Sales Guide
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IBM BladeCenter HS21

Product Overview

CONTENTS

Product Overview	1
Selling Features	2
Key Features	4
Key Options	9
HS21 Images	10
HS21 Specifications	11
The Bottom Line	13
Server Rec. Map	14
For More Information	14
Legal Information	14

Uncompromising 2-socket blade server for business-critical or telecommunications applications

Suggested uses: *Front-and mid-tier applications requiring high performance, enterprise-class availability and extreme flexibility and power efficiency.*

Today's data center environment is tougher than ever. You are looking to reduce IT cost, complexity, space requirements, power consumption and heat output, while increasing flexibility, utilization and manageability. Incorporating IBM **X-Architecture**™ features, the **IBM® BladeCenter® HS21 blade server**, combined with the various BladeCenter chassis, can help you accomplish all of these goals.

Reducing an entire server into as little as **.5U** of rack space does *not* mean trading away features and capabilities for smaller size. Each HS21 blade server offers features comparable to many 1U rack-optimized full-featured servers: The HS21 supports up to **two** of the latest full-performance/low-power-draw **quad-** and **dual-core** Intel® **Xeon®** processors. The Xeon processors are designed with **4MB** (dual-core) or **8MB** (quad-core) of **L2** cache, a leading-edge **1066** or **1333MHz** front-side bus (FSB), and **64-bit extensions** (**EM64T**), to help provide the computing power you require to match your business needs and growth. The HS21 supports up to **32GB** of **667MHz PC2-5300 Fully Buffered ECC** (Error Checking and Correcting) double data rate II (**DDR2**) memory in **8** DIMM slots**,** using the **Memory and I/O Expansion Unit**, with optional **Chipkill**™ protection, for high performance and reliability. The base HS21 is packaged as a single-wide (30mm) blade and supports up to **16GB** of memory in **4** DIMM slots.

Integrated **dual Gigabit Ethernet**[1] controllers are standard, providing high-speed data transfers and offering **TOE** (TCP Offload Engine) support, **load-balancing** and **failover** capabilities. The **Memory and I/O Expansion Unit** provides **two** additional **Gigabit Ethernet** controllers (without TOE support). Via optional expansion cards, each blade can also connect to additional Ethernet, **Myrinet**, **Fibre Channel**, **iSCSI, InfiniBand**™, and other high-speed communication switches housed in the chassis. Optional **2-port Expansion Cards** add additional fabrics to the HS21 server as needed. This blade is designed with **power management capability** to provide the maximum uptime possible for your systems. In extended thermal conditions or power brownouts, rather than shut down completely, or fail, the HS21 automatically reduces the processor frequency to maintain acceptable thermal and power levels.

All HS21 models offer impressive features at an equally impressive price, including up to **two SAS** hard disk drives, with **RAID-0** data striping or **RAID-1** disk mirroring support. An optional 30mm **Storage and I/O Expansion Unit** connects to a blade (model-dependent) to provide an **additional three** 2.5" SAS HDDs with **hot-swap** support, optional **RAID-5** with **battery-backed cache**, and **four** additional **communication** ports. Moreover, the HS21 is **optimized** for diskless operation, offering each blade server access to essentially unlimited storage capacity via Fibre Channel or iSCSI.

A single **BladeCenter E** or **BladeCenter H** chassis supports up to **14 hot-swappable** 30mm-wide HS21 blades in only **7U** (BladeCenter E) or **9U** (BladeCenter H) of rack space or up to **8** hot-swappable blades in the rugged **8U BladeCenter T** chassis or up to **12** in the **12U BladeCenter HT** high-speed telecommunications chassis, including **NEBS-3**/**ETSI-compliant** blade servers. In addition to the blade servers, these chassis also hold up to **four** (BladeCenter E/BladeCenter T) **communication switches**, or up to **ten switches**/**bridges** (BladeCenter H) internally. Not only can this save significant data center space (and therefore the cost of floor space and rack hardware) compared to 1U servers, it also consolidates switches/bridges and cables for reduced complexity and lower cabling costs, and allows clients to manage everything in the solution as one. Using a BladeCenter E chassis, up to **84** HS21 servers (**168** processors) can be installed in one **industry-standard 42U** rack but the value of BladeCenter extends far beyond high density data center environments.

[1] Actual data transfer speed will vary and is often less than the maximum possible. Gigabit Ethernet transfer speed requires support on both system and server, and appropriate network infrastructure.

The various BladeCenter chassis are designed to monitor environmental conditions in the chassis and each blade and send alerts to the administrator**.** Advanced standard features, such as **Active Memory™**, **Predictive Failure Analysis™, light path diagnostics**, **hot-swap redundant power supplies and blower modules** with **Calibrated Vectored Cooling™**; **IPMI 2.0** support, including **highly secure remote power control**; **text-console redirect over LAN**, a **Management Module** (upgradeable with a redundant MM), **IBM Director** management software including **IBM PowerExecutive™**, **Remote Deployment Manager**, and **IBM ServerGuide™** help maintain system availability with increased uptime.

If you need highly manageable, high-performance computing power in a space- or power-constrained environment, the HS21 is the ideal system.

Selling Features

Price/Performance

- There is an HS21 model to fit all budgets. The HS21 offers a choice of high-performance **multi-core Xeon** processors with 64-bit extensions, either a **1066MHz** or a **1333MHz** front side bus and either **8MB** or **4MB** (processor-specific) of integrated Level 2 cache.
- **Low-voltage processors** draw less power and produce less waste heat than high-voltage processors, thus helping to reduce data center energy costs. Some **dual-core** Xeon processors use only **65W**. This is half the wattage consumed by older 130W processors. On a per-core basis, the **quad-core** processors are even more economical. Some consume only **50W** (**12.5W** per core, vs. **40W** per core for the 80W dual-core processors). For even lower power utilization, consider dual-core processors operating at **40W** and even **35W** (**20W** and **17.5W** per core, respectively.)
- **Fully buffered PC2-5300** ECC memory operates at **667MHz** with **dual-interleaving**, for high performance.
- Selected HS21 blade servers are **NEBS3/ETSI-compliant** and feature long-life availability. These blades are ideal for telecom or Next Generation Network (NGN) applications such as IPTV, IP Multimedia Subsystem (IMS) and security. NEBS3/ETSI-compliance testing of the BladeCenter HT chassis by Underwriters Laboratories is in progress. When complete, the BladeCenter HT chassis will be covered under a UL-certified NEBS Level 3/ETSI test report, which will be available for customer review.
- The **extremely high degree of integration** in the various BladeCenter chassis reduces the need for server components, replacing numerous fans, KVM and Ethernet cables, power supplies, external switches and other components with fewer *shared* hot-swap/redundant components in the chassis itself. This integration also can greatly **reduce** the amount of **power consumed** and **heat produced**, relative to an equivalent number of 1U servers. This can significantly reduce a data center's power bill. The **reduced datacenter footprint** can also save on infrastructure cost.
- The chassis midplane provides **high-speed blade-to-blade, blade-to-switch-module and module-to-module communication** internally as well as externally. The midplane in the BladeCenter H provides **four 10Gb** data channels to each blade, and supports **4X InfiniBand** and **10Gb Ethernet** high-speed switch modules.
- The various BladeCenter chassis use **ultrahigh efficiency power supplies**. Most industry-standard servers use power supplies that are between **65-75% efficient** at converting power from AC wall current to the DC power used inside servers. BladeCenter power modules can be **more than 90% efficient**. This helps save even more money, as more of the power input you are paying for is used for processing, rather than released into the data center as waste heat.
- BladeCenter also **reduces the number of parts required** to run the system. Sharing fans, systems management, floppy devices and media means fewer parts to buy and maintain, and fewer items that can bring the solution down.

