IBM

Redpaper

Randall Davis
David Watts

IBM BladeCenter HS22V Technical Introduction

The IBM® BladeCenter® HS22V is a two-socket blade server running the latest Intel® Xeon processors with the memory capacity of up to 288 GB with 18 DIMM sockets. It is ideal for virtualization and enterprise business applications.

This IBM Redpaper™ publication is a comprehensive technical introduction to the IBM BladeCenter HS22V.

This paper covers the following topics:

ibm.com/redbooks   **1**

Introduction

The IBM BladeCenter HS22V is a high-density blade that offers outstanding performance for virtualization with new levels of memory capacity and CPU performance. The IBM BladeCenter HS22V has been designed for outstanding performance in virtualized environments. The HS22V is compatible with the IBM BladeCenter H, E, S, and HT chassis.

The HS22V supports up to two Intel Xeon® Processor 5500 or 5600 series multi-core processors, 18 DIMMs modules, two 1.8-inch solid state drives, two PCI Express connectors, and one internal USB connector. Figure 1 shows the HS22V.
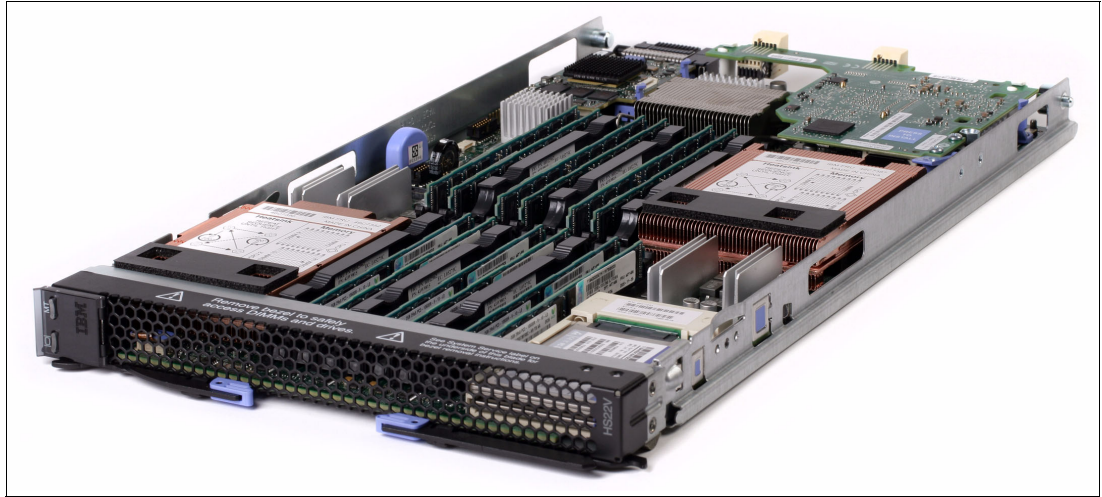

Figure 1   The HS22V type 7871

Table 1 lists the features of the HS22V.

The key benefit of the HS22V over the HS22 is the larger number of available DIMM sockets, 18 versus 12. This means that you can either install more memory using the same DIMMs or you can use more smaller (and perhaps lower-cost) DIMMs to achieve the same amount of installed memory.

Table 1   Features of the HS22V type 7871

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	18 DIMM slots
Memory Maximums	Models with Intel Xeon 5600 series processors: 288 GB using 16GB DIMMs Models with Intel Xeon 5500 series processors: 144 GB using 8GB DIMMs

Feature	
Memory types	DDR 3 ECC Very Low Profile (VLP) Registered DIMM DDR 3 ECC Very Low Profile Low Power Registered DIMM
Hot swap disk drives	None
Non hot swap SSD (std/max)	0 / 2
Maximum internal storage	Optional: up to two 1.8-inch 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 HS22V.
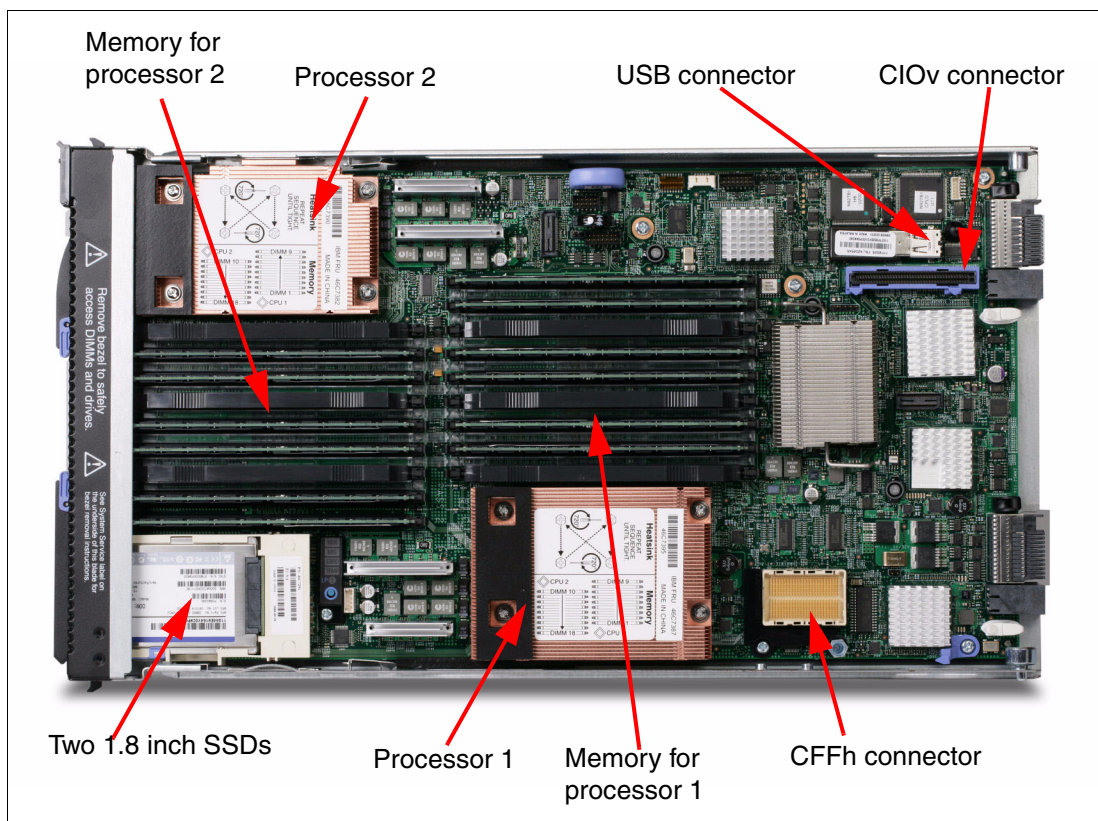

Figure 2   Layout of the HS22V system board

Model information

Table 2 lists the available models of the HS22V.

