x	x	x	x	x		x
2	11	x	x	x	x	x	x	x	x	x	x		x
2	12	x	x	x	x	x	x	x	x	x	x	x	x

Terminology: The term *DIMMs per channel* is commonly referred to as the abbreviation DPC. One DIMM per channel can be referred to as 1DPC and, likewise, two DIMMs per channel can be referred to as 2DPC. The ability to run two DIMMs per channel at 1333 MHz is often referred to as the abbreviation, 2DPC@1333MHz.

Memory modes

The HS22 type 7870 supports two memory modes. These modes can be selected in the UEFI BIOS setup.

Independent channel mode

Independent channel mode gives a maximum of 96 GB of usable memory with one CPU installed, and 192 GB of usable memory with two CPUs installed (using 16 GB DIMMs). The DIMMs can be installed without matching sizes. Independent channel mode is the most appropriate memory mode for most HS22 configurations.

Note: If ServeRAID MR10ie is installed, the battery is installed in DIMM slot 7. Therefore, DIMM slot 7 cannot be used for memory. This will limit the total amount of memory that can be installed.

Memory mirroring mode

Memory mirroring works much like disk mirroring and provides high server availability in the event of a memory DIMM failure. The total memory is divided into two channels. The third channel is unused. Data is written concurrently to both channels. With mirroring enabled, only one-third of total memory is available for use because two DIMM slots are the primary channel, two DIMM slots are the backup channel, and two DIMM slots are not used. Due to the double writes to memory, performance is affected. Figure 5 illustrates the HS22 memory mirroring layout.

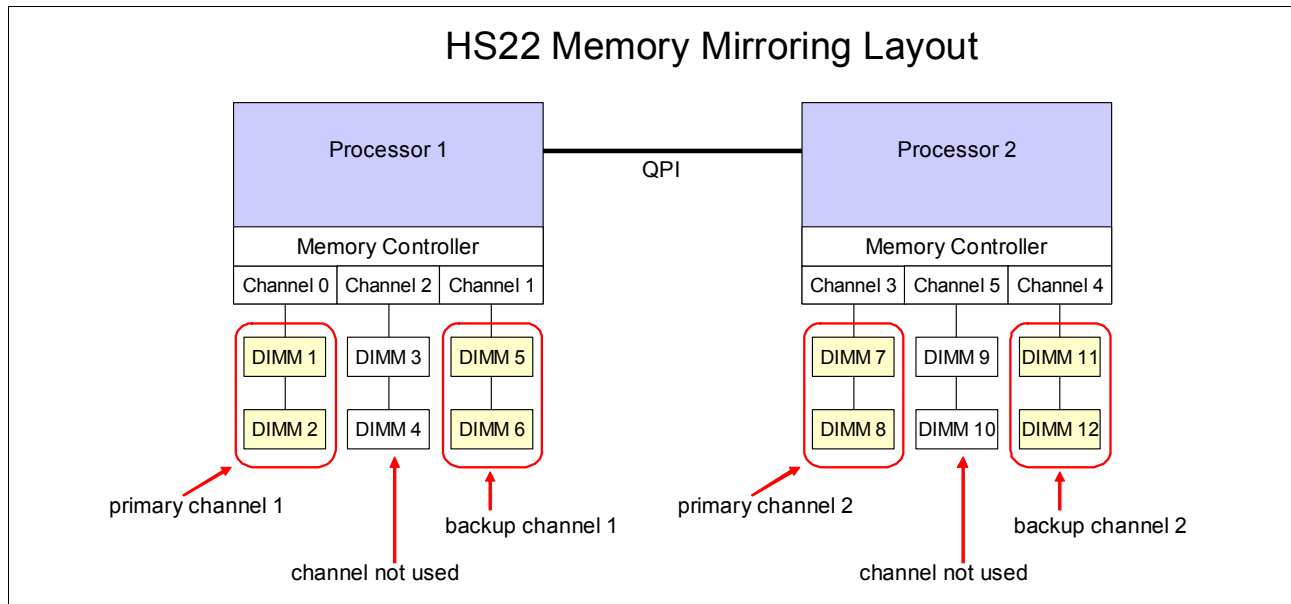


Figure 5 The HS22 type 7870 memory mirroring layout

If a failed DIMM is one of the DIMMs in the primary channel, it is instantly disabled and the mirrored (backup) memory in the other channel becomes active (primary) until the failing DIMM is replaced. Mirroring is handled at the hardware level, and no operating system support is required.

Note: If ServeRAID MR10ie is installed, the battery is installed in DIMM slot 7. Therefore, DIMM slot 7 cannot be used for mirroring. This limits the amount of memory available when using memory mirroring.

The HS22 type 7870 supports different memory features and DIMM options depending on the series of Xeon processor installed, as detailed in the following sections:

- ▶ “Memory for HS22 servers with Xeon 5500 series processors” on page 17
- ▶ “Memory for HS22 servers with Xeon 5600 series processors” on page 20

Memory for HS22 servers with Xeon 5500 series processors

All supported DIMMs installed in the HS22 with Xeon 5500 series processors operate at 1.5 volts. The HS22 supports the installation of certain 1.35-volt low-power memory options, but with the Xeon 5500 series processors installed these DIMMs also operate at 1.5 volts, and thus lose their energy-efficient capability.

The largest memory DIMM that is supported in the HS22 with the Xeon 5500 series processor is 8 GB.