Flexibility

The **HS21** has the ability to grow with your application requirements, thanks to:

- Up to **two multi-core** Xeon processors **(four** or **eight cores** in all).
- A choice of speeds from **1.6** to **3.0GHz** (*dual*-core), and **1.6** to **2.66GHz** (*quad*-core), a choice of **1066** or **1333GHz** FSB, and a choice of power draw from **35W** to **120W**.
- Up to **16GB** (standard) or **32GB** (using the optional **Memory and I/O Expansion Unit**) of high-speed **fully buffered 667MHz** PC2-5300 **DDR2** error checking and correcting (ECC) system memory with optional **Chipkill** protection.
- Up to **two** internal **2.5**-inch SAS HDDs, up to **three 2.5**-inch SAS HDDs in an adjacent **Storage and I/O Expansion Unit**, and access to terabytes of external **IBM System Storage™** and IBM **TotalStorage™** SAN and NAS storage devices. **2.5-inch** drives consume approximately *half the power* of 3.5-inch drives.
- **Two** Gigabit Ethernet ports standard; plus more, using either a **2-port Gigabit Ethernet Expansion Card**, a **Memory and I/O Expansion Unit**, or a **PCI I/O Expansion Unit II**.

In addition, the various **BladeCenter chassis** offer a high degree of flexibility:

- A 30mm HS21 blade server can be upgraded, via a **Memory and I/O Expansion Unit** to a double-wide HS21 (with expanded capabilities). With or without the Memory and I/O Expansion Unit, the blade can be expanded further with a **Storage and I/O Expansion Unit** and/or a **PCI I/O Expansion Unit**. This expandability allows configurations that are **30mm**, **60mm**, **90mm** or **120mm** wide, with a variety of memory, storage and I/O options, depending on need.
- Xeon processor-based **HS21** blades can be used in the same chassis as Intel processor-based **HS20**/**HS40** blades, Opteron processor-based **LS20**/**LS21**/**LS41** blades, and IBM PowerPC® processor-based **JS20**/**JS21** blades. Depending on the blade servers used, the various BladeCenter chassis support Microsoft **Windows**, **Linux**, **Netware**, IBM **AIX**® and Sun **Solaris 10** operating systems in the same chassis.
- *Every HS/LS/JS blade server ever released by IBM is supported in BladeCenter H, and most are supported in every BladeCenter chassis ever release*d, going back to 2002. Every switch module released by IBM is equally compatible. (Ask HP and Dell how far back *their* compatibility goes.) Future blades and fabric switches are expected to continue to be compatible with previous chassis for the foreseeable future.
- A blade server has access to as many as **10 communication switches** and/or bridges in one **BladeCenter H** chassis. (Up to **6** switches in a BladeCenter E or BladeCenter T chassis.) And the switches can be Ethernet, iSCSI, InfiniBand, Fibre Channel, Myrinet, or anything else designed and ServerProven for BladeCenter use. Switches, bridges and interface cards are currently available from such vendors as Brocade, Cisco, Intel, McData, Nortel, QLogic, Cisco Topspin and others, in addition to IBM.

Manageability

- The HS21 blade server includes a **Baseboard Management Controller (BMC)** to monitor server availability, perform Predictive Failure Analysis, etc., and trigger IBM Director alerts.
- Each BladeCenter chassis includes an **Advanced Management Module** to provide additional systems management capabilities, including *Web-based out-of-band control; virtual floppy and CD-ROM support; Windows "blue screen" error capture; LDAP and SSL support; and remote redirection of video, text, keyboard and mouse*.
- Integrated industry-standard **IPMI 2.0** support works with the BMC to alert IBM Director to anomalous environmental factors, such as voltage and thermal conditions. It also supports **highly secure remote power control**.
- IBM **PowerExecutive 2.0**, an IBM-exclusive, is designed to take advantage of new system power management features, by monitoring *actual* power usage and providing power consumption capping features. More accurate power usage data helps with data center construction planning and the sizing of power and cooling needs, as well as allowing you to use available power more efficiently.
- The HS21 supports an optional feature card that provides **concurrent KVM (cKVM)** and **concurrent media (cMedia)** access by multiple administrators at once. (This card uses a dedicated slot and does not affect the use of PCI-X/PCI-E adapters.)
- IBM **Director 5.x** is included for proactive systems management and works with both the blade's internal BMC and the chassis' management module. It comes with a portfolio of tools, including *IBM PowerExecutive, Management Processor Assistant, RAID Manager, Update Assistant,* and *Software Distribution*. In addition, IBM Director offers extended systems management tools for additional server management and increased availability. When a problem is encountered, IBM Director can issue administrator alerts via e-mail, pager, and other methods.

Availability and Serviceability

- BladeCenter chassis are designed for operation with **greatly reduced potential for single points of failure**. Most aspects of operation, from blade servers to communication modules, to management modules, to power and blower modules, are **hot-swappable**. The midplane connections are **redundant** and the other features can be made so, when used in pairs.
- HS21 blade servers support the use of **Chipkill-enabled memory DIMMs**. Chipkill memory can be up to **16X** better than standard ECC memory at correcting some types of memory errors. This can help reduce downtime caused by memory errors.
- **IPMI 2.0** supports highly secure remote system power on/off using data encryption. This allows an administrator to restart a server without having to visit it in person, saving travel time and getting the server back up and running quickly and securely.
- **Environmentally tuned blower modules** in the chassis adjust to compensate for changing thermal characteristics. At the lower speeds they draw less power and suffer less wear. Equally important in a crowded data center, temperature-controlled blowers produce less ambient noise in the data center than if they were constantly running at full speed.
- **Text and graphics console redirection** support allows the administrator to remotely view HS21 text and graphic messages over serial or LAN connections.

- A **standard three-year (parts and labor) limited onsite warranty**[2] affords you peace of mind and greater potential investment protection.

BladeCenter Design Philosophy

The philosophy behind the design of the HS21 and the various BladeCenter chassis involves four major aspects, Openness, Collaborative Innovation, Virtualization, and Technology Innovation that Matters:

- Unlike competitive blade solutions, many parts of the BladeCenter **specifications have been made open**. More than 400 of vendors have downloaded the specifications, and nearly 100 so far have released products designed specifically for BladeCenter, including **Brocade**, **Topspin**, **Cisco**, **Nortel**, **Emulex**, and others. This provides a wider selection of options to better fit your needs than a purely proprietary offering could.
- IBM has collaborated with industry leaders to offer **innovative solution packages for specific industry segments**, including banking, retail, telco and others. In addition, IBM formed **Blade.org**, a planned collaborative organization, to focus on accelerating the expansion of solutions for BladeCenter. Founding members in the blade.org community include Brocade, Citrix Systems, Intel Corporation, Network Appliances, Nortel, Novell and VMware.
- IBM offers virtualization capabilities in a number of ways: **desktop virtualization via Hosted Clients**, **InfiniBand virtualization** and **native blade virtualization**.
- Technology for technology's sake is pointless. Instead IBM BladeCenter focuses on technological innovation that provides real customer benefits. Examples of this include a **high degree of blade and module compatibility** across all chassis, the use of fewer and lower-power components to enable **significant power and cooling savings**, and hot-swap and redundant components that reduce **single points of failure**.