Table 2   Models of the HS22V type 7871

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							
7871-N2x[c]	Intel Xeon L5640	2.26 GHz	1 / 2	6	12 MB	1066 MHz	3x 2 GB / 288 GB
7871-B6x	Intel Xeon E5649	2.53 GHz	1 / 2	6	12 MB	1333 MHz	3x 4GB / 288 GB
7871-HAx[d]	Intel Xeon X5650	2.66 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 288 GB
7871-H2x	Intel Xeon X5650	2.66 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 288 GB
7871-H4x	Intel Xeon X5670	2.93 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 288 GB
7871-C6x	Intel Xeon X5675	3.06 GHz	1 / 2	6	12 MB	1333 MHz	3x 4GB / 288 GB
7871-F2x	Intel Xeon X5680	3.33 GHz	1 / 2	6	12 MB	1333 MHz	3x 2 GB / 288 GB
7871-C8x	Intel Xeon X5690	3.46 GHz	1 / 2	6	12 MB	1333 MHz	3x 4GB / 288 GB
Intel Xeon 5600 series Quad Core processors							
7871-A5x	Intel Xeon E5603	1.60 GHz	1 / 2	4	4 MB	1066 MHz	1x 4GB / 288 GB
7871-A7x	Intel Xeon E5607	2.26 GHz	1 / 2	4	8 MB	1066 MHz	1x 4GB / 288 GB
7871-G2x	Intel Xeon E5620	2.40 GHz	1 / 2	4	12 MB	1066 MHz	3x 2 GB / 288 GB
7871-G4x	Intel Xeon E5640	2.66 GHz	1 / 2	4	12 MB	1066 MHz	3x 2 GB / 288 GB
7871-GDx[e]	Intel Xeon E5640	2.66 GHz	1 / 2	4	12 MB	1066 MHz	3x 2 GB / 288 GB
7871-B5x	Intel Xeon X5647	2.93 GHz	1 / 2	4	12 MB	1066 MHz	3x 4GB / 288 GB
7871-H5x	Intel Xeon X5667	3.06 GHz	1 / 2	4	12 MB	1333 MHz	3x 2 GB / 288 GB
7871-C5x	Intel Xeon X5672	3.20 GHz	1 / 2	4	12 MB	1333 MHz	3x 4GB / 288 GB
7871-F3x	Intel Xeon X5677	3.46 GHz	1 / 2	4	12 MB	1333 MHz	3x 2 GB / 288 GB
7871-C7x	Intel Xeon X5687	3.60 GHz	1 / 2	4	12 MB	1333 MHz	3x 4 GB / 288 GB
Intel Xeon 5500 series Quad Core processors							
7871-A4x	Intel Xeon E5507	2.26 GHz	1 / 2	4	4 MB	800 MHz	3x 1 GB / 288 GB
7871-B4x	Intel Xeon E5540	2.53 GHz	1 / 2	4	8 MB	1066 MHz	3x 2 GB / 288 GB
7871-C4x	Intel Xeon X5570	2.93 GHz	1 / 2	4	8 MB	1333 MHz	3x 2 GB / 288 GB
Intel Xeon 5500 series Dual Core processors							
7871-D3x	Intel Xeon E5503	2.00 GHz	1 / 2	2	4 MB	800 MHz	3x 1 GB / 288 GB

a. Model numbers provided are worldwide generally available variant (GAV) model numbers that are not orderable as listed and must be modified by country. The U.S. GAV model numbers use the following nomenclature: xxU. For example, the U.S. orderable part number for 7871-A2x is 7871-A2U. See the product-specific Official IBM announcement letter for other country-specific GAV model numbers.
b. Maximum system memory capacity of 288 GB is based on using 18 x 16 GB memory DIMMs.

c. Designated as a low-power (60 W) processor model.

d. Model 7871-HAx includes an Emulex Virtual Fabric Adapter (CFFh) I/O Expansion card.

e. Model 7871-GDx includes an Intel 10Gb 2-port Ethernet Expansion Card (CFFh) I/O Expansion card.

Chassis support

The HS22V type 7871 is supported in the BladeCenter chassis (Table 3).

Table 3 HS22V 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
HS22V	130W	Yes[b]	No	No	No	Yes[d]	No	Yes[e]
HS22V	Up to 95W	Yes[b]	Yes[c]	No	No	Yes[d]	Yes[e]	Yes[e]

a. Thermal Design Power of the processor in the server. See Table 7 on page 10 to determine to which HS22V 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 HS22V 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 HS22V 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 HS22V 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 HS22V is not supported in BladeCenter E chassis with power supplies that have a capacity less than 2000 W.

► The HS22V with 130 W processors is not supported on the BladeCenter E at all.

► The HS22V always requires an advanced management module to be installed in the BladeCenter E.

There are restrictions regarding the number of HS22V blades that can be installed and in which bays when using a BladeCenter E chassis with 2000 W power supplies, as listed in Table 4. In 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 blade server *except* an HS22 or HS22V.

► An E in a square means that the bay must remain empty.

Table 4   Placement of HS22V and other blades in a BladeCenter E with 2000 W power supplies

Power rating of HS22V 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	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	blue	0
95 W	11	11	green	green	green	green	green	E	green	green	green	green	green	green	E	E	3
95 W	6	12	blue	blue	blue	blue	blue	blue	green	green	green	green	green	green	E	E	2
95 W	5	13	green	green	green	green	green	E	blue	blue	blue	blue	blue	blue	blue	blue	1
80 W	12	12	green	green	green	green	green	E	green	green	green	green	green	green	green	E	2
80 W	7	13	blue	blue	blue	blue	blue	blue	green	green	green	green	green	green	green	E	1
60 W	13	13	green	green	green	green	green	green	green	green	green	green	green	green	green	E	1
60 W	6	14	green	green	green	green	green	green	blue	blue	blue	blue	blue	blue	blue	blue	0
40 W	14	14	green	green	green	green	green	green	green	green	green	green	green	green	green	green	0

a. See Table 7 on page 10 to determine to which HS22V server models these apply.

For example, consider the second row of Table 4. If you want to install HS22V 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).

HS22V servers with 130 W processors are not supported at all in the BladeCenter E with 2000 W power supplies. This is shows 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 HS22V blades that are supported in the BladeCenter E with 2320 W power supplies installed. As you can see, the BladeCenter E with 95 W 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, *except* for the HX5.

► A blue square ( ) in a bay means that it can hold any blade server *except* an HS22 or HS22V or HX5.

► An E in a square means that the bay must remain empty.

Table 5   Placement of HS22V and other blades in a BladeCenter E with 2320 W power supplies

Power rating of HS22V 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 7 on page 10 to determine to which HS22V 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 HS22V servers.

With HS22V 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 lists the number of HS22V servers that are supported in models of the BladeCenter H chassis. In Table 6:

► A green square (▢) in a cell means that the chassis can be filled with HS22V 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 HS22V 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   HS22V support in the BladeCenter H

Power rating of HS22V CPU[a]	Maximum number of servers supported in each chassis				
	BC-H (models other than 8852-4Tx)				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 7 on page 10 to determine to which HS22V 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 HS22V 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 HS22V servers with 130 W processors, up to ten servers can be installed in the BladeCenter HT. The two remaining bays must remain empty, one in each power domain.

For NEBS support, HS22V 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 9 on page 12 to determine which HS22V server models these apply to:

► Intel Xeon E5620 (80W/4c)
► Intel Xeon E5645 (80W/6c)
► Intel Xeon L5638 (60W/6c)
► Intel Xeon L5618 (40W/4c)

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

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

Processor

The HS22V type 7871 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 5500 or 5600 series processors in the HS22V 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.

