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Abstract

This technology brief describes the architecture and the implementation of major technologies in the HP Integrity Servers c-Class server blades based on the Intel® Itanium® processor 9300 series modules. The HP Integrity server blades architecture opens a chapter in server scalability by using a common base 2S (two socket) base blade to build four and eight socket systems. Integrity Blade Links attach to common base server blades to scale from two (BL860c i2), to four (BL870c i2) or eight socket systems (BL890c i2). See Figure 1 for a physical view of the three form factors.

It is assumed that the reader is familiar with HP Integrity server technology and has some knowledge of BladeSystem architecture. For more information about the infrastructure components and complete specifications of each server blade, see the HP website: www.hp.com/go/bladesystem

Figure 1: HP Integrity BL860c i2, BL870c i2, and BL890c i2 server bladeform factor view

Integrity server blade architecture

BL860c i2 server blade details

Figure 2 shows a block diagram for the base blade HP Integrity BL860c i2 server blade. The server blade features:
- Two Intel Itanium processor 9300 series module
- Twenty four DDR3 DIMMs operating at 800 MHz
- Three PCIe Gen2 x8 Mezzanine IO cards
- Two embedded dual-ported 10 GbE network adapters for a total of four 10 GbE ports
- Two SAS Hot Plug disk drives that could be configured as Raid 1 or 0 or HBA mode
- Optional TPM 1.2 support
- Dual USB 2.0 ports
- RN50 Radeon VGA
- Intel® 7500 IOH/ICH10 chipset
- iLO 3 Manageability Chip network accessible
- Blade Link Connector for system scaling

**Balanced I/O architecture**

The BL860c i2 features PCIe Gen 2 with x8 link width Mezzanine cards. In addition, x4 Gen 2 PCIe links connect to each of the two 10 GbE LOM NICs. This is an uncompromised aggregate 32 GBps IO bandwidth. The Intel® 7500 IOH PCIe controller connects to two Intel Itanium processor 9300 series, via dedicated 19.2 GBps links for a total of 37.4 GBps aggregate bandwidth. This makes the BL860c i2 a system with not only a high IO bandwidth capability, but also a fully balanced system. The IO bandwidth scales proportionately with the number of Intel® 7500 per system.

**Figure 2:** HP Integrity BL860c i2 server blade system block diagram

**BL870c i2 server blade details**

By using the Integrity Blade Link-2, two BL860c i2 blades are combined to scale double the available system resources of a single BL860c i2. Resources hosted on the ICH MEZZ Card (See Figure 2) are not replicated. Refer to Table 1 for a view of the available resources for a BL870c i2.
BL890c i2 server blade details

By using an Integrity Blade Link, four BL860c i2 blades are combined to scale to quadruple the available system resources of a single BL860c i2. Resources hosted on the ICH MEZZ Card (See Figure 2) are not optional and not duplicated. Refer to Table 1 for a view of the available resources for a BL890c i2.

### Table 1: HP Integrity server blades maximum supported configurations

<table>
<thead>
<tr>
<th>System Name</th>
<th>CPU Sockets</th>
<th>CPU Cores</th>
<th>DIMM Slots</th>
<th>Hot Plug Disks</th>
<th>Mezzanine Cards</th>
<th>10 GbE LOMs</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL860c i2</td>
<td>2</td>
<td>8</td>
<td>24</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>BL870c i2</td>
<td>4</td>
<td>16</td>
<td>48</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>BL890c i2</td>
<td>8</td>
<td>32</td>
<td>96</td>
<td>8</td>
<td>12</td>
<td>16</td>
</tr>
</tbody>
</table>

Scalable blade technology

HP Integrity server blades offer unprecedented flexibility to scale up your system. Each base server blade features a Blade Link connector that allows two or four base blades to be connected together to form up to an eight socket server. The base blades are connected with Integrity Blade Links. There are two Integrity Blade Link connectors to choose from—Blade Link-2 or Blade Link-4 used to scale to four and eight socket systems respectively.

The Integrity Blade Links connect selected QPI ports among processors, the required clocks, and side band signals for the system to operate a scale up multiprocessor system. See Figure 3 for link connectivity representations of the 4S and 8S (four and eight socket) topologies.