Key Features

Multicore Intel Xeon Processors

The HS21 supports up to **two** identical Xeon processors (that is, the same clock rate and cache size and the same number of cores). The choice of processors includes:

- **120W quad-core** Xeon processor model **X5355** at 2.66GHz, with 64-bit extensions, *only **30W** per core* power draw, a **1333MHz** FSB, and **8MB** of L2 processor cache (2 x 4MB); supported in BladeCenter H and BladeCenter HT chassis only.
- **80W quad-core** Xeon processor models **E5310**, **E5320**, **E5330**, and **E5345** at 1.6, 1.86, 2.0, or 2.33GHz (respectively), with 64-bit extensions, *reduced power draw (only **20W** per core)*, a **1066MHz** (1.6 or 1.86GHz) or **1333MHz** (2.33GHz) FSB, and **8MB** of L2 processor cache (2 x 4MB); supported in all BladeCenter chassis.
- **50W quad-core** Xeon processor models **L5310** and **L5320** at 1.6 or 1.86GHz (respectively), with 64-bit extensions, *low power draw (only **12.5W** per core)*, a **1066MHz** FSB, and **8MB** of L2 processor cache (2 x 4MB); supported in all BladeCenter chassis.
- **80W** dual-core Xeon processor model **E5160** at 3.0GHz, with 64-bit extensions, *reduced power draw*, a **1333MHz** FSB, and **4MB** of **shared** L2 processor cache; supported in BladeCenter E, BladeCenter H, and BladeCenter HT chassis only.
- **65W** dual-core Xeon processor models **E5110** or **E5120** at 1.6 or 1.86GHz (respectively), with a **1066MHz** FSB**,** or models **E5130**, **E5140**, or **E5150** at 2.0, 2.33, or 2.66GHz, with a **1333MHz** FSB. These processors feature 64-bit extensions, *low power draw* and **4MB** of **shared** L2 processor cache. Select models also feature an embedded processor with *long life support* as well as NEBS 3/ETSI compliance. Supported in all BladeCenter chassis.
- **40W** dual-core Xeon processor model **E5148** at 2.33GHz, with 64-bit extensions, *ultralow power draw (only **20W** per core)*, a **1333MHz** FSB, and **4MB** of **shared** L2 processor cache; supported in all BladeCenter chassis.
- **35W** dual-core Xeon processor model **E5138** at 2.13GHz, with 64-bit extensions, *ultralow power draw (only **17.5W** per core)*, a **1066MHz** FSB, and **4MB** of **shared** L2 processor cache; supported in all BladeCenter chassis. This processor is a long-life, embedded offering, intended for a NEBS environment.

The **dual-core Xeon** processors contain **two complete processor cores**; **quad-core** processors, similarly, contain **four** cores. The processors also contain one **unified shared 4MB** (dual-core) or **2 x 4MB** (quad-core) cache. The shared cache is dynamically allocated between the cores as needed. The two cores appear to software as two physical processors. The dual-core processors offer considerably higher performance than a same-speed Xeon processor with a single core. Likewise, quad-core processors offer considerably higher performance than a

[2] For terms and conditions or copies of the IBM Statement of Limited Warranty, call 800-772-2227 in the U.S. In Canada call 800-426-2255. Telephone support may be subject to additional charges. For warranties including onsite labor, a technician is sent after IBM attempts to resolve the problem remotely. International warranty service is available in any country in which this product is sold.

same-speed Xeon processor with dual cores.

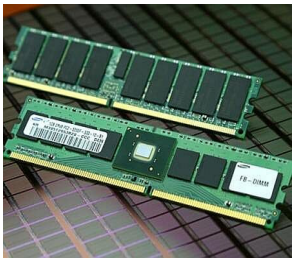
Intelligent Power Capability powers individual processor elements on and off as needed, to reduce power draw.

Intel **Extended Memory 64 Technology (EM64T)** 64-bit extensions allow Xeon processors to use large memory addressing when running with a 64-bit operating system. This can result in higher performance. Additional registers and instructions (SSE3) can further boost performance for applications written to use them. Contact your software providers to determine their software support for EM64T.

DDR II ECC Fully Buffered Memory with Chipkill Protection

The HS21 ships with **PC2-5300 fully-buffered** double data rate II (DDR II) memory (operating at **667MHz**) for faster access, and provides Active Memory features, including advanced **Chipkill** memory protection (using 1GB or larger DIMMs), for **up to 16X** better error correction than standard ECC memory. The HS21 supports up to **16GB** of memory in **four** DIMM slots. Adding a 30mm **Memory and I/O Expansion Unit** doubles the memory support to **32GB** in **eight** DIMM slots.

The fully buffered memory in the HS21 provides up to **triple** the memory bandwidth (up to **21.3GBps** in *four* channels of PC2-5300 fully-buffered DIMMs vs. a maximum of 6.4GBps in two channels of unbuffered PC2-3200 memory. By performing reads and writes simultaneously, it eliminates the previous memory read-to-write blocking latency. In addition, it also offers innovative data reliability and security features to help improve data integrity, including enhanced CRC protection, data retry on error detect and buffer registers for improved fault isolation.



For increased availability, the HS21 offers two additional (but mutually exclusive) levels of IBM Active Memory protection: online **memory mirroring**, and **online hot-spare memory**.

Memory mirroring works much like disk mirroring. The total memory is divided into two channels. Data is *written concurrently to both channels*. If a DIMM fails in 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. One-half of total memory is available for use with mirroring enabled. (***Note:*** Due to the double writes to memory, performance is affected.)

When *online hot-spare memory* is enabled, using single and/or dual-rank DIMMs **one rank** is set aside per branch as online spares in case one of the other ranks fails. *The spare rank must have capacity at least that of the largest active rank*. In an HS21 with **16GB** installed, up to **8GB** (using 4 *single*-rank 4GB DIMMs) or **12GB** (using 4 *dual*-rank 4GB DIMMs) of memory is available when the hot-spare feature is active. (The lowest-numbered rank of those with the highest capacity in each branch is used for the hot-spares.) If a **Memory and I/O Expansion Unit** is installed to upgrade an HS21 to **32GB** of RAM, up to **24GB** (using 8 *single*-rank 4GB DIMMs) or **28GB** (using 8 *dual*-rank 4GB DIMMs) of memory is available when the hot-spare feature is active.

Either of these features requires operating system support.

PC2-5300 fully buffered memory is available in **1GB**, **2GB**, **4GB** and **8GB** memory **kits** (**two** 512MB, 1GB, 2GB or 4GB DIMMs per kit, respectively). DIMMs are installed in pairs for increased performance, provided by dual-interleaving.