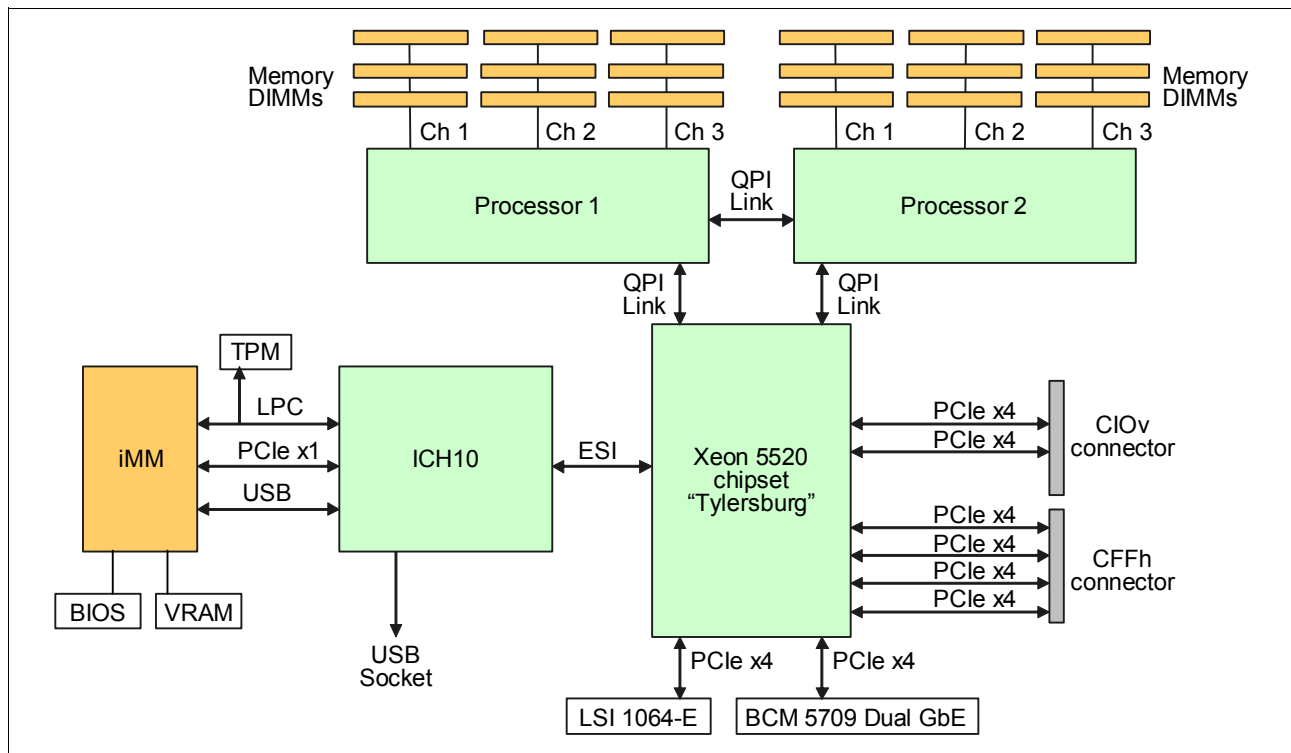Figure 3 shows the major components of the HS22V system.

Figure 3   HS22V processor board block diagram

The blade server HS22V type 7871 supports either:

► Up to two Intel Xeon Processor 5600 Series (Westmere-EP) 6-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 on this page and Table 8 on page 11 define the features of the processor models available for the HS22V.

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 GHz	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
Standard									
Xeon E5649	2.53 GHz	Yes	Yes	12 MB	6	80 W	5.86 GT/s	1333 MHz	No
Xeon X5647	2.93 GHz	Yes	Yes	12 MB	4	130 W	5.8 GT/s	1066 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
Basic									
Xeon E5607	2.26 GHz			8 MB	4	80 W		1066 MHz	No
Xeon E5603	1.60 GHz			4 MB	4	80 W		1066 MHz	No
Low Power									
Xeon L5640	2.26 GHz	Yes	Yes	12 MB	6	60 W	5.86 GT/s	1066 MHz	No
Xeon L5630	2.13 GHz	Yes	Yes	12 MB	4	40 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 13, 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
Standard									
Xeon E5540	2.53 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 E5503	2.00 GHz	No	No	4 MB	2	80 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 13, for details.

The Xeon 5500 and 5600 series of processors have a number of features:

► 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

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, refer to 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, refer to the following URL:

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

The Xeon 5600 series of processors have additional features:

► 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 cost-effectively deployed.

► Processor P-States

The P-state mechanism involves running the processor clock at a lower frequency. This results in less power consumption, as power consumption is linearly related to clock speed. It has the additional advantage that a processor running at a lower frequency can operate at a lower voltage. The combination of the two provides a linear reduction in power consumption, with a good power-to-performance trade-off. The server hardware and the OS can utilize the Processor P-States functionality to effectively control power capping and power savings.

Table 9 lists the processor options for the HS22V.

Table 9   Processors for the HS22V type 7871

Description	Part number	Feature code	Supported model
Xeon 5600 series			
Intel Xeon X5690 6C 3.46GHz 12MB 1333MHz 130w	81Y6046	A163	C8x
Intel Xeon X5687 4C 3.60GHz 12MB 1333MHz 130w	81Y6045	A164	C7x
Intel Xeon X5680 6C 3.33 GHz 12 MB Cache 1333 MHz	69Y4748	7672	F2x
Intel Xeon X5677 4C 3.46 GHz 12 MB Cache 1333 MHz	69Y4747	7671	F3x
Intel Xeon X5675 6C 3.06GHz 12MB 1333MHz 95w	81Y6044	A165	C6x
Intel Xeon X5672 4C 3.20GHz 12MB 1333MHz 95w	81Y6043	A166	C5x
Intel Xeon X5670 6C 2.93 GHz 12 MB Cache 1333 MHz	69Y0922	7720	H4x
Intel Xeon X5667 4C 3.06 GHz 12 MB Cache 1333 MHz	69Y0921	7719	H5x

Description	Part number	Feature code	Supported model
Intel Xeon X5660 6C 2.80 GHz 12 MB Cache 1333 MHz	69Y0923	7721	CTO
Intel Xeon X5650 6C 2.66 GHz 12 MB Cache 1333 MHz	69Y0924	7722	H2x, HAx
Intel Xeon E5649 6C 2.53GHz 12MB 1333MHz 80w	81Y6042	A167	B6x
Intel Xeon X5647 4C 2.93GHz 12MB 1066MHz 130w	81Y6041	A168	B5x
Intel Xeon E5645 6C 2.40 GHz 12 MB Cache 1333 MHz	69Y4744	7668	CTO
Intel Xeon E5640 4C 2.66 GHz 12 MB Cache 1066 MHz	69Y0925	7723	G4x, GDx
Intel Xeon L5640 6C 2.26 GHz 12 MB Cache 1333 MHz	69Y0928	7726	N2x
Intel Xeon L5638 6C 2.0 GHz 12 MB Cache 1333 MHz	69Y4745	7669	CTO
Intel Xeon E5630 4C 2.53 GHz 12 MB Cache 1066 MHz	69Y0926	7724	CTO
Intel Xeon L5630 4C 2.13 GHz 12 MB Cache 1066 MHz	69Y0929	7727	CTO
Intel Xeon E5620 4C 2.40 GHz 12 MB Cache 1066 MHz	69Y0927	7725	G2x
Intel Xeon L5609 4C 1.86 GHz 12 MB Cache 1066 MHz	69Y4746	7670	CTO
Intel Xeon E5607 4C 2.26GHz 8MB 1066MHz 80w	81Y6040	A169	A7x
Intel Xeon E5606 4C 2.13GHz 8MB 1066MHz 80w	81Y6039	A16A	CTO
Intel Xeon E5603 4C 1.60GHz 4MB 1066MHz 80w	81Y6038	A16B	A5x
Xeon 5500 series			
Intel Xeon X5570 QC 2.93 GHz 8 MB Cache 1333 MHz	49Y5172	4549	C4x
Intel Xeon E5540 QC 2.53 GHz 8 MB Cache 1066 MHz	49Y5163	4543	B4x
Intel Xeon E5507 4C 2.26 GHz 4 MB Cache 800 MHz	69Y0931	7729	A4x
Intel Xeon E5506 QC 2.13 GHz 4 MB Cache 800 MHz	49Y5151	4629	CTO
Intel Xeon E5503 2C 2.00 GHz 4 MB Cache 800 MHz	69Y0932	7730	D3x

For more information about the Intel Xeon 5000 series processors, see the following URL:

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

Memory

The HS22V has nine DIMM sockets per processor for 18 DIMM sockets in total. The HS22V with the Xeon 5600 series processor can support up to 288 GB of memory in total when using 16 GB DIMMs and with both processors installed. The HS22V with the Xeon 5500 series processor can support up to 144 GB of memory in total when using 8 GB DIMMs and with both processors installed. The HS22V uses Double Data Rate-3 (DDR-3) VLP registered DIMMs.