The maximum speed at which the memory channel runs on the HS22 is a combination of:

- ▶ The processor
 - The X (Advanced) range of Xeon 5500 series processors has a maximum memory channel speed of 1333 MHz. This is the only range of Xeon processors capable of running memory DIMMs that are rated at 1333 MHz that are actually at 1333 MHz.
 - The E and L ranges of Xeon 5500 series processor models have a maximum memory speed of 1066 MHz or 800 MHz and therefore cannot run the memory any faster than this.
- ▶ The memory DIMM module
 - Not all DIMMs support running at 1333 MHz.
 - Certain memory DIMMs only operate up to 1066 MHz. Even if these 1066 MHz DIMMs are used with a processor that supports 1333 MHz, the memory channel speed will still not exceed 1066 MHz.
 - Dual-rank DIMMs offer better interleaving and thus better performance than single-rank DIMMs. See Table 14 on page 20 to determine the maximum memory channel speed that each DIMM supports and the number of ranks (note the Rank column in those tables).
- ▶ The number of DIMM modules installed
 - With the Xeon 5500 series of processors, the more memory DIMMs per channel, the lower the speed at which the memory channels operate.
 - If a processor that supports running the memory channels at 1333 MHz has one DIMM per channel, and the DIMM installed is also capable of running at 1333 MHz, then the memory channels run at 1333 MHz. If any or all of the memory channels have a second DIMM installed, then the memory channels run at 1066 MHz.
 - DIMM modules should be installed in lots of three, which for the HS22 is either three or six DIMM modules per processor. This makes the best use of the bandwidth available to the processor's three memory channels.

See Table 8 on page 10 to determine the maximum memory channel speed for a given Xeon 5500 series processor.

Key information: Note the following key information:

- ▶ If the 1.35-volt low-power DIMMs are installed in the HS22 with the Xeon 5500 series processor, then these low-power DIMMs will operate at 1.5 volts and thus lose their energy-efficient capability.
- ▶ The X (Advanced) range of Xeon 5500 series processors have a maximum memory channel speed of 1333 MHz and can therefore run 1DPC@ 1333 MHz.
- ▶ The HS22 with the Xeon 5500 series processor does not support 2DPC@ 1333 MHz.

Figure 6 shows a graphical representation of one and two DIMM modules per processor memory channel.

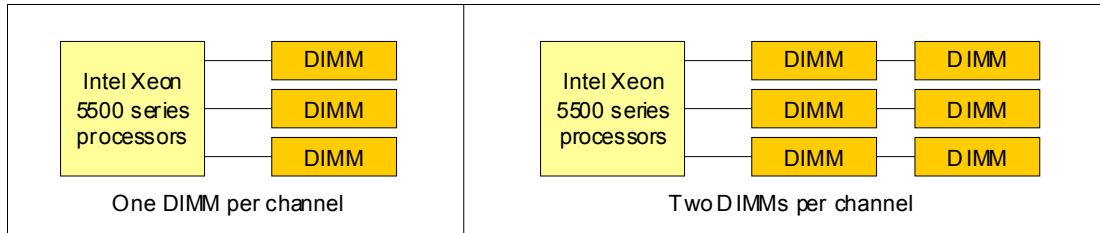


Figure 6 Intel Xeon 5500 series processor with one and two DIMMs per channel

Table 13 lists the supported memory speed for a given Xeon 5500 series processor type with one or two DIMM modules per channel installed.

Table 13 Xeon 5500 series processor memory speeds and DIMMs per channel

Processor type ^a	QPI link speed ^b	Max DDR3 speed	1DPC ^c	2DPC ^c
Advanced	6.4 GT/s	1333 MHz	1333 MHz	1066 MHz
Standard	5.86 GT/s	1066 MHz	1066 MHz	1066 MHz
Basic	4.8 GT/s	800 MHz	800 MHz	800 MHz

a. For more information about processor type, see Table 8 on page 10.

b. GT/s = giga transfers per second.

c. Maximum memory speed possible. Actual memory speed also depends on other factors, such as those described on page 18.

Table 14 on page 20 lists the memory options for the HS22 using the Xeon 5500 series processors (ordered by DIMM capacity).

Table 14 Memory modules supported in the HS22 type 7870 using the Xeon 5500 series processors

Part number	Feature code	Description	Rank
49Y1427	8928	1 GB (1x 1 GB, 1Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP RDIMM	Single
44T1485	1072	1 GB (1x 1 GB) Single Rank PC3-10600 CL9 ECC DDR3-1333 VLP LP RDIMM	Single
49Y1428	8929	2 GB (1x 2 GB, 2Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP RDIMM	Dual
49Y1429	8930	2 GB (1x 2 GB, 1Rx4, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP RDIMM	Single
44T1487	1073	2 GB (1x 2 GB) Single Rank PC3-10600 CL9 ECC DDR3-1333 VLP RDIMM	Single
44T1486	1916	2 GB (1x 2 GB) Dual Rank PC3-10600 CL9 ECC DDR3-1333 VLP LP RDIMM	Dual
44T1594	A0YV	2 GB (1x 2 GB, 1Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Single
46C0560 ^a	A0WX	2 GB (1x 2 GB, 1Rx8, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Single
49Y1430	8931	4 GB (1x 4 GB, 2Rx4, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP RDIMM	Dual
44T1488	1074	4 GB (1x 4 GB) Dual Rank PC3-10600 CL9 ECC DDR3-1333 VLP RDIMM	Dual
44T1596	1908	4 GB (1x 4 GB, 2Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP RDIMM	Dual
46C0563 ^a	A0WY	4 GB (1x 4 GB, 1Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Single
46C0564 ^a	A0WZ	4 GB (1x 4 GB, 2Rx8, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Dual
49Y1431	8932	8 GB (1x 8 GB, 2Rx4, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP RDIMM	Dual
44T1579 ^{bc}	1911	8 GB (1x 8 GB) Dual Rank PC3-8500 CL7 ECC DDR3-1066 VLP RDIMM	Dual
46C7451	1910	8 GB (1x 8 GB, Dual Rankx4) PC3-10600 CL9 ECC DDR3-1333 VLP	Dual

a. Will run at 1.5 V only when used in blade server with the Xeon 5500 series processor.

b. The 8 GB Dual Rank DIMM (44T1579) has a maximum memory speed of 1066 MHz.

c. 44T1579 was withdrawn from marketing in September 2010.

Memory for HS22 servers with Xeon 5600 series processors

Standard DIMMs supported in the HS22 operate at 1.5 volts. The HS22 server with the Xeon 5600 series processors installed also supports low-power DIMMs that can operate at 1.35 volts. The 1.35-volt low-power memory DIMMs can be up to 10% more energy efficient than existing 1.5-volt memory DIMMs.