Gigabit Ethernet Controllers

The HS21 includes **two** integrated **Broadcom BCM5708S** Gigabit Ethernet controllers for up to 10X higher maximum throughput than a 10/100 Ethernet controller. The controllers offer **TOE** (TCP Offload Engine) support, as well as **failover** and **load balancing** for better throughput and system availability. It also supports highly secure remote power management using **IPMI 2.0**, plus Wake on LAN® and PXE (Preboot Execution Environment) Flash interface.

For additional Gigabit Ethernet controllers, an optional **Memory and I/O Expansion Unit** may be added. This provides **two Broadcom BCM5714S** controllers (no TOE support). An optional **2-port Ethernet** expansion card adds two additional Gigabit Ethernet ports per HS21 server.

Large HDD Storage Capacity

The HS21 offers a choice of disk storage, supporting up to **two 2.5-inch** internal **fixed SAS** drives, as well as an expansion unit that offers additional direct-attached storage.

- **10K** RPM **2.5-inch** — 36.4, 73.4, or **146.8GB** capacities (**293.6GB** maximum)

If this is not enough internal storage, an optional "sidecar" storage blade is available. The **Storage and I/O Expansion Unit** is a 30mm blade that supports up to **three 2.5-inch hot-swap SAS** HDDs. It is installed in the slot adjacent to an HS21 blade server.

Fully populating both the HS21 blade and the expansion unit provides up to **734GB** of local storage to the HS21 blade server. This storage can be configured as a single **RAID-1** or **RAID-5**

array, or as two separate RAID arrays—one in the expansion unit and the other in the base blade—for even more flexibility. If you need more storage space, terabyte capacities are possible with optional external iSCSI and SAN storage solutions.

External Tape Storage

The HS21 supports various external rack-mounted SAN-attached tape drives. Supported tape technologies include:

- **IBM 2U Universal Tape Autoloader**
- **IBM 4U Universal Tape Library**

Disk Controllers

All HS21 models include an integrated **LSI 1064E SAS** controller. This controller supports up to **two** internal SAS LVD (low-voltage differential) drives and offers *hardware* **RAID-0**/**1** support.

If an optional **Storage and I/O Expansion Unit** is used, the integrated **ServeRAID-8k-l** controller offers *hardware* **RAID-0**/**1**/**1E** support and **32MB** of fast **PC2-4200 DDR2** cache for the internal drives. A **ServeRAID-8k** option adds **RAID-5** support for up to **five** direct-attached SAS drives, along with **256MB** of cache memory for higher performance, and battery backup, *without* consuming a valuable adapter slot.

The **SAS** controller provides data transfer speeds of up to **300MB** per second[3] in *each* direction (**full-duplex**) across the SAS bus, for an aggregate speed of **600MBps**, nearly double that of Ultra320 SCSI's **320MBps** (half-duplex) bandwidth. The serial design of the SAS bus allows maximum performance to be maintained as additional drives are added.

High-Performance Adapter Slots

The HS21 blade server includes **one x8 PCI-E** and **one 133MHz PCI-X** adapter slot on each blade. *Either* **one** legacy **PCI-X** expansion card *or* **one** SFF (small form factor) **PCI-E** adapter can be installed in this blade (one card total).

One of three possible expansion units may be added to increase the number of expansion card slots available. *Each will utilize the PCI-E slot* in the HS21:

- The 30mm **Memory and I/O Expansion Unit** provides **one PCI-X** slot in addition to the one on the HS21 blade.
- The 30mm **PCI I/O Expansion Unit II** provides **two PCI-X** slots in addition to the **one** on the HS21 blade (**3 PCI-X** slots usable).
- The 30mm **Storage and I/O Expansion Unit** provides **two** adapter slots: either **two PCI-X** cards or **one PCI-X** and **one PCI-E** slot in addition to the **one PCI-X** slot on the HS21 blade. (The first PCI-X card installed in the expansion unit must be a Gigabit Ethernet card, because it is routed to module bays 1 and 2.)

The HS21 also supports an optional feature card (in a dedicated slot) that provides **concurrent KVM (cKVM)** and **concurrent media (cMedia)** access by multiple administrators at once. Adapters can also be used to add interfaces to BladeCenter communication modules, including Fibre Channel, Myrinet, additional Gigabit Ethernet modules, InfiniBand, etc.

BladeCenter Chassis

IBM offers ***four*** *choices* of chassis in which to use various blade servers. Each chassis serves different customer needs. The original 7U **BladeCenter E** chassis offers maximum density, great flexibility and a wide variety of expansion options at an entry-level price. The next-generation **BladeCenter H** chassis (9U) offers all of BladeCenter's capabilities, and adds new high-performance features. If you need a **ruggedized** chassis (for example, government/military or telcos), the 8U **BladeCenter T** offers special features optimized for those environments. The next-generation **BladeCenter HT** (12U) is a high-performance **ruggedized** telecommunications platform. There is a high degree of interchangeability and compatibility of features among the chassis. Any or all of these chassis can be installed in a rack along with other rack-optimized equipment.

See the separate *BladeCenter Chassis Sales Guide* for details.

Light Path Diagnostics

Light path diagnostics enables a technician to quickly identify and locate a failed or failing system component, such as a specific blower module or memory DIMM. This enables quick replacement of the component, which helps increase server uptime and lower servicing costs.

[3] Data transfer rates depend on many factors and are often less than the maximum possible.

The front of each blade server—and the chassis itself—has an LED indicator light to show possible component failures. This lets the servicer identify the failing component without the need to or remove the blade server from the chassis. The light path diagnostics panel tells the servicer which component of the affected server requires attention.

In addition, many components have their own identifying LEDs. For example, each of the memory modules has an LED next to the socket, as do both processors. This allows the servicer to easily identify exactly which component needs servicing. By following the "light path," the component can be replaced quickly, and without guesswork. (***Note:*** In the event of a failed DIMM, the system will restart and mark the DIMM as bad while offline, thus allowing the system to continue running, with reduced memory capacity, until serviced.)

Advanced Systems Management Capabilities

Each BladeCenter chassis offers a high level of systems management capabilities that are well-suited to remote locations as well as to stand-alone environments. Features include the Advanced Management Module (AMM), Baseboard Management Controller (BMC), Automatic Server Restart, PowerExecutive, Wake on LAN® support, PXE 2.0 support, text and graphics console redirect, Real Time Diagnostics, Predictive Failure Analysis, IBM Director and Remote Deployment Manager.

The **AMM**, in combination with the HS21 blade server **BMC**, provides industry-standard **Intelligent Platform Management Interface** (**IPMI**) **2.0**-compliant systems management. It provides a number of important system functions, including:

- Monitoring of system and battery voltage, system temperature, fans, power supplies, processor and DIMM status
- Fan speed control
- Product ID and Family ID detection
- Highly secure remote power on/off
- System reset control
- NMI/SMI detection and generation
- System diagnostic LED control (power, HDD, activity, alerts, heartbeat)
- IPMI over LAN
- Serial Over LAN
- Proxy server support
- LAN messaging and alerting
- Text console redirection over LAN
- VLAN support
- Enhanced authentication and encryption algorithms (RMCP+, SHA-1, AES)
- Local update of BMC firmware
- Firmware firewall
- Support for IPMI v2.0 compliant management software (e.g., xCAT)
- Other mandatory and optional IPMI BMC functions

The BMC, via the management module, alerts IBM Director to anomalous environmental factors, such as voltage and thermal conditions—even if the server has failed.