Unlike previous generations of Intel Xeon processors, the Xeon 5500 and 5600 series processors have an integrated memory controller. The HS22V has 18 memory DIMM sockets in total (Figure 4). The memory DIMMs connect directly to one of the processors. With one processor installed only nine DIMMs can be accessed. To access memory in the other nine DIMM connectors, the second processor must be installed.
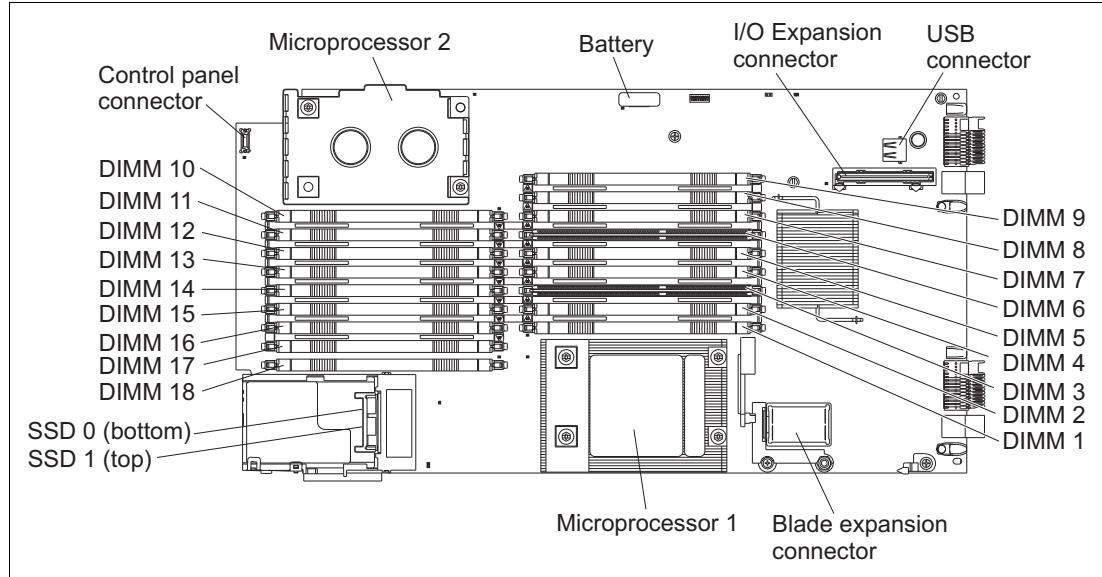

Figure 4   DIMM layout on the HS22V system board

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

Table 10   HS22V memory channel configuration

Processor	Memory channel	DIMM connector
1	Channel 0	DIMM connector 1, 2, and 3
	Channel 1	DIMM connector 7, 8, and 9
	Channel 2	DIMM connector 4, 5, and 6
2	Channel 3	DIMM connector 10, 11, and 12
	Channel 4	DIMM connector 16, 17, and 18
	Channel 5	DIMM connector 13, 14, and 15

Topics in this section:

► "Memory DIMM installation recommendations" on page 14
► "Memory modes" on page 16
► "Memory for HS22V servers with Xeon 5500 series processors" on page 18
► "Memory for HS22V servers with Xeon 5600 series processors" on page 20
► "Memory performance" on page 24

Memory DIMM installation recommendations

The HS22V 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:

► Three, six, or nine memory DIMMs in a single processor HS22V blade server
► Six, 12, or 18 memory DIMMs in a dual-processor HS22V 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 on page 16 if you have two processors installed

Table 11   Suggested DIMM installation for the HS22V 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	DIMM 13	DIMM 14	DIMM 15	DIMM 16	DIMM 17	DIMM 18
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									
1	7	x	x	x		x	x		x	x									
1	8	x	x	x	x	x	x		x	x									
1	9	x	x	x	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	DIMM 13	DIMM 14	DIMM 15	DIMM 16	DIMM 17	DIMM 18
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
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
2	13	x	x	x		x	x		x	x		x	x		x	x		x	x
2	14	x	x	x		x	x		x	x	x	x	x		x	x		x	x
2	15	x	x	x	x	x	x		x	x	x	x	x		x	x		x	x
2	16	x	x	x	x	x	x		x	x	x	x	x	x	x	x		x	x
2	17	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
2	18	x	x	x	x	x	x	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@1333 MHz.

Memory modes

The HS22V type 7871 supports two different memory modes:

► Independent channel (normal) mode
► Memory mirroring mode

These modes can be selected in the UEFI BIOS setup.

Independent channel mode
Independent channel mode gives a maximum of 144 GB of usable memory with one CPU installed, and 288 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 HS22V configurations.

> **Note:** If ServeRAID MR10ie is installed, the battery is installed in DIMM slot 10. Therefore, DIMM slot 10 cannot be used for memory. This limits 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 three DIMM slots are the primary channel, three DIMM slots are the backup channel, and three DIMM slots are not used. Due to the double writes to memory, performance is affected. Figure 5 illustrates the HS22V memory mirroring layout.
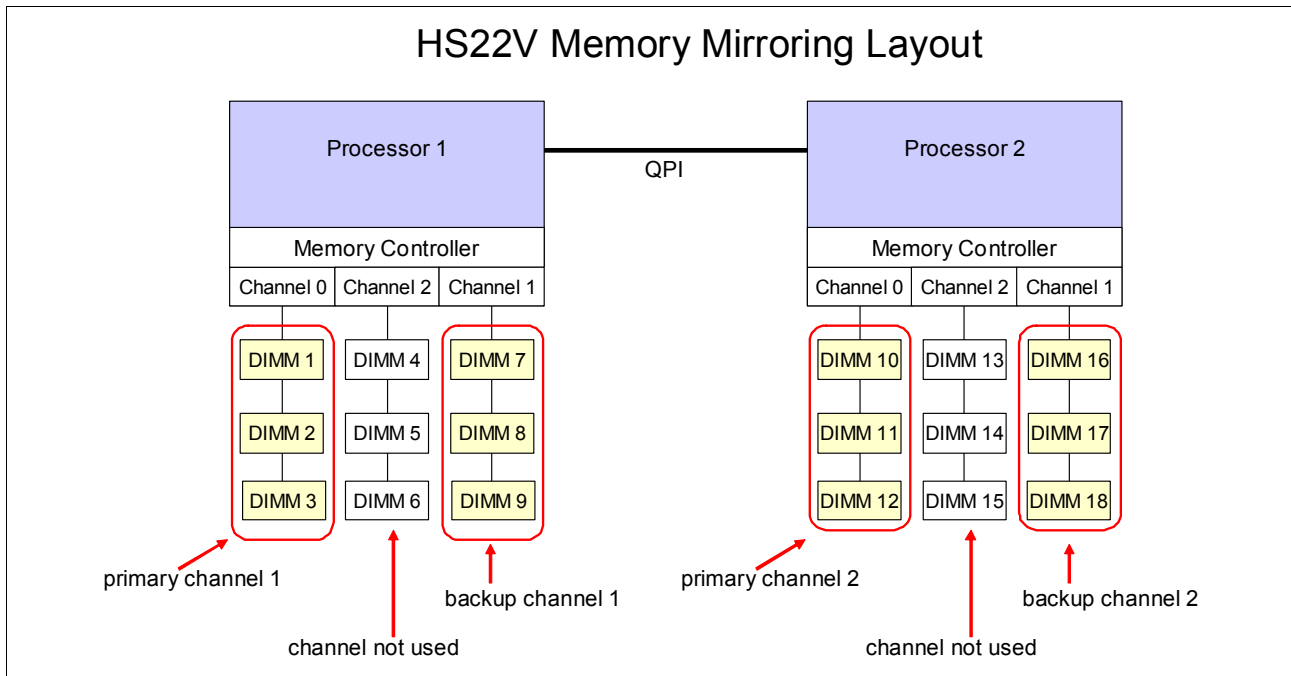
Figure 5 The HS22V type 7871 memory mirroring layout

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 10. Therefore, DIMM slot 10 cannot be used for mirroring. This limits the amount of memory available when using memory mirroring.