The HS22 models with one of the Advanced (X) ranges of the Xeon 5600 series processor installed have the ability to run specific DIMMs at 1333 MHz even when two DIMMs per channel are populated. Table 7 on page 10 shows which processors support two DIMMs per channel. Table 16 on page 22 shows which DIMMs support two DIMMs per channel at 1333 MHz.

The maximum speed at which the memory channel will run on the HS22 is a combination of:

- ▶ The processor
 - The X (Advanced) range of Xeon 5600 series processors has a maximum memory channel speed of 1333 MHz. This is the only range of Xeon processors capable of running memory DIMMs that are rated at 1333 MHz that are actually at 1333 MHz.
 - The E and L ranges of Xeon 5600 series processor models have a maximum memory speed of 1066 MHz or 800 MHz and therefore cannot run the memory any faster than this.

- ▶ The memory DIMM module
 - Not all DIMMs support running at 1333 MHz.
 - Certain memory DIMMs only operate up to 1066 MHz. Even if these 1066 MHz DIMMs are used with a processor that supports 1333 MHz, the memory channel speed will still not exceed 1066 MHz.
 - Dual-rank DIMMs offer better interleaving and thus better performance than single-rank DIMMs. See Table 16 on page 22 to determine the maximum memory channel speed that each DIMM supports and the number of ranks (note the Rank column in those tables).
- ▶ The number of DIMM modules installed
 - The X (Advanced) range of Xeon 5600 series processors has the ability to run two DIMMs per memory channel and still operate the memory bus speed at 1333 MHz.
 - With the E and L ranges of the Xeon 5600 series range of processors, the more memory DIMMs per channel, the lower the speed at which the memory channels operate.
 - DIMM modules should be installed in lots of three, which for the HS22 is either three or six DIMM modules per processor. This makes the best use of the bandwidth available to the processor's three memory channels.

See Table 7 on page 10 to determine the maximum memory channel speed for a given Xeon 5600 series processor.

Key information: Note the following key information:

- ▶ The HS22 with Intel Xeon 5600 series processors supports 1.35 V or 1.5 V DIMMs.
- ▶ Low-power 1.35-volt memory DIMMs is a feature supported for the HS22 using the Intel Xeon 5600 series processor only.
- ▶ The ability to run two DIMMs per channel (2DPC) at 1333 MHz is a feature supported for the HS22 using the Intel Xeon 5600 series processor only.
- ▶ If the low-power 1.35-volt DIMMs are installed with standard 1.5-volt DIMMs, then these low-power DIMMs also operate at 1.5 volts and thus lose their energy-efficient capability.
- ▶ For models with the Xeon 5600 processor: 1.35-volt DIMMs operate at 1.5 volts if you enable 2DPC at 1333 MHz in UEFI.
- ▶ Low-power 1.35-volt DIMMs support 1DPC at 1333 MHz or 2DPC at 1066 MHz, whereas 1.5-volt DIMMs support 2DPC at 1333 MHz (provided that the processor also supports these memory speeds).

Figure 7 shows a graphical representation of one and two DIMM modules per processor memory channel.

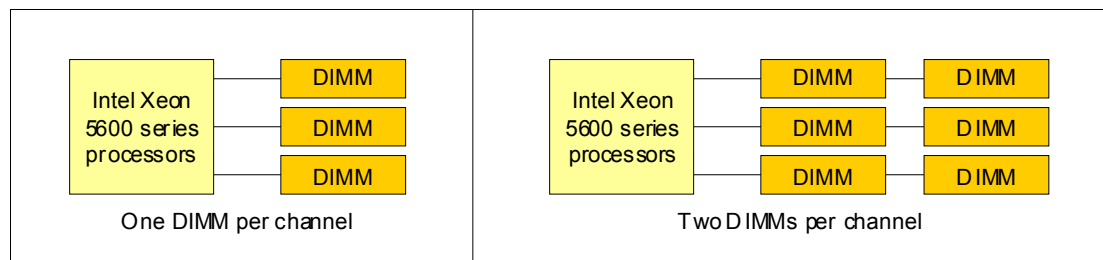


Figure 7 Intel Xeon 5600 series processor with one and two DIMMs per channel

Table 15 lists the supported memory speed for a given Xeon 5600 series processor type with one or two DIMM modules per channel installed.

Table 15 Xeon 5600 series processor memory speeds and DIMMs per channel

Processor type ^a	QPI link speed ^b	Max DDR3 speed	Memory voltage	1DPC ^c	2DPC ^c
Advanced	6.4 GT/s	1333MHz	1.5V	1333 MHz	1333 MHz
			1.35V	1333 MHz	1066 MHz
Standard	5.86 GT/s	1066MHz	1.5V	1066 MHz	1066 MHz
			1.35V	1066 MHz	1066 MHz
Basic	4.8 GT/s	800MHz	1.5V	800 MHz	800 MHz
			1.35V	800 MHz	800 MHz

a. For more information about processor type, see Table 7 on page 10.

b. GT/s = giga transfers per second.

c. Maximum memory speed possible. Actual memory speed also depends on other factors.

Table 16 lists the memory options for the HS22 using the Xeon 5600 series processors (ordered by voltage and then DIMM capacity).