Other systems management features offered for the combination of blade server and chassis include:

- Predictive Failure Analysis for system processors, memory and HDDs, as well as chassis switch modules, blower modules and power modules
- Web-based out-of-band control
- Windows "blue screen" capture
- Remote virtual media
- High-speed remote redirection of PCI video, keyboard and mouse
- SSL (Secure Socket Layer) and LDAP (Lightweight Directory Access Protocol) support

In order to put control of processor power-saving features at the fingertips of administrators, IBM developed **IBM PowerExecutive™**. IBM PowerExecutive is designed to take advantage of new processor features, such as balancing the performance of the system according to available power input. It provides the ability to plan and predict power consumption based on your BladeCenter hardware configuration. It also allows you to reduce the infrastructure required for redundancy, by using fewer servers on smaller power feeds and potentially lowering your overall data center support costs. It does this by inventorying all components at the blade level, then

adding up the power draw for each blade and tracking that usage. In failure mode, PowerExecutive (through the BladeCenter Management Module) might request that certain blades in each domain throttle down to reduce power consumption.

Automatic Server Restart (ASR) helps reduce downtime by restarting the server automatically in the event of a system lockup. ASR technology is a combination of hardware circuitry tied into the server's system reset function and a device driver. As long as the server continues running, the ASR watchdog timer will keep being reset, but if the operating system crashes or the hardware freezes somehow the ASR software will be unable to reset the hardware timer. If the timer is not reset within five minutes, it automatically triggers the ASR hardware, which immediately restarts the server (and logs an ASR event with IBM Director). These features are designed so that *no more than five minutes can pass before the server is restarted*.

Text and Graphics Console Redirect support allows the administrator to remotely view HS21 text and graphics messages over serial or LAN.

Wake on LAN permits the server to be remotely powered on if it has been shut off. Once powered up, the server can be controlled across the network, using the **Preboot Execution Environment** (PXE).

Like Wake on LAN, **PXE** is system firmware. It allows software such as the **IBM Remote Deployment Manager** to take control of a system before the BIOS, operating system or applications are loaded (using Wake on LAN/PXE) and lets an administrator perform many low-level tasks remotely that would otherwise require a visit to each system. These tasks may include such things as formatting a hard disk drive, updating system firmware, or deploying a Windows or Linux operating system.

Predictive Failure Analysis (PFA) enables the MM/aMM and the BMC to detect impending failure of supported components (processors; memory; expansion cards; switch, blower and power supplies; and hard disk drives) as much as 48 hours before actual failure, and alert the administrator through IBM Director. This gives you the ability to replace the failing component *before* it fails, resulting in increased uptime.

IBM Director 5.x software for advanced workgroup management is included with the server. IBM Director comes with a portfolio of tools, including *Management Processor Assistant, Rack Manager, RAID Manager, Update Assistant* and *Software Distribution*. *System Availability* (a no-charge download) and *Capacity Manager* (sold separately) are available as add-ons for additional server management and increased availability. IBM Director provides a single uniform graphical interface for all of these systems management functions.

IBM Director enables you to customize thresholds and monitor system components (for things like temperature, voltage regulation, etc.) to help maximize uptime.

Extensive System Support Features

The IBM services and technical support portfolio provides world-class, consistent, high-quality service and support. From the start, IBM programs make it easier for you to plan for, configure and purchase BladeCenter servers, get them running and keep them running long-term. These features include IBM Express Portfolio, IBM ServerProven®, the IBM Standalone Solutions Configuration Tool, IBM System x and BladeCenter Power Configurator IBM ServerGuide, IBM Electronic Service Agent™, Product Customization Services and extensive technical support offerings.

ON DEMAND EXPRESS PORTFOLIO
BUILT FOR MID-SIZED BUSINESS.

Select configurations of xSeries servers are part of the **IBM Express Portfolio**, designed, developed and priced to meet the specific needs of midsized businesses. The IBM Express Portfolio of solutions are easy to acquire, install and manage. And they leverage IBM technology to provide tangible solutions to help you solve business problems in an on demand world.

IBM Server Proven

The IBM **ServerProven** program provides the confidence that specific options and operating systems have been tested on the blade servers and are officially supported to work together. It is updated frequently to keep the latest compatibility information at your fingertips.

The IBM **Standalone Solutions Configuration Tool** (SSCT) is a downloadable tool that simplifies the often complex chore of configuring a full rack of servers (including blade servers) and confirming that you have all the cables, power distribution units, KVM (keyboard, video and mouse) switch boxes and other components you need, as well as the proper airflow clearances, electrical circuits and other environmental conditions.

IBM **System x and BladeCenter Power Configurator** helps IT managers plan for data center power needs, by providing the following information for specific configurations of System x and BladeCenter systems: *power input* (watts), *PDU sizing* (amps), *heat output* (BTUs), *airflow requirements through chassis* (CFM), *VA rating*, *leakage current* (mA), and *peak inrush current* (amps).

IBM **ServerGuide** (installed from CD) simplifies the process of installing and configuring xSeries servers. ServerGuide goes beyond mere hardware configuration by assisting with the automated installation of the Microsoft® Windows® Server 2000 and 2003 operating systems,

device drivers and other system components, with minimal user intervention. (Drivers are also included for support of Novell NetWare, Red Hat Linux and SUSE LINUX.) This focus on deployment helps you reduce both your total cost of ownership and the complexity that administrators and technical personnel face.

IBM **Electronic Service Agent**™ is an innovative "call home" feature that allows System x and BladeCenter servers to automatically report hardware problems to IBM support, which can even dispatch onsite service[4] if necessary to those customers entitled to onsite support under the terms of their warranty or an IBM Maintenance Agreement. Electronic Service Agent resides on a server and provides electronic support and problem management capabilities through a highly secure electronic dialogue between your systems and IBM. It monitors networked servers for hardware errors and it can perform hardware and software inventories and report inventory changes to IBM. All information sent to IBM is stored in a highly secure database and used for improved problem determination.

Additional services include hardware warranty upgrades and factory-installed **Product Customization Services** (PCS), such as asset tagging, hardware integration, software imaging and operating systems personalization.

IBM offers extensive **technical support** by phone and via the Web. Support options include links to forums/newsgroups, problem submission, online shopping support, service offerings, device drivers for all IBM product lines, software downloads and even upcoming technical seminar worldwide schedules and registration. Also available are remote installation, configuration and usage support for both xSeries hardware and software, as well as onsite custom services to provide the level of expertise you require.

Key Options

IBM options for xSeries servers let you take your servers to a higher level

You can rely on xSeries and blade options to supply a comprehensive solution for your business needs. Options help you create an optimized server system to meet your data protection, storage and availability needs. Every IBM option is designed and tested for peak performance and flexibility, helping to maximize your return on investment. The combination of xSeries servers and options lets you keep your fingers on the pulse of your e-business.

Processors — The Intel Xeon processor provides high clock rates, 64-bit extensions, a large cache, Hyper Threading Technology and advanced features for availability and manageability. Large cache size, combined with a **1066MHz** or **1333MHz** system bus speed, reduce memory latency and facilitate the movement of data through the processor and I/O devices. (***Note:*** System performance depends not only on the number of processors in the server but also on the power and functionality of each processor.) Adding a second processor may be a cost-effective way to achieve significant performance improvements.