The HS22V type 7871 supports different memory features and DIMM options depending on the series of Xeon processor installed:

Memory for HS22V servers with Xeon 5500 series processors

All supported DIMMs installed in the HS22V with the Xeon 5500 series processor will operate at 1.5 volts. The HS22V server 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.

Memory configuration can be critical in the HS22V, and there are several things to consider to achieve optimal memory subsystem performance. The memory controller in the HS22V is integrated into the Intel Xeon processor. In the HS22V, each processor has three memory channels, with three DIMM sockets per channel.

The maximum speed at which the memory channel will run on the HS22V 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 range of Xeon processor models have a maximum memory speed of 1066 MHz or 80 0MHz 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 at up to 1066 MHz. Even if these 1066 MHz DIMMs are used with a processor that supports 1333 MHz, the memory channel speed still does 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 Table 14 on page 20).

► 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. If any or all of the memory channels have a third DIMM installed, then the memory channels run at 800 MHz.

– DIMM modules should be installed in lots of three, which for the HS22V is either three, six, or nine DIMM modules per processor. This makes the best use of the bandwidth available to the processor's three memory channels.

– With three DIMMs per channel (3DPC) installed, the memory speed runs at 800 MHz regardless of what DIMMs are installed.

Refer to Table 8 on page 11 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 HS22V with the Xeon 5500 series processor, then these low-power DIMMs operate at 1.5 volts and thus lose their energy-efficient capability.
>
> ▶ The X (Advanced) range of Xeon 5500 series processors has a maximum memory channel speed of 1333 MHz and can therefore run 1DPC @ 1333 MHz.
>
> ▶ The HS22V with the Xeon 5500 series processor does not support 2DPC @ 1333MHz.
>
> ▶ With three DIMMs per channel (3DPC) installed, the memory speed runs at 800 MHz regardless of what DIMMs are installed.

Refer to Figure 6 for a graphical representation of one, two, and three DIMM modules per processor memory channel. Table 13 lists the supported memory speed for a given Xeon 5500 series processor type with one, two, or three DIMM modules per channel installed.
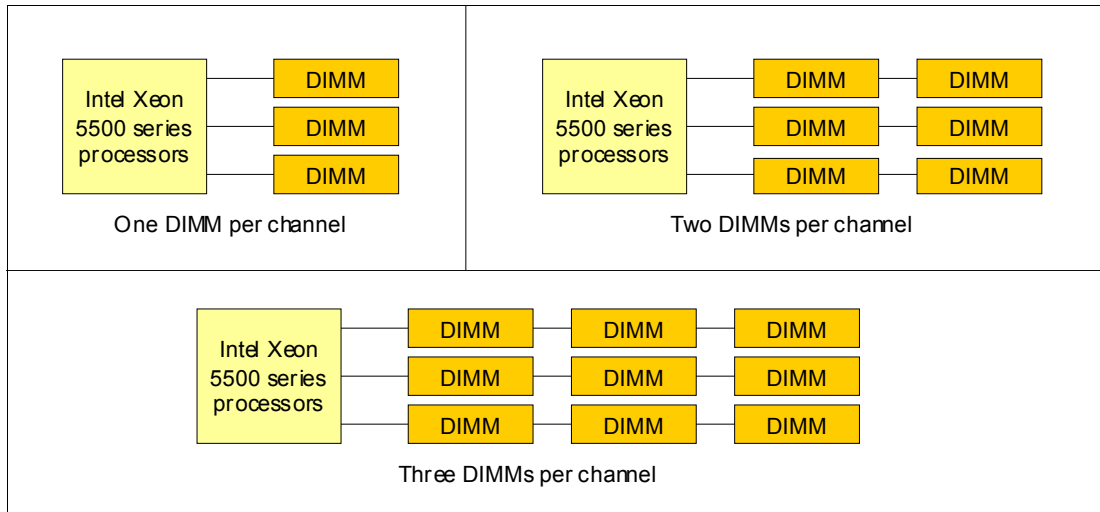
Figure 6   Intel Xeon 5500 series processor with one, two, and three DIMMs per channel

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

Processor type[a]	QPI link speed[b]	Max DDR3 speed	One DIMM per channel[c]	Two DIMMs per channel [c]	Three DIMMs per channel[c]
Advanced	6.4 GT/s	1333 MHz	1333 MHz	1066 MHz	800 MHz
Standard	5.86 GT/s	1066 MHz	1066 MHz	1066 MHz	800 MHz
Basic	4.8 GT/s	800 MHz	800 MHz	800 MHz	800 MHz

a. For more information about processor type, see Table 8 on page 11.
b. GT/s = giga transfers per second.
c. Maximum memory speed possible. Actual memory speed also depends on other factors, as described on page 18.

Table 14 lists the memory options for the HS22V using the Xeon 5500 series processors (ordered by DIMM capacity).

Table 14   List of memory modules for the HS22V type 7871 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	Single
46C0560[a]	A0WX	2GB (1x 2 GB, 1Rx8, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Single
46C0561[a]	3890	2 GB (1x 2 GB, 1Rx4, 1.35V) PC3L-10600 CL9 ECC DDR3 1333 MHz	Single
46C0567[a]	3891	4 GB (1x 4 GB, 2Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz	Dual
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	Dual
46C0563[a]	A0WY	4GB (1x 4 GB, 1Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Single
46C0564[a]	A0WZ	4GB (1x 4 GB, 2Rx8, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz VLP	Dual
46C0568[a]	8644	8 GB (1x 8 GB, 2Rx4, 1.35 V) PC3L-10600 CL9 ECC DDR3 1333 MHz	Dual
46C0569[a]	3892	8 GB (1x 8 GB, 2Rx4, 1.35 V) PC3L-8500 CL7 ECC DDR3 1066 MHz	Dual
49Y1431	8932	8 GB (1x 8 GB, 2Rx4, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP RDIMM	Dual
46C7451	1910	8 GB (1x 8 GB, Dual Rankx4) PC3-10600 CL9 ECC DDR3-1333 VLP	Dual

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

Memory for HS22V servers with Xeon 5600 series processors

Standard DIMMs supported in the HS22V operate at 1.5 volts. The HS22V 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 HS22V models with one of the advanced 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 23 shows which DIMMs support two DIMMs per channel at 1333 MHz.

Memory configuration can be critical in the HS22V, and there are several things to consider to achieve optimal memory subsystem performance. The memory controller in the HS22V is

integrated into the Intel Xeon processor. In the HS22V, each processor has three memory channels, with three DIMM sockets per channel.

The maximum speed at which the memory channel runs on the HS22V 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 range 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 still does not exceed 1066 MHz.

– Dual-rank DIMMs offer better interleaving and thus better performance than single-rank DIMMs.

► The number of DIMM modules installed

– The X (Advanced) range of Xeon 5600 series processors have the ability to run two DIMMs per memory channel and still operate the memory bus speed at 1333 MHz.

– With the rest of the Xeon 5600 series range of processors, the more memory DIMMs per channel, the lower the speed at which the memory channels operate.

– With three DIMMs per channel (3DPC) installed, the memory speed runs at 800 MHz no matter what type of processor is installed.

– DIMM modules should be installed in lots of three, which for the HS22V is either three, six, or nine DIMM modules per processor. This makes the best use of the bandwidth available to the processor's three memory channels.

Note: Even though installing three memory DIMMs per channel slows the memory speed down to 800 MHz, the additional amount of memory available to the server might be beneficial to the application that is running on the server.

See Table 7 on page 10 to determine the maximum memory channel speed for a given Xeon 5600 series processor. See Table 16 on page 23 to determine the maximum memory channel speed that each DIMM supports and the number of ranks (note the Rank column in those tables).

Key information: Note the following key information:

► The HS22V with Intel Xeon 5600 series processors supports 1.35 V or 1.5 V DIMMs.

► Low-power 1.35-volt memory DIMMs are a feature supported for the HS22V 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 HS22V 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.