Table 16 List of memory modules for the HS22 type 7870 using the Xeon 5600 series processors

Part number	Feature code	Description	2DPC @1333 ^a	Rank
Standard DIMMs (1.5 V)				
49Y1427	8928	1 GB (1x 1 GB, 1Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Single
49Y1428	8929	2 GB (1x 2 GB, 2Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Dual
49Y1429	8930	2 GB (1x 2 GB, 1Rx4, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Single
44T1594	A0YV	2 GB (1x 2 GB, 1Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Single
49Y1430	8931	4 GB (1x 4 GB, 2Rx4, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Dual
44T1596	1908	4 GB (1x 4 GB, 2Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Dual
49Y1431	8932	8 GB (1x 8 GB, 2Rx4, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Dual
Low Power DIMMs (1.35 V)^b				
46C0560	A0WX	2 GB (1x 2 GB, 1Rx8, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Yes ^c	Single
46C0561	1907	2 GB (1x 2 GB, 1Rx4, 1.35 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes ^c	Single
46C0563	A0WY	4 GB (1x 4 GB, 1Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Yes ^c	Single
46C0564	A0WZ	4 GB (1x 4 GB, 2Rx8, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Yes ^c	Dual
46C0567	1908	4 GB (1x 4 GB, 2Rx4, 1.35 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes ^c	Dual
46C0568	8644	8 GB (1x 8 GB, 2Rx4, 1.35 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes ^c	Dual
46C0569 ^d	1909	8 GB (1x 8 GB, 2Rx4, 1.35 V) PC3-8500 CL7 ECC DDR3 1066 MHz VLP	No	Dual
46C0599	2422	16 GB (1x 16 GB, 2Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Yes ^c	Dual

See table notes on the following page.

- a. These DIMMs are supported to run two DIMMs per channel at a memory bus speed of 1333 MHz (“2DPC@1333MHz”) with the X (Advanced) range of Intel Xeon 5600 series processors. See Table 7 to determine the processors in the X range.
- b. Low-power 1.35v DIMMs operate at 1.5 volts if they are mixed with 1.5-volt DIMMs.
- c. Supports 2DPC@1333 MHz only when operating at 1.5 V.
- d. The 8 GB Dual Rank DIMM (46C0569) has a maximum memory speed of 1066 MHz.

Memory performance

For best memory performance:

- ▶ Choose a Xeon processor model that can support the highest required maximum memory speed. Certain Xeon processor models only run memory at 800 MHz, as shown in the right-most column in Table 7 on page 10 or Table 8 on page 10.
- ▶ Choose a Xeon 5600 processor model and memory DIMM combination that supports running 2DPC@1333MHz.
- ▶ Always populate both processors with equal amounts of memory to ensure a balanced system.
- ▶ Always populate all three memory channels on each processor with equal memory capacity.
- ▶ Ensure that an even number of ranks are populated per channel.
- ▶ Use dual-rank DIMMs when possible.
- ▶ Disable memory mirroring mode.

Mindset change: Memory in Intel servers has historically been installed in pairs (due to interleaving requirements). It was common to see servers configured with 2 GB, 4 GB, 8 GB, 16 GB, or 32 GB of memory installed.

With the Xeon 5500 and 5600 series processors, for optimal performance, install memory in triplets. Therefore, as an example, configure the HS22 with 6 GB, 12 GB, 24 GB, or 48 GB of memory.

For further information about optimizing memory performance, refer to the IBM white paper *Optimizing the Performance of IBM System x and BladeCenter Servers using Intel Xeon 5500 Series Processors*:

<http://www.ibm.com/systems/in/info/x/newgeneration/hs22/pdf/XSW03025USEN.PDF>

Standard onboard features

The HS22 blade server has the following standard onboard features.

UEFI

The HS22 uses an integrated Unified Extensible Firmware Interface (UEFI) next-generation BIOS.

New capabilities include:

- ▶ Human readable event logs - no more beep codes
- ▶ Complete setup solution by allowing adapter configuration function to be moved into UEFI

- ▶ Complete out-of-band coverage by Advance Settings Utility to simplify remote setup

Using all of the features that UEFI offers requires a UEFI-aware operating system and adapters. UEFI is fully backwards-compatible with heritage BIOS.

For more information about UEFI, see the IBM white paper *Introducing uEFI-Compliant Firmware on IBM System x and BladeCenter Servers*, available from:

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5083207>

Onboard network adapter

The HS22 includes a dual-port Gigabit Ethernet controller with the following specifications:

- ▶ Broadcom BCM5709S Gigabit Ethernet controller
- ▶ Supports TOE (TCP Offload Engine)
- ▶ Supports failover and load balancing for better throughput and system availability
- ▶ Supports highly secure remote power management using IPMI 2.0
- ▶ Supports Wake on LAN and PXE (Preboot Execution Environment)
- ▶ Support for IPv4 and IPv6

Integrated systems management processor

The HS22 type 7870 blade server includes an Integrated Management Module (IMM) to monitor server availability, perform Predictive Failure Analysis and so on, and trigger IBM Systems Director alerts. The IMM performs the functions of the Baseboard Management Controller (BMC) of earlier blade servers, and adds the features of the Remote Supervisor Adapter found in System x® servers, as well as remote control and remote media. A separate card, like the cKVM card, is no longer required for these functions (the cKVM card is not supported on the HS22).

For more information about the IMM, see the IBM white paper *Transitioning to UEFI and IMM*, which is available from:

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5079769>

Video controller

The Video subsystem in the HS22 is a component of the Integrated Management Module (IMM) and is based on the Matrox G200eV video core with 16 MB of video memory. Table 17 lists the supported video resolutions.

Table 17 Supported video resolutions

Resolution	Maximum refresh
640 x 480	85 Hz
800 x 600	85 Hz
1024 x 768	75 Hz

Trusted Platform Module (TPM)

Trusted computing is an industry initiative that provides a combination of secure software and secure hardware to create a trusted platform. It is a specification that increases network security by building unique hardware IDs into computing devices.

The HS22 implements TPM Version 1.2 support.

The trusted platform module (TPM) in the HS22 is one of the three layers of the trusted computing initiative (Table 18).

Table 18 Trusted computing layers

Layer	Implementation
Level 1: Tamper-proof hardware, used to generate trustable keys	Trusted Platform Module
Level 2: Trustable platform	UEFI or BIOS Intel processor
Level 3: Trustable execution	Operating system Drivers

Local storage

The HS22 blade server features an onboard LSI Logic 53C1064E SAS controller with two hot-swap drives bay accessible from the front of the blade server (Figure 8). The LSI Logic 53C1064E SAS controller provides RAID 0 or RAID 1 capability and supports up to two internal hot-swap SAS or SATA HDDs or two internal hot swap solid-state drives. The LSI 53C1064E SAS controller ports operate at a burst rate of 1.5 or 3.0 Gbps. An optional ServeRAID MR10ie is available that provides battery-backed write cache for internal and external disk drives.