Memory — Memory is a significant factor in systems application performance. Adding more memory to a BladeCenter server is one of the most effective ways to increase application performance. For best performance in a server with a dual-core processor, there should be twice as much memory available as for a single-core processor.

Hard Disk Drives — IBM hard disk drives help you improve the transaction and cost performance of your HS21 servers. The choice of hard disk drives can be a critical aspect of maximizing the I/O throughput of the system. **SAS** hard disk drives (**2.5-inch**) are available for the HS21 with capacities up to **146.8GB** at **10,000** RPMs. Additionally, a **Storage and I/O Expansion Unit** can be attached to the HS21 to add up to **three** additional **2.5-inch** SAS drives.

I/O slots — The HS21 supports the addition of a **PCI I/O Expansion Unit II**, which provides **two front-accessible standard PCI-X slots**. Also, the **Storage and I/O Expansion Unit** provides **two** additional adapter slots: either **two legacy PCI-X** cards or **one PCI-X** and **one PCI-E** slot. (The first PCI-X card added must be a Gigabit Ethernet card.). Adding a 30mm **Memory and I/O Expansion Unit** to an HS21 provides a PCI-E slot and a *second* PCI-X slot.

External Storage — The **IBM System Storage**™ **DS3000** series is a powerful and affordable new storage family with integrated management software designed to meet SMB and departmental needs. The DS3000 series is a perfect antidote to SMBs' largest headache: rapid and uncontrolled proliferation of data. The **DS3200** and **DS3400** each offer single-controller and dual-controller models to help maintain data-availability. The DS3200 is direct-attached storage with support for clustering and a **3Gbps SAS** connection to the host. The DS3400 can be direct-attached or used in a SAN configuration via **4Gbps Fibre Channel** connectivity. In addition, the DS3000 expands to **48** drives (via 3 optional **EXP3000** expansion units) and **14.4TB** of storage.

Midrange **TotalStorage DS4000** products are designed to support the large and growing data-storage requirements of business-critical applications. Because DS4000 solutions can support connectivity distances of up to **10km (6.2 miles)** at Fibre Channel rates of up to **2Gbps**,

[4] For onsite labor, IBM will attempt to diagnose and resolve the problem remotely before sending a technician.

companies can more easily configure offsite System x servers and storage systems to keep critical data available around the clock—even in the event of a catastrophe.

These storage servers are designed to provide highly-available Fibre Channel RAID protected storage that provide the foundation for Storage Area Networks (SANs). **DS4000** storage servers deliver scalability up to **32.8TB** of Fibre Channel storage or **56TB** of SATA storage (**DS4500** only). They provide end-to-end Fibre Channel solutions with high-availability fault-tolerant components.

Additionally, external LAN-attached tape storage is available.

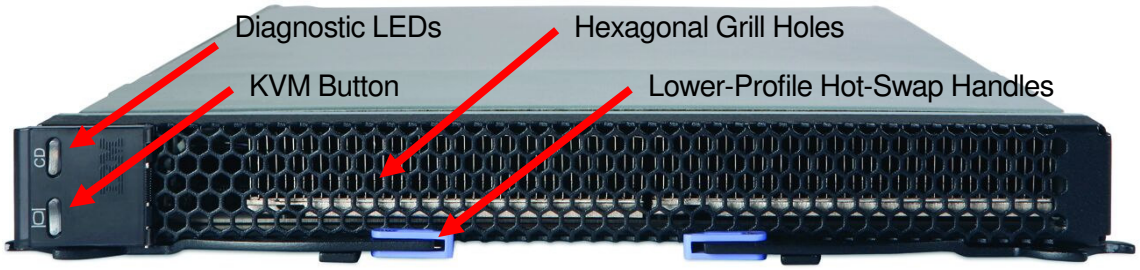
Communication Modules — The various BladeCenter chassis support integrated communication and I/O switches and/or bridges for Gigabit Ethernet, Myricom, Fibre Channel, InfiniBand, and others. Expansion adapters for individual HS21 blades are available to interface with these modules.

Rear Door Heat eXchanger — The unit attaches to the back of an IBM S2 42U Enterprise Rack. It is capable of removing up to 50,000 BTUs (14KVa) from the data center using water lines under the raised floor. The door swings open for servicing.

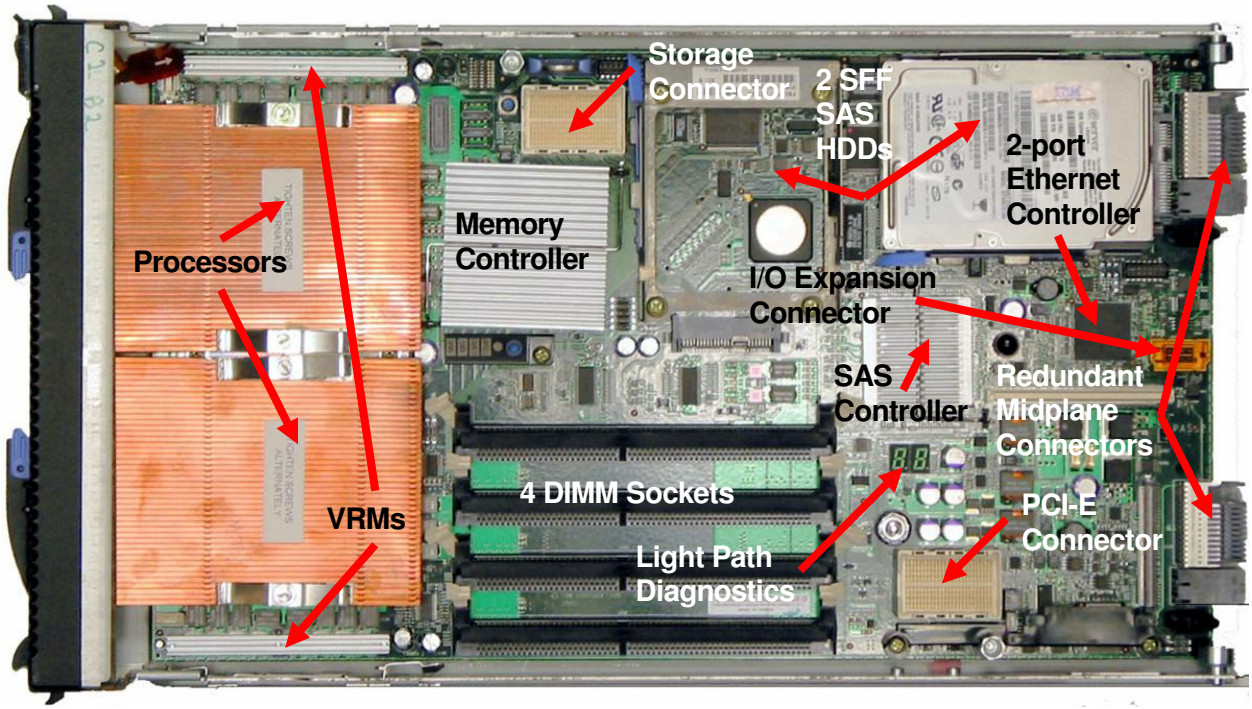
Redundant features — Optional power supply modules, blower modules, management modules, switches and bridges provide redundancy for the various BladeCenter chassis.