► If more than six of the low-power 1.35-volt DIMMs are installed per processor, then they operate at 1.5 volts and thus lose their energy-efficient capability.

► For models with the Xeon 5600 processor, the 1.35-volt DIMMs operate at 1.5 volt if you enable 2DPC at 1333 MHz.

► Low-power 1.35-volt DIMMs support 1DPC@ 1333 MHz or 2DPC@ 1066 MHz, whereas 1.5-volt DIMMs support 2DPC@ 1333 MHz (provided that the processor also supports these memory speeds).

Figure 7 is a graphical representation of one, two, and three DIMM modules per processor memory channel. Table 15 lists the supported memory speed for a given Xeon 5600 series processor type with one, two, and three DIMM modules per channel installed.
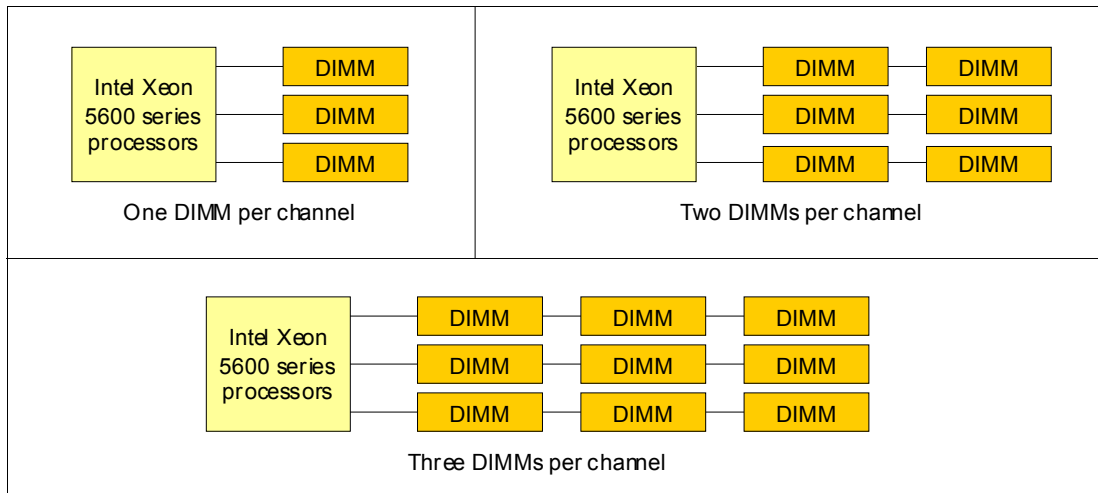
Figure 7   Intel Xeon 5600 series processor with one, two, and three DIMMs per channel

Table 15   Memory speeds when using the Xeon 5600 series processor and certain memory types

Intel Xeon 5600 processor type[a]	DIMM type[b]	Memory channel speed based on how many DIMMs per channel (DPC) installed		
		1 DPC	2 DPC	3 DPC
Advanced (X models)	DIMMs that support 2DPC@1333MHz	1333 MHz	1333 MHz	800 MHz
Advanced (X models)	Low-power DIMMs	1333 MHz	1066 MHz	800 MHz
Standard (E models)	Any supported DIMM	1066 MHz	1066 MHz	800 MHz
Low-power (L models)	Any supported DIMM	1066 MHz	1066 MHz	800 MHz

a. Advanced processors have a model number starting with X. Standard processors have a model number starting with E. Low-power processors have a model number that starts with L. See Table 7 on page 10 for details.
b. See Table 16 on page 23 for supported DIMMs and to determine whether a DIMM supports 2DPC@ 1333 MHz or whether it is a low-power DIMM.

Table 16 lists the memory options for the HS22V using the Xeon 5600 series processors (ordered by DIMM capacity).

Table 16   List of memory modules for the HS22V type 7871 using the Xeon 5600 series processors

Part number	Feature code	Description	2DPC @1333[a]	Rank
Standard DIMMs (1.5v)				
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	2GB (1x 2GB, 1Rx8, 1.5V) PC3-10600 CL9 ECC DDR3 1333 MHz	Yes	Single
44T1596	1908	4 GB (1x 4 GB, 2Rx8, 1.5 V) PC3-10600 CL9 ECC DDR3 1333 MHz	Yes	Dual
49Y1430	8931	4 GB (1x 4 GB, 2Rx4, 1.5V) PC3-10600 CL9 ECC DDR3 1333 MHz VLP	Yes	Dual
49Y1431	8932	8 GB (1x 8 GB, 2Rx4, 1.5V) PC3-10600 CL9 ECC DDR3 1333MHz VLP	Yes	Dual
Low Power DIMMs (1.35v)[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	8GB (1x 8GB, 2Rx4, 1.35V) PC3-10600 CL9 ECC DDR3 1333 MHz	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

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 9 on page 12 to determine the processors in the X range.
b. Low-power 1.35v DIMMs operate at 1.5v if more than six DIMMs are installed per CPU or if they are mixed with other 1.5v DIMMs.
c. Supports running at both 1.35 V and 1.5 V. (1.35 V supports 1333MHz@1DPC or 1066MHz@2DPC, whereas 1.5 V supports 1333MHz@2DPC, dependant on processor speed.)
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 and Table 8 on page 11.

► Choose a Xeon 5600 processor model and memory DIMM combination that supports running 2DPC@ 1333 MHz.

► 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 or 5600 series processors, for optimal performance, install memory in triplets. Therefore, as an example, configure the HS22V with 6 GB, 12 GB, 24 GB, or 48 GB of memory.

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

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

Standard onboard features

The HS22V blade server has the standard onboard features that we discuss in this section.

UEFI

The HS22V use 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 BIOS.

For more information about UEFI see the IBM white-pine *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 adapters

The HS22V 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 HS22V 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 (and the cKVM card is not supported on the HS22V).

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 HS22V 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 HS22V implements TPM Version 1.2 support.

The trusted platform module (TPM) in the HS22V 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 HS22V blade server features an onboard LSI Logic 53C1064E SAS controller that connect to two SAS ports at the front of the HS22V motherboard. The LSI Logic 53C1064E SAS controller provides RAID 0 or RAID 1 capability and supports up to two internal non-hot-swap 1.8-inch solid state drives (SSDs). 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 external disk drives only (Figure 8).

SSD 1 (top)

SSD 0
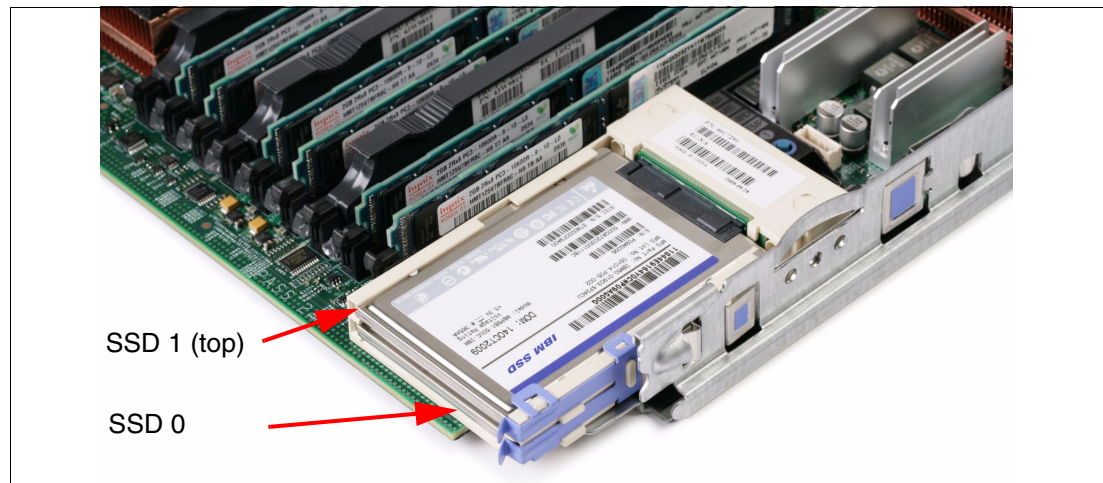
Figure 8   The HS22V with the front bezel removed and showing the 1.8 inch SSDs

ServeRAID-MR10ie

The optional ServeRAID-MR10ie, part number 46C7167, is a SAS RAID controller for the HS22V. It is installed in the CIOv expansion socket. It provides RAID support with battery-backed cache for 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 that is:

► 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
► Supports only external disk drives in the HS22V

- ► Includes battery backup module
- ► Supports RAID levels 0, 1, 10, 5, 50, 6, and 60
- ► Supports SAS disks
- ► Supports OS Boot over SAS

Note: The ServeRAID-MR10ie cannot connect to the SSD drives on the HS22V blade server and is used for attaching to external disk drives.