Figure 8 The HS22 showing the front hot-swap disk drive bays

ServeRAID-MR10ie

The optional ServeRAID-MR10ie, part number 46C7167, is a SAS RAID controller for the HS22. It is installed in the CIOv expansion socket. It provides RAID support with

battery-backed cache for onboard and external disk drives. With the ServeRAID-MR10ie, you can connect to BladeCenter S storage or the external System Storage® EXP3000 disk enclosure.

Key features of the ServeRAID-MR10ie controller are:

- ▶ Provides 256 MB of ECC DDR-2 battery-backed cache
- ▶ Utilizes an LSI 1078 controller
- ▶ Supports data speeds of 1.5 or 3.0 Gbps
- ▶ Supports up to 26 disk drives
- ▶ Support for onboard and external disk drives
- ▶ Includes battery backup module
- ▶ Supports RAID levels 0, 1, 10, 5, 50, 6, and 60
- ▶ Support for SAS disks
- ▶ Support for OS Boot over SAS

Note: The ServeRAID-MR10ie does not support the use of SATA or SSD drives on the HS22 blade server.

The ServeRAID-MR10ie option ships with a battery backup unit, in the form of a DIMM (which is installed in DIMM socket 7). IBM recommends that you replace the battery unit annually. The replacement battery unit is part number 46M0800.

Tip: If the ribbon cable is not used to connect the card to the battery, the AMM event log will indicate that battery backup unit (BBU) is not present and write-back cache will not be a configurable option in the SAS configuration utility.

For customers in countries with configure-to-order capability, the ServeRAID-MR10ie is available with and without the battery. Table 19 shows relevant part numbers and feature codes.

Table 19 Part numbers and feature codes

Description	Part number	Feature code
ServeRAID-MR10ie (CIOv) Controller with battery	46C7167	0070
ServeRAID-MR10ie (CIOv) Controller without battery	Not available	0071
Replacement battery	46M0800	Not available

Note: If the ServeRAID MR10ie is installed, the battery is installed in DIMM slot 7. Therefore DIMM slot 7 cannot be used for memory. This will limit the total amount of memory that will be able to be installed.

Local SAS or SATA disk drives

The HS22 type 7870 has support for up to two hot-swap SFF SAS or SATA hard disk drives. These two hot-swap hard disk drives are accessible from the front of the blade server without removing the blade server from the BladeCenter chassis. See Table 20 for a list of supported SAS and SATA HDDs.

Table 20 Supported SAS and SATA HDDs

Part Number	Feature Code	Description
SAS hard disk drives		
43W7535	1048	IBM 73 GB 10 K SAS 2.5" SFF Slim-HS HDD
43W7536	1049	IBM 146 GB 10 K SAS 2.5" SFF Slim-HS HDD
43W7545	1050	IBM 73 GB 15 K SAS 2.5" SFF Slim-HS HDD
42D0632 ^a	5537	IBM 146 GB 10 K 6 Gbps SAS 2.5" SFF Slim-HS HDD
42D0637 ^a	5599	IBM 300 GB 10 K 6 Gbps SAS 2.5" SFF Slim-HS HDD
42D0672 ^a	5522	IBM 73 GB 15 K 6 Gbps SAS 2.5" SFF Slim-HS HDD
42D0677 ^a	5536	IBM 146 GB 15 K 6 Gbps SAS 2.5" SFF Slim-HS HDD
42D0707 ^a	5409	IBM 500 GB 7200 6 Gbps NL SAS 2.5" SFF Slim-HS HDD
49Y2003	5433	IBM 600 GB 10 K 6 Gbps SAS 2.5" SFF Slim-HS HDD
81Y9690 ^a	A1P3	IBM 1TB 7.2K 6Gbps NL SAS 2.5" SFF HS HDD
SATA hard disk drives		
43W7670	5595	300 GB 10 K SATA 2.5" Slim-HS HDD
42D0747	5405	IBM 160 GB 7200 NL SATA 2.5" SFF Slim-HS HDD
81Y9722 ^a	A1NX	IBM 250GB 7.2K 6Gbps NL SATA 2.5" SFF HS HDD
42D0752	5407	IBM 500 GB 7200 NL SATA 2.5" SFF Slim-HS HDD
81Y9726 ^a	A1NZ	IBM 500GB 7.2K 6Gbps NL SATA 2.5" SFF HS HDD
81Y9730 ^a	A1AV	IBM 1TB 7.2K 6Gbps NL SATA 2.5" SFF HS HDD

a. Will only operate up to 3 Gbps when installed in the HS22

Solid state drives

Solid state drives (SSD) are a relatively new technology in the server world. SSDs are more reliable than spinning hard disk drives and they consume much less power than a standard SAS drive. Target applications for SSDs include video surveillance, transaction-based DB and other applications that have high performance but moderate space requirements.

Table 21 on page 28 lists the supported SSDs.

Table 21 Supported Solid State Drives (SSDs)

Part number	Feature code	Description
43W7648 ^a	1051	IBM 31.4 GB SATA 2.5" SFF Slim-HS SSD
41Y8264 ^a	5403	IBM 31.4 GB SATA 2.5" SFF Slim-HS SSD V2
43W7714	3745	IBM 50 SATA 2.5" SFF Slim-HS High IOPS SSD

a. IBM has withdrawn this option from marketing

The performance specifications for the 50 GB SATA High IOPS SSD drive are as follows:

- ▶ Formatted capacity: 50,000 MB
- ▶ Drive to host interface that supports SATA-1.0a, 1.5 Gbps burst rate
- ▶ SATA interface
- ▶ Combination 67% read/33% write transaction processing rate: Up to 2600 IOPS

IBM High IOPS SSD adapters

The HS22 type 7870 can support the installation of one or two IBM High IOPS SSD adapters in a PCI Express expansion unit attached to the blade server. The combination of the HS22 and the expansion unit will take up two blade slots in a BladeCenter chassis. This allows for self-contained high-performance servers and computing appliances in a BladeCenter environment. These adapters deliver throughput of up to 100,000 I/O operations per second (IOPS), while providing the added benefits of lower power, cooling, and management overhead, and a smaller storage footprint.