HS21 Images

Front View



Interior View



BladeCenter HS21 Specifications						
Machine type	**8853-AxX/AxY**, **CxX/CxY**, **HxX/HxY, JxX/JxY**, **LxX/LxY**, **NxX/NxY**					
Form factor	30mm blade					
Processor type	**Quad-core** Intel **Xeon (53xx)** **1.6GHz** E5310 (A1X/A1Y), **1.6GHz** L5310 (J1X/J1Y), **1.86GHz** E5320 (C1X/C1Y), **1.86GHz** L5320 (J2X/J2Y), **2.0GHz** E5330 (A2X/A2Y), **2.33GHz** E5345 (C2X/C2Y), **2.66GHz** X5355 (C3X/C3Y)			**Dual-core** Intel **Xeon (51xx)** **1.6GHz** 5110 (L1X/L1Y), **1.86GHz** 5120 (L2X/L2Y), **2.0GHz** 5130 (L3X/L3Y), **2.13GHz** 5138 (NTX/NTY), **2.33GHz** 5140 (L4X/L4Y), **2.33GHz** 5148 (H1X/H1Y), **2.66GHz** 5150 (L5X/L5Y), **3.0GHz** 5160 (L6X/L6Y)		
Processor power draw	**35W** (NTX/NTY)	**40W** (H1X/H1Y)	**50W** (J1X/J1Y, J2X/J2Y)	**65W** (L1X/L1Y, L2X/L2Y, L3X/L3Y, L4X/L4Y, L5X/L5Y)	**80W** (AxX/AxY, C1X/C1Y, C2X/C2Y, L6X/L6Y)	**120W** (C3X/C3Y)
Front-side bus (FSB) speed	**1066MHz** (AxX/AxY, C1X/C1Y, L1X/L1Y, L2X/L2Y, NTX/NTY)			**1333MHz** (C2X/C2Y, C3X/C3Y, H1X/H1Y, L3X/L3Y, L4X/L4Y, L5X/L5Y, L6X/L6Y)		
# of processors standard / maximum	1 / 2					
NEBS/ETSI Compliance	Select blades are NEBS3/ETSI-compliant. (Contact IBM sales for details.)					
Internal L2 cache	**8MB** (2 x 4MB *shared* cache)—AxX/AxY, CxX/CxY, JxX/JxY			**4MB** (1 x 4MB *shared* cache)—all other models		
Chipset	Intel 5000P					
Standard / maximum memory[5]	**1GB** (2 x 512MB) dual-core, or **2GB** (2x1GB) quad-core / **16GB** (32GB using a **Memory and I/O Expansion Unit**)					
Standard memory type	**PC2-5300 (667MHz) Fully Buffered** DDR II ECC					
Memory interleaving	Yes					
DIMM capacities supported	512MB, 1GB, 2GB, 4GB					
Chipkill protection supported	Yes (using 1GB or larger DIMMs)					
# of DIMM sockets total / available	4 / 2 (standard)			8/6 (using a **Memory and I/O Expansion Unit**)		
# of 2.5-inch drive bays total / available	**2 / 2 SAS (standard)**			**5 / 5 SAS** (using a **Storage and I/O Expansion Unit**)		
# of 3.5-inch drive bays total / available	None					
Maximum internal 2.5" HDD capacity	**Standard** **293.6GB** (2 x 146.8GB) **fixed SAS** (using SFF card or no expansion card); **146.8GB** (1 x 146.8GB) **fixed SAS** (using legacy expansion card)			**Using a Storage and I/O Expansion Unit** **734GB** (5 x 146.8GB)—two **fixed SAS** in the base blade, plus three **hot-swap SAS** in the expansion unit		
2.5-inch HDD capacities supported	36.4, 73.4, **146.8GB** — 10K RPMs					
# of HDDs standard	None					
# of optical drives standard	None (one standard in chassis)					
# of diskette drives standard	None (one standard in BladeCenter E or BladeCenter H chassis)					
Internal tape drives supported	None (SAN-attached)					
Disk drive technology	**SAS**					

[5] Maximum memory and disk capacity may require the replacement of standard components with the largest supported component available.

BladeCenter HS21 Specifications		
Integrated disk controller	**LSI Logic 53C1046E** (standard in HS21)	**ServeRAID-8k-l** (using a **Storage and I/O Expansion Unit**)
Optional RAID controller	None	**ServeRAID-8k** (using a **Storage and I/O Expansion Unit**)
RAID levels supported	RAID-0/1 (standard)	RAID-0/1/1E (ServeRAID-8k-l); RAID-0/1/1E/**5** (ServeRAID-8k)
# of disk drives supported *per channel*	4 (four drive limit, due to available bays)	
External disk drive support	NAS/SAN-attach	
# of adapter slots standard	**1** legacy PCI-X slot, plus **1** PCI-E *or* a **second** PCI-X slot on the blade	
# of PCI-E slots	**1** (in place of second PCI-X slot); **1** PCI-E slot available with the optional **Storage and I/O Expansion Unit** (**1** total)	
# of PCI-X slots	**1** or **2** (in place of PCI-E slot); **2** extra via optional **PCI Expansion Unit II** (**3** total); **1** or **2** extra via optional **Storage and I/O Expansion Unit** (**3** total)	
# of legacy PCI slots	None	
# of video ports	None (chassis-attached)	
Video controller	ATI Radeon ES1000	
Video memory	16MB SDRAM	
Maximum video resolution at 32-bit color	1024 x 768 x 32-bit color at 85Hz	
Gigabit Ethernet controllers	**Dual** Broadcom **BCM5708S** (standard) — TOE-enabled	**Dual** Broadcom **BCM5714S** (in the **Memory and I/O Expansion Unit**) — *not* TOE enabled
# of Gigabit Ethernet ports	**2** (standard)	**4** when using the **Memory and I/O Expansion Unit**. Up to **8** when using the **2-Port Ethernet Expansion Card**.
# of RS485 ports	None	
# of serial ports	None (1 direct via BladeCenter H chassis, or Serial over LAN in BladeCenter E and BladeCenter H)	
# of parallel ports	None	
# of mouse ports	None (1 via chassis)	
# of keyboard ports	None (1 via chassis)	
# of USB ports	None (2 via chassis)	
Systems management controller	Integrated BMC	
Diagnostic LEDs (front panel)	Power good, blade location, over temperature, information, general fault	
Predictive Failure Analysis support	Processor, memory, HDDs, expansion cards	
Power supply size	Contained in chassis	
# of power supplies standard / maximum	Contained in chassis	
# of fans/blowers standard / maximum	Contained in chassis	
Dimensions (HWD) / weight	9.7” (245mm) **H** 1.14” (29mm) **W** 17.6” (446mm) **D**	12 **lbs** (maximum) 5.44 **kg** (maximum)
Operating systems supported	Microsoft Windows Server 2003 (Standard/Web/Enterprise Editions) 32-bit and 64-bit, RHEL 3/4 32-bit and 64-bit, SLES 9 32-bit and 64-bit, Novell NetWare 6.5, Sun Solaris	

BladeCenter HS21 Specifications	
	10, VMware ESX Server 3.0
Extended/long life support	Select blades are supported for long life. (Contact IBM sales for details.)
Length of limited warranty	3 years (parts and labor) onsite