The ServeRAID-MR10ie option ships with a battery backup unit, in the form of a DIMM (which is installed in DIMM socket 10). 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 the 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 10. Therefore, DIMM slot 10 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 HS22V type 7871 does not have the capacity to have local SAS or SATA disk drives installed.

Solid state drives

The HS22V type 7871 supports up to two non-hot-swap 1.8-inch Solid State Devices (SSDs). Accessing these SSDs requires the front bezel of the HS22V to be removed. Table 20 on page 27 lists the supported SSDs.

Table 20   Supported Solid State Drives (SSDs)

Part Number	Feature Code	Description
43W7734	5314	IBM 50GB SATA 1.8-inch non-hot-swap SSD
43W7726	5428	IBM 50 GB SATA 1.8-inch MLC SSD
43W7746[a]	5420	IBM 200 GB SATA 1.8-inch MLC SSD

a. Future support is planned for this SSD.

BladeCenter Storage and I/O Expansion Unit (SIO)

The HS22v type 7871 does not currently support the attachment of the Storage and I/O Expansion Unit.

Integrated virtualization

The HS22V offers an IBM 2 GB standard USB Flash Drive option preloaded with VMware ESXi 3.5 Update 4, VMware ESXi 4.0, or VMware ESXi 4.1. This is an embedded version of VMware ESX. 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 HS22V motherboard as shown in Figure 9. The CIOv expansion card is installed over the top of the USB memory key.
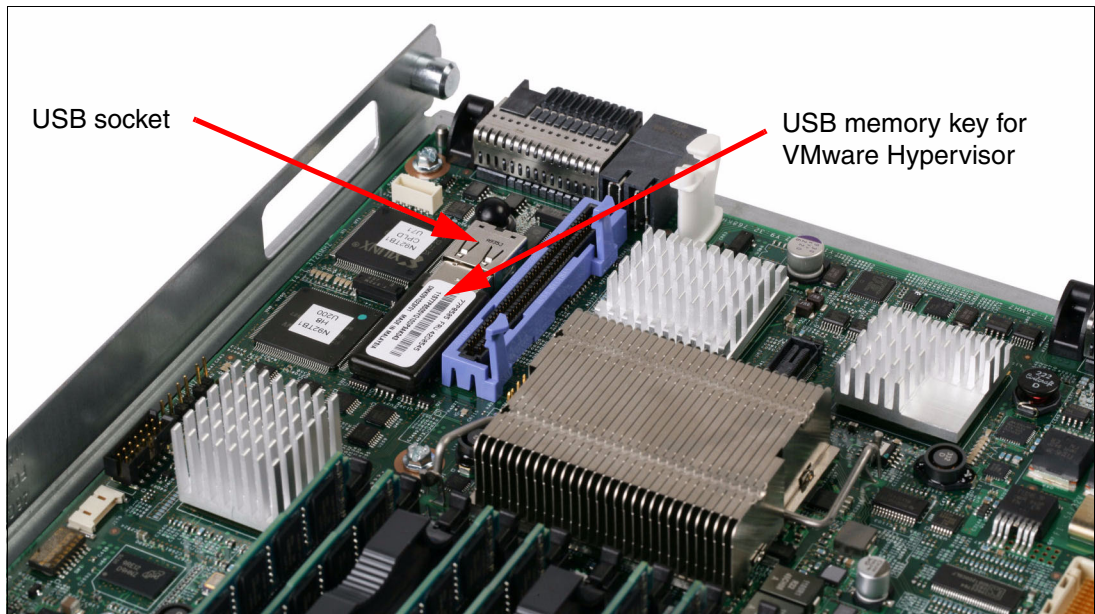
Figure 9   Rear view of HS22V motherboard showing position of USB port with embedded hypervisor memory key installed

Table 21 lists the part number, feature code, and description of the IBM USB Memory Key for VMware Hypervisor.

Table 21   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 support the HS22V 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 HS22V type 7871 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 HS22V 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 HS22V type 7871 blade server supports two formats of I/O expansion cards: the 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 22 lists the CIOv expansion cards that are supported in the HS22V type 7871.

Table 22   Supported CIOv Expansion Cards for the HS22V 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 about the expansion cards supported by the HS22V:

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

CIOv expansion cards are installed in the CIOv slot in the HS22V (Figure 10).
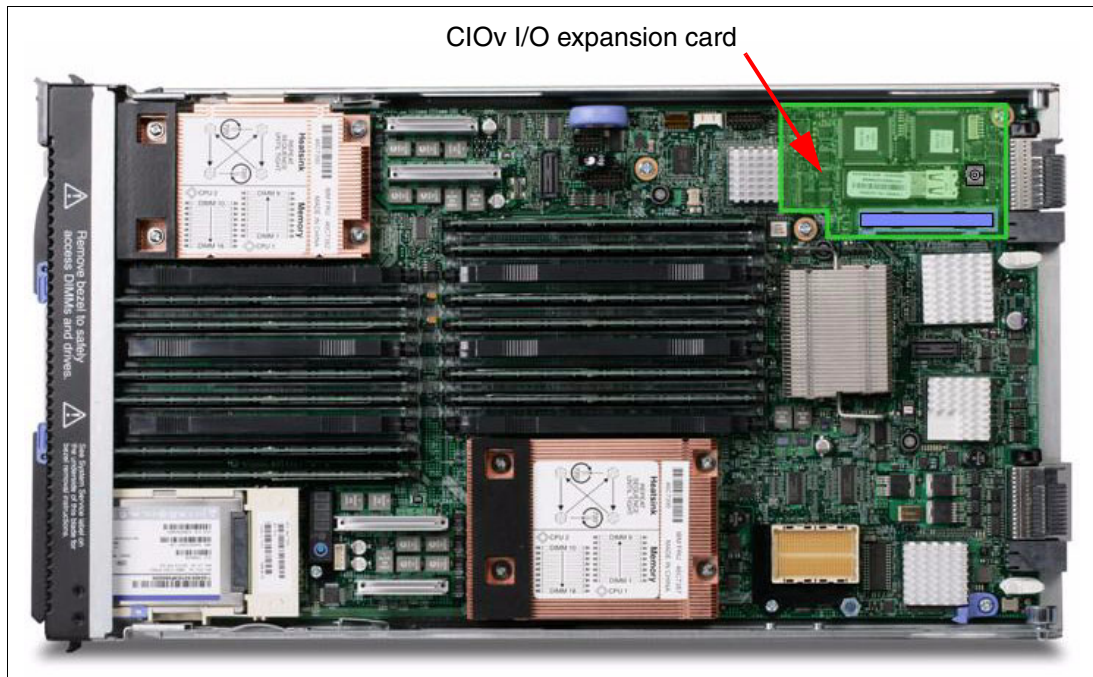

Figure 10   The HS22V type 7871 showing the CIOv I/O Expansion card position

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 23 lists the CFFh expansion cards that are supported in the HS22V type 7871.