One or two IBM High IOPS SSD adapters can be installed in the PCI Express I/O expansion unit. Table 22 lists the IBM High IOPS SSD adapters and the supported PCI Express expansion units.

Table 22 IBM High IOPS SSD PCIe Adapters and the supported PCI Express expansion units

Part number	Feature code	Description	PCI Express I/O Expansion Unit 43W4391	PCI Express Gen 2 Expansion Blade 46M6730
46M0877	0096	IBM 160GB High IOPS SS Class SSD PCIe Adapter	Y	N
46M0898	1649	IBM 320GB High IOPS MS Class SSD PCIe Adapter	Y	N
81Y4519	5985	640GB High IOPS MLC Duo Adapter	Y	N

The IBM High IOPS SSD PCIe Adapters have the following specifications:

- ▶ 160 GB or 320 GB storage capacity
- ▶ Functions as a PCIe storage and controller device
- ▶ PCI Express low-profile MD2 form factor
- ▶ PCI Express 1.1 x4 host interface
- ▶ Power dissipation: 6 W (nominal), 9 W (maximum)

For more information about the IBM High IOPS SSD PCIe Adapters see the *IBM High IOPS SSD PCIe Adapters at-a-glance guide*:

<http://www.redbooks.ibm.com/abstracts/tips0729.html>

BladeCenter Storage and I/O Expansion Unit (SIO)

The HS22 type 7870 does not currently support the attachment of the Storage and I/O Expansion Unit.

Integrated virtualization

The HS22 offers an IBM standard USB Flash Drive option preloaded with VMware ESXi. This is an embedded version of VMware ESXi. It is fully contained on the flash drive, without requiring any disk space. The IBM USB Memory Key for VMware Hypervisor plugs into the USB port at the rear of the HS22 motherboard as shown in Figure 9. The CIOv expansion card is installed over the top of the USB memory key.

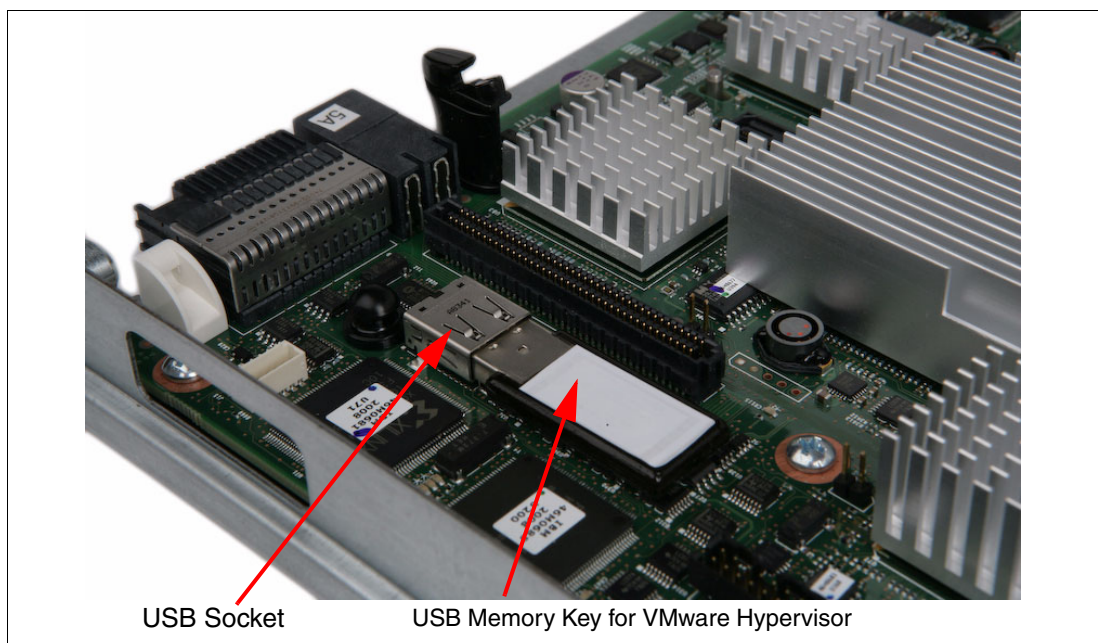


Figure 9 Rear view of HS22 motherboard showing position of USB port with embedded hypervisor memory key installed

Table 23 lists the part number, feature code, and description of the IBM USB Memory Key for VMware Hypervisor.

Table 23 IBM USB Memory Key for VMware Hypervisor

Part Number	Feature Code	Description
41Y8269 ^a	1774	IBM USB Memory Key for VMware Hypervisor (ESXi 3.5 U4)
41Y8283	1749	IBM USB Memory Key for VMware Hypervisor (ESXi 3.5 U5)
41Y8278	1776	IBM USB Memory Key for VMware Hypervisor (ESXi 4.0)
41Y8287	3033	IBM USB Memory Key for VMware Hypervisor (ESXi 4.1)

a. Does not provide support for the HS22 using the Xeon 5600 series processor

For a complete description of the features and capabilities of VMware ESX Server see:

<http://www.vmware.com/products/vi/esx/>

I/O expansion

The HS22 type 7870 is able to connect to a wide variety of networks and fabrics by installing the appropriate I/O expansion card. Supported networks and fabrics include 1 Gb and 10 Gb Ethernet, 4 Gb and 8 Gb Fibre Channel, Serial Attached SCSI (SAS), and InfiniBand. An HS22 blade server with an I/O expansion card installed must be installed in a BladeCenter chassis with switch modules (or pass-thru) that are compatible with the I/O expansion card.