The Bottom Line

The HS21 offers maximum bang for the buck by incorporating outstanding features in a tiny package:

Performance:

- **Dual-core processors** — Up to two **1.6** to **2.66GHz quad-core** or **1.6** to **3.0GHz dual-core** 64-bit (EM64T) **Xeon** processors
- **Fast front-side bus** — **1066** or **1333MHz** FSB
- **Large cache** — **8MB** or **4MB** of L2 processor cache
- **Fast memory** — **667MHz Fully Buffered PC2-5300 DDR II** ECC memory
- **Fast disk technology** — Internal **SAS** storage (**2 HDDs**), with the option for **three** additional SAS HDDs in an adjacent **Storage and I/O Expansion Unit** (**5 HDDs** total); **RAID-0** data striping
- **Fast I/O** — **4X InfiniBand, Myrinet**, **iSCSI** or **Fibre Channel** connectivity via an optional expansion card; support for 10Gb Ethernet when available
- **Fast communications** — Integrated **dual Gigabit** Ethernet, with the option for two additional Gigabit Ethernet ports via expansion cards (total **8** ports per blade) and expansion unit

Flexibility:

- **Single- (30mm)**, **double- (60mm)**, **triple- (90mm)**, or **quadruple-wide (120mm)** configurations
- **Large memory capacity** — Up to **16GB** standard using **four 4GB** DIMMs (or up to **32GB** and **eight** DIMM slots, using the **Memory and I/O Expansion Unit**)
- **High-capacity disk storage** — Up to **293.6GB** of internal **SAS** storage, with the option for **three** additional 2.5-inch SAS HDDs in an adjacent **Storage and I/O Expansion Unit** (**5 HDDs, 734GB** total)
- Integrated RAID — **RAID-1** mirrored arrays standard; enhanced **RAID-1E** arrays optional (using a **Storage and I/O Expansion Unit)**; **RAID-5** arrays available using the optional **ServeRAID-8k** controller
- **One** *available* **adapter slot** standard —
  - One **legacy** slot for standard PCI-X adapters, *or*
  - One high-speed **PCI-E** slot
- Additional ***optional*** adapter slots —
  - Two **legacy PCI-X** slots or one **PCI-X** and one high-speed **PCI-E** slot provided by the **Storage and I/O Expansion Unit**[6]
  - Two standard **PCI-X** slots provided by the **PCI I/O Expansion Unit II**[7]
  - One standard **PCI-X** slot and one high-speed **PCI-E** slot provided by the **Memory and I/O Expansion Unit**[8]

Manageability and Availability:

- IBM **Director** systems management software, including:
  - IBM PowerExecutive
  - IBM Management Processor Assistant
  - IBM Rack Manager
  - IBM RAID Manager
  - IBM Update Assistant
  - IBM Software Distribution
  - IBM System Availability
- Integrated **Baseboard Management Controller**:
  - **IPMI 2.0** compliance, including highly secure remote power control

[6] The Storage and I/O Expansion Unit requires an adjacent blade slot.
[7] The PCI I/O Expansion Unit II requires an adjacent blade slot.
[8] The Memory and I/O Expansion Unit requires an adjacent blade slot.

- Interface to one or two **Advanced Management Modules** in the chassis for advanced systems management capability
  - ❑ Supports **LDAP** and **SSL** industry standards
  - ❑ **Text and graphics console redirection** systems management
  - ❑ **Serial over LAN**
- Optional **concurrent KVM** and **concurrent media** support
- Numerous **hot-swap/redundant capabilities** provided via the chassis
- **Hot-swap SAS storage** via an optional **Storage and I/O Expansion Unit**

BladeCenter Server Recommendation Map

Solution Area	Requirements									BladeCenter Blade Servers							
	Scalability	Floating Point Performance	Memory Throughput	Integer Performance	I/O & Storage	Density	High Availability	Systems Management	Distributed Deployment	HS20 ULP	HS21	HS21 XM	LS20	LS20	LS21	LS41	JS21
Business Continuity	■				■	■	■	■	■	○	●	●	●	●	◗	◗	●
Cluster / HPC	■	■	■	■	■	■		■		○	●	●	◗	◗	●	●	◗
Database	■	■	■	■	■	■	■	■		○	◗	◗	○	○	●	●	○
E-mail / Collaboration	■		■	■	■	■	■	■	■	●	●	●	○	○	◗	◗	○
File & Print	■		■		■	■	■	■		●	●	●	○	○	◗	◗	○
Grid Computing	■	■	■	■	■			■	■	○	●	●	◗	◗	●	◗	●
Hosted Client	■		■	■	■	■	■	■	■	●	●	●	○	○	◗	◗	○
Security	■	■	■	■	■	■	■	■		○	◗	◗	◗	◗	●	○	●
Virtualization & SCON	■	■	■	■	■	■	■	■		○	●	●	○	○	◗	●	●
Web Serving		■	■	■		■	■	■		●	●	●	●	●	◗	◗	●
Business Intelligence	■	■	■	■	■	■	■	■		○	◗	◗	◗	◗	◗	●	○
Content / Doc Mgmt	■	■	■	■	■		■	■	■	●	●	◗	○	○	●	○	○
Digital Media	■	■	■	■	■	■	■	■		◗	●	●	●	●	●	◗	◗
ERP/SCM/CRM/PLM	■	■	■	■	■	■	■	■	■	○	◗	◗	○	○	◗	●	◗
Modeling & Simulation	■	■	■	■		■	■	■		○	◗	●	◗	◗	●	◗	○

For More Information

IBM BladeCenter Servers and Options	**ibm.com**/systems/bladecenter
Electronic Service Agent	**ibm.com**/support/electronic
IBM System x and BladeCenter Power Configurator	**ibm.com**/systems/bladecenter/powerconfig
Standalone Solutions Configuration Tool (SSCT)	**ibm.com**/servers/eserver/xseries/library/configtools.html
Configuration and Options Guide	**ibm.com**/servers/eserver/xseries/cog
ServerProven Program	**ibm.com**/servers/eserver/serverproven/compat/us
Technical Support	**ibm.com**/server/support
Other Technical Support Resources	**ibm.com**/servers/eserver/techsupport.html

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Some machines are designed with a power management capability to provide customers with the maximum uptime possible for their systems. In extended thermal conditions, rather than shutdown completely, or fail, these machines automatically reduce the processor frequency to maintain acceptable thermal levels.

MB, GB and TB = 1,000,000, 1,000,000,000 and 1,000,000,000,000 bytes, respectively, when referring to storage capacity. Accessible capacity is less; up to 3GB is used in service partition. Actual storage capacity will vary based upon many factors and may be less than stated.

Performance is in Internal Throughput Rate (ITR) ratio based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput that any user will experience will depend on considerations such as the amount of multiprogramming in the user’s job stream, the I/O configuration, the storage configuration and the workload processed. Therefore, no assurance can be given that an individual user will achieve throughput improvements equivalent to the performance ratios stated here.

Maximum internal hard disk and memory capacities may require the replacement of any standard hard drives and/or memory and the population of all hard disk bays and memory slots with the largest currently supported drives available. When referring to variable speed CD-ROMs, CD-Rs, CD-RWs and DVDs, actual playback speed will vary and is often less than the maximum possible.