Table 23   Supported CFFh Expansion Cards for the HS22V type 7871 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)

Part number	Feature code	Description
42C1830	3592	QLogic 2-port 10 Gb Converged Network Adapter (CFFh)
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 10Gb 2-port Ethernet Expansion Card (CFFh)
81Y1650	5437	Brocade 2-Port 10Gb Converged Network Adapter (CFFh)

See IBM ServerProven for the latest information about the expansion cards supported by the HS22V:

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

CFFh expansion cards are installed in the CFFh slot in supported servers, such as the HS22V (Figure 11).
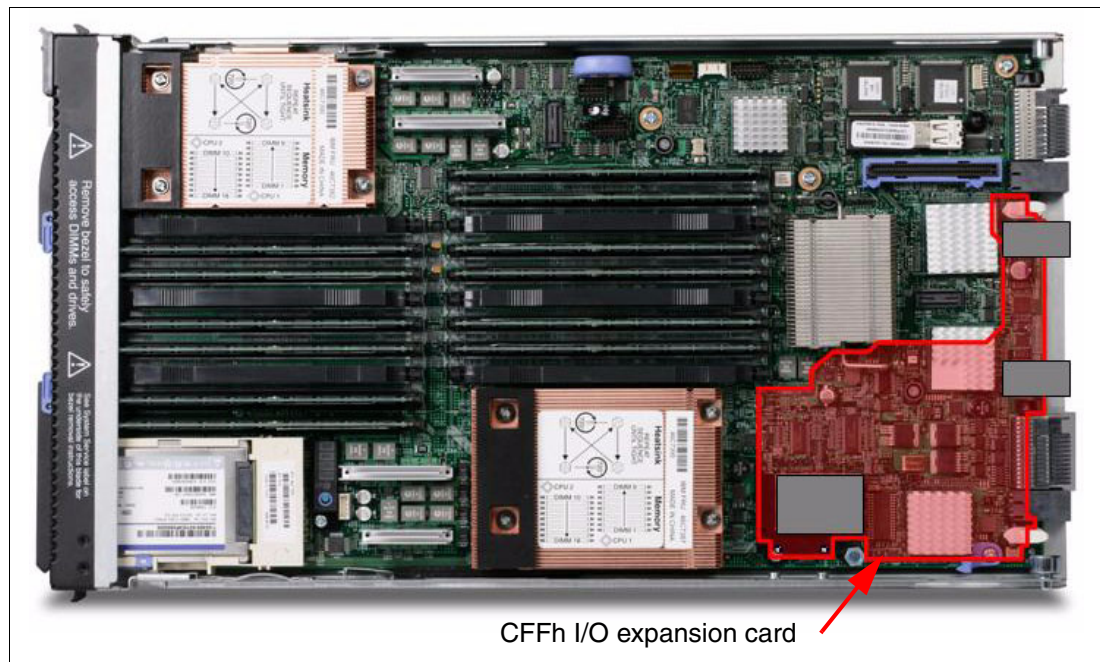

CFFh I/O expansion card

Figure 11   The HS22V type 7871 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 HS22V supports the attachment of one PCI Express I/O Expansion Unit. The PEU3e allows standard PCI-Express type adapters to be attached to the HS22V.

PCI Express Gen 2 Expansion Blade (BPE4)

The HS22V currently does not support the attachment of the PCI Express Gen 2 Expansion Blade.

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 HS22V Installation and User's Guide*

  http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5083318
- ► *IBM BladeCenter HS22V Problem Determination and Service Guide*

  http://www.ibm.com/support/docview.wss?uid=psg1MIGR-5083319
- ► IBM BladeCenter Information Center

  http://publib.boulder.ibm.com/infocenter/bladectr/documentation
- ► *IBM BladeCenter Interoperability Guide*

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

The team who wrote this paper

This paper was produced by a team of specialists from around the world working at the International Technical Support Organization, Raleigh Center.

Randall Davis is a Senior IT Specialist working in the System x pre-sales team for IBM Australia as a Field Technical Sales Support (FTSS) specialist. He regularly performs System x, BladeCenter, and Storage demonstrations for customers at the IBM Demonstration Centre in Melbourne, Australia. He also helps instruct Business Partners and customers on how to configure and install the BladeCenter. His areas of expertise are the IBM BladeCenter, System x servers, VMware, and Linux®. Randall started at IBM as a System 36 and AS/400® Engineer in 1989.

David Watts is a Consulting IT Specialist at the IBM ITSO Center in Raleigh. He manages residencies and produces IBM Redbooks® publications on hardware and software topics related to IBM System x and BladeCenter servers and associated client platforms. He has authored over 80 books, papers, and technotes. He holds a Bachelor of Engineering degree

from the University of Queensland (Australia) and has worked for IBM both in the US and Australia since 1989. David is an IBM Certified IT Specialist.

Now you can become a published author, too!

Here's an opportunity to spotlight your skills, grow your career, and become a published author—all at the same time! Join an ITSO residency project and help write a book in your area of expertise, while honing your experience using leading-edge technologies. Your efforts will help to increase product acceptance and customer satisfaction, as you expand your network of technical contacts and relationships. Residencies run from two to six weeks in length, and you can participate either in person or as a remote resident working from your home base.

Find out more about the residency program, browse the residency index, and apply online at:

ibm.com/redbooks/residencies.html

Comments welcome

Your comments are important to us!

We want our papers to be as helpful as possible. Send us your comments about this paper or other IBM Redbooks publications in one of the following ways:

► Use the online **Contact us** review Redbooks form found at:

   ibm.com/redbooks

► Send your comments in an email to:

   redbooks@us.ibm.com

► Mail your comments to:

IBM Corporation, International Technical Support Organization
Dept. HYTD Mail Station P099
2455 South Road
Poughkeepsie, NY 12601-5400

Stay connected to IBM Redbooks

► Find us on Facebook:

   http://www.facebook.com/IBMRedbooks

► Follow us on Twitter:

   http://twitter.com/ibmredbooks

► Look for us on LinkedIn:

   http://www.linkedin.com/groups?home=&gid=2130806

► Explore new Redbooks publications, residencies, and workshops with the IBM Redbooks weekly newsletter:

   https://www.redbooks.ibm.com/Redbooks.nsf/subscribe?OpenForm

► Stay current on recent Redbooks publications with RSS Feeds:

   http://www.redbooks.ibm.com/rss.html

Notices

This information was developed for products and services offered in the U.S.A.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:
IBM Director of Licensing, IBM Corporation, North Castle Drive, Armonk, NY 10504-1785 U.S.A.

The following paragraph does not apply to the United Kingdom or any other country where such provisions are inconsistent with local law: INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Certain states do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to the names and addresses used by an actual business enterprise is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs.

This document REDP-4647-02 was created or updated on May 13, 2011.

Send us your comments in one of the following ways:
- ► Use the online **Contact us** review Redbooks form found at:
  ibm.com/redbooks
- ► Send your comments in an email to:
  redbooks@us.ibm.com
- ► Mail your comments to:
  IBM Corporation, International Technical Support Organization
  Dept. HYTD Mail Station P099
  2455 South Road
  Poughkeepsie, NY 12601-5400 U.S.A.

IBM®

Redpaper™

Trademarks

IBM, the IBM logo, and ibm.com are trademarks or registered trademarks of International Business Machines Corporation in the United States, other countries, or both. These and other IBM trademarked terms are marked on their first occurrence in this information with the appropriate symbol (® or ™), indicating US registered or common law trademarks owned by IBM at the time this information was published. Such trademarks may also be registered or common law trademarks in other countries. A current list of IBM trademarks is available on the web at http://www.ibm.com/legal/copytrade.shtml

The following terms are trademarks of the International Business Machines Corporation in the United States, other countries, or both:

AS/400®	Redbooks®	ServerProven®
BladeCenter®	Redpaper™	System Storage®
IBM®	Redbooks (logo) ®	System x®

The following terms are trademarks of other companies:

Intel Xeon, Intel, Intel logo, Intel Inside logo, and Intel Centrino logo are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries.

Linux is a trademark of Linus Torvalds in the United States, other countries, or both.

Other company, product, or service names may be trademarks or service marks of others.