The HS22 type 7870 blade server supports two formats of I/O expansion cards: the new CIOv format and the CFFh format, as discussed in the following sections.

CIOv

The CIOv I/O expansion connector provides I/O connections to modules located in bays 3 and 4 of a supported BladeCenter chassis. The CIOv slot is a second-generation PCI Express 2.0 x8 slot. A maximum of one CIOv I/O expansion card is supported per single-wide blade server. A CIOv I/O expansion card can be installed on a blade server at the same time as a CFFh I/O expansion card is installed. Table 24 lists the CIOv expansion cards that are supported in the HS22 type 7870.

Table 24 Supported CIOv Expansion Cards for the HS22 server

Part number	Feature code	Description
44W4475	1039	Ethernet Expansion Card (CIOv)
46M6065	3594	QLogic 4 Gb Fibre Channel Expansion Card (CIOv)
43W4068	1041	SAS Connectivity Card (CIOv)
46C7167	0070 / 0071 ^a	ServeRAID-MR10ie (CIOv) Controller
46M6140	3598	Emulex 8 Gb Fibre Channel Expansion Card (CIOv)
44X1945	1462	QLogic 8 Gb Fibre Channel Expansion Card (CIOv)

a. Feature code 0070 is for the ServeRAID-MR10ie *with* the external battery. Feature code 0071 is for the ServeRAID-MR10ie *without* the external battery.

See IBM ServerProven® for the latest information on the expansion cards supported by the HS22:

<http://ibm.com/servers/eserver/serverproven/compat/us/>

CIOv expansion cards are installed in the CIOv slot in the HS22 (Figure 10).

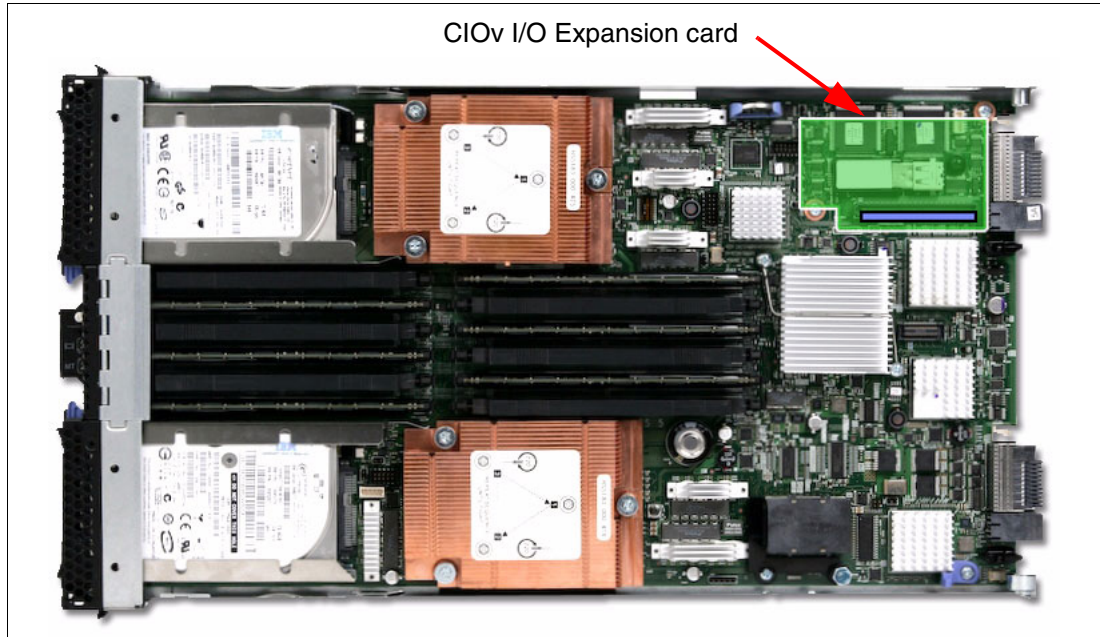


Figure 10 The HS22 type 7870 showing the CIOv I/O Expansion card position

The CIOv Expansion Cards require that a supported I/O module is installed in bay 3 and bay 4 of the chassis where the cards and servers are installed.

CFFh

The CFFh I/O expansion connector provides I/O connections to high speed switch modules located in bays 7, 8, 9, and 10 of a BladeCenter H or BladeCenter HT chassis or to switch bay 2 in a BladeCenter S chassis. The CFFh slot is a second-generation PCI Express x16 (PCIe 2.0 x16) slot. A maximum of one CFFh I/O expansion card is supported per blade server. A CFFh I/O expansion card can be installed on a blade server at the same time as a CIOv I/O expansion card is installed. Table 25 lists the CFFh expansion cards that are supported in the HS22 type 7870.

Table 25 Supported CFFh Expansion Cards for the HS22 type 7870 server

Part number	Feature code	Description
43W4420	1036	Voltaire 4X InfiniBand DDR Expansion Card (CFFh)
43W4423	1038	4X InfiniBand DDR Expansion Card (CFFh)
44W4466	5489	Broadcom 10 Gb 2-port Ethernet Exp Card (CFFh)
44W4465	1076	Broadcom 10 Gb 4-port Ethernet Exp Card (CFFh)
46M6168	0099	Broadcom 10 Gb Gen 2 2-port Ethernet Expansion Card (CFFh)
46M6164	0098	Broadcom 10 Gb Gen 2 4-port Ethernet Expansion Card (CFFh)
44W4479	1077	2/4 Port Ethernet Expansion Card (CFFh)
44X1940	1078	QLogic Ethernet and 8 Gb Fibre Channel Exp Card (CFFh)
42C1830	3592	QLogic 2-port 10 Gb Converged Network Adapter (CFFh)

Part number	Feature code	Description
46M6001	0056	2-Port 40 Gb InfiniBand Expansion Card (CFFh)
49Y4235	5755	Emulex Virtual Fabric Adapter (CFFh) for IBM BladeCenter
49Y4275	2435	Emulex Virtual Fabric Adapter Advanced (CFFh)
42C1810	3593	Intel 10 Gb 2-port Ethernet Expansion Card (CFFh)
81Y1650	5437	Brocade 2-Port 10Gb Converged Network Adapter (CFFh)
90Y3570	A1NW	Mellanox 2-port 10 Gb Ethernet Expansion Card (CFFh)

See IBM ServerProven for the latest information on the expansion cards supported by the HS22:

<http://ibm.com/servers/eserver/serverproven/compat/us/>

CFFh expansion cards are installed in the CFFh slot in supported servers, such as the HS22 (Figure 11).

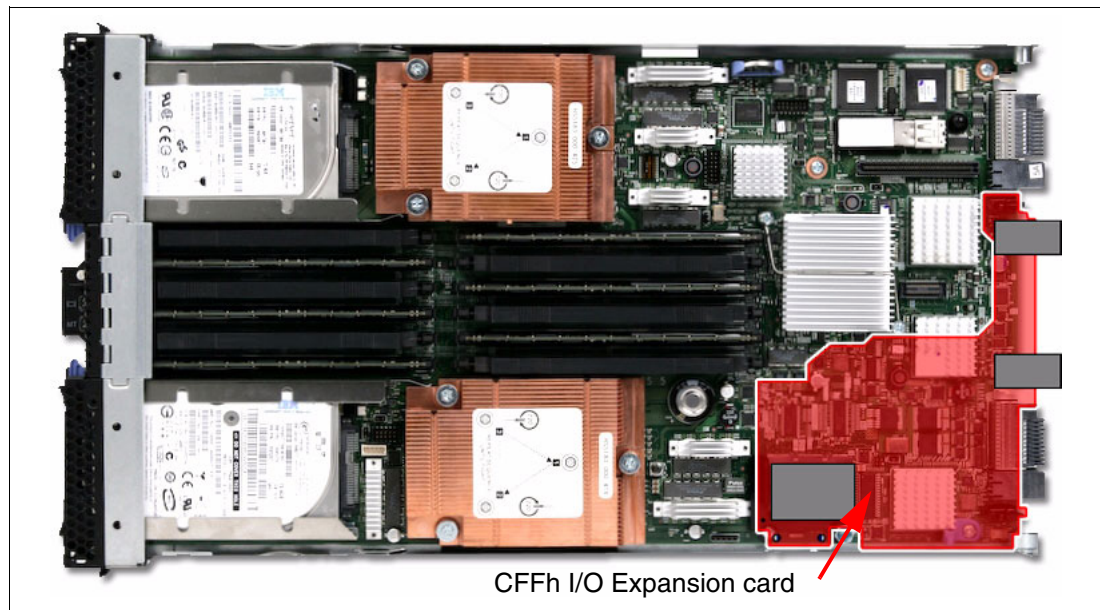


Figure 11 The HS22 type 7870 showing the CFFh I/O Expansion card position

The CFFh I/O Expansion Card requires that a supported high speed I/O module is installed in bay 7, bay 8, bay 9, and/or bay 10 of the BladeCenter H or BladeCenter HT chassis. Examples of the types of modules supported in the high speed I/O module bays are the InfiniBand Pass-Thru Module and the BNT 10G Ethernet Switch Module.

A Multi-switch Interconnect Module can be used in the high speed switch module bays of the BladeCenter H (MSIM) or BladeCenter HT (MSIM-HT) to allow connectivity to standard switch modules.

In a BladeCenter S chassis, the CFFh I/O Expansion Card requires a supported switch module in bay 2. When used in a BladeCenter S chassis, a maximum of two ports are routed from the CFFh I/O Expansion Card to the switch module in bay 2.

Refer to *IBM BladeCenter Interoperability Guide* for the latest information about the switch modules that are supported with each CFFh I/O expansion card:

<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073016>

PCI Express I/O Expansion Unit (PEU3e)

The HS22 supports the attachment of one PCI Express I/O Expansion Unit. The PEU3e allows standard PCI-Express type adapters to be attached to the HS22.

PCI Express Gen 2 Expansion Blade (BPE4)

The HS22 supports the attachment of up to four PCI Express Gen 2 Expansion Blades. The BPE4 allows certain standard PCI-Express adapters to be attached to the HS22. If there is a CFFh I/O Expansion Card already installed on the HS22, it must be removed to allow for the attachment of the PCI Express Gen 2 Expansion Blade. The CFFh I/O Expansion Card can then be installed in the top most PCI Express Gen 2 Expansion Blade. No other type of expansion blade can be mixed with the PCI Express Gen 2 Expansion Blade.

For more information about the BPE4 see *IBM BladeCenter PCI Express Gen 2 Expansion Blade*, TIPS0783, available from:

<http://www.redbooks.ibm.com/abstracts/tips0783.html>

IBM BladeCenter GPU Expansion Blade (BGE)

The HS22 supports the attachment of up to three IBM BladeCenter GPU Expansion Blades. The BGE ships integrated with one NVIDIA Tesla M2070 or Tesla M2070Q GPU adapter that can be attached to the HS22. If there is a CFFh I/O Expansion Card already installed on the HS22, it must be removed to allow for the attachment of the IBM BladeCenter GPU Expansion Blade. The CFFh I/O Expansion Card can then be installed in the top most IBM BladeCenter GPU Expansion Blade. No other type of expansion blade can be mixed with the IBM BladeCenter GPU Expansion Blade.

For more information about the BGE4 see *IBM BladeCenter GPU Expansion Blade*, TIPS0798, available from:

<http://www.redbooks.ibm.com/abstracts/tips0798.html>

Related publications

For more information, see the following publications

- ▶ *IBM BladeCenter Products and Technology*, SG24-7523
<http://www.redbooks.ibm.com/abstracts/sg247523.html>
- ▶ *IBM BladeCenter HS22 Installation and User's Guide*
<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5079689>
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- ▶ *IBM BladeCenter Interoperability Guide*
<http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5073016>

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