Supported technologies

The HP Integrity server blades based on Intel Itanium processor 9300 series include mission-critical class technologies:

- Two Itanium processor 9300 series modules—four to eight processors when conjoined with a Blade Link
- Thermal Logic technologies
- Multiple slots for IO cards
- Integrated multifunction Ethernet network adapters that support TCP/IP offload engine and iSCSI acceleration
- Hot Plug disk drives
- Power management
- Scaling base blades with different Integrity Blade Links; from 2S to 4S and 8S server blades supported

Refer to Table 1 for system scaling options.
**Supported enclosures**

The HP Integrity server blade is a full-height 8U server that slides into HP BladeSystem c-Class enclosures. Three different c-Class enclosures are available to meet the needs of large or small IT environments:

- The HP BladeSystem c7000 rack enclosure is 10U high and holds up to sixteen ProLiant server blades, up to eight BL860c i2, up to four BL870c i2 or up to two BL890c i2 server blades.
- The HP BladeSystem c3000 rack enclosure is 6U high and holds up to eight ProLiant, up to four BL860c i2, up to two BL870c i2 or up to one BL890c i2 server blades.
- The HP BladeSystem c3000 tower enclosure is designed with casters for sites without racks.

The rack enclosures fit in HP 10000 series racks and can operate with as few as one server blade installed. The greatest advantage of blade architecture, however, is the ease of adding more server blades. Integrity server blades, ProLiant server blades and StorageWorks storage blades can all be used simultaneously in the same c-Class enclosure.
Processor technologies

Intel Itanium processor 9300 series micro-architecture is the world’s first processor with more than 2 billion transistors. The most significant improvements in the Itanium processor 9300 series include doubling the number of processing cores to 4 from the previous Itanium processor 9100 series, many fold increase in bandwidth, greater physical memory capacity and next generation reliability, availability, serviceability (RAS) and manageability features.

The HP Integrity server blades are equipped with Itanium processor 9300 series. Each processor can host up to four processing cores. Each processor features two memory controllers and QuickPath Interconnect Technology to boost bandwidth between processors, memory, and I/O subsystems.

Multi-level caches

Intel Itanium processor 9300 series have a three level cache hierarchy (Figure 4)

- An on-core 32 KB Level 1 (L1) cache split into 16 KB for Instruction and 16 KB for data. The L1 cache can deliver six instructions every clock cycle.
- The on-core Level 2 (L2) cache is organized as 512 KB Instruction and 256 KB data caches.
- Each processor core features up to 6 MB Level 3 (L3) cache. All L3 caches amount to a total of up to 24 MB per processor socket.
- Each memory controller also features a 1 MB directory cache.
Hyper-threading

With four multi-threaded cores, each processor can execute up to eight simultaneous software threads. Thread management has improved compared to previous Itanium generations. Earlier thread switching occurred when a thread was stalled due to a high latency event such as waiting for data from main memory. Itanium processor 9300 series supports switching for medium latency events and for spin-lock loops. This and other enhancements to thread switching logic help to boost core utilization. This feature improves application response time and overall system throughput.

Turbo Boost technology

Intel® Turbo Boost technology complements hyper-threading. For workloads and applications that do not benefit from multi-threading, Turbo Boost technology can increase performance. Turbo Boost is engaged by default. It automatically increases the clock frequency and voltage of active cores operating below power and thermal design points determined by the processor. Turbo Boost technology is operating-system-independent, which means that Advanced Configuration and Power Interface-aware (ACPI) operating systems require no changes to support it.

Integrated memory controllers and Scalable Memory Interconnect

Communication channels between the processor cores and main memory have been dramatically improved. Each processor has two integrated memory controllers that provide peak memory bandwidth up to 34 GBps, which is up to six times the bandwidth of the previous generation processor. The Scalable Memory Interconnect (SMI) connects to the Intel® Scalable Memory Buffers to support larger physical memory configurations. The memory subsystem supports up to eight times more memory than previous generations using DDR3 memory components.

Enhanced instructions-level parallelism

Instructions-level parallelism (ILP) refers to the ability to process multiple instructions on each software thread. Itanium processor 9300 series disperse instructions to 11 functional units, via a six-instruction wide and eight-stage deep pipeline. To minimize threads from stalling the pipeline, the processor supports zero cycle load-use penalties and zero-cycle branch re-steers plus extensive bypasses.

QuickPath Interconnect architecture

Each QuickPath Interconnect (QPI) consists of two unidirectional links that operate simultaneously in opposite directions using differential signaling. Unlike a typical serial bus, the QPIs transmit data packets in parallel across multiple lanes, and packets are broken into multiple parallel transfers. Each link is comprised of twenty 1-bit lanes. A maximum of 16 bits (2 bytes) are used to transfer data and error correction use the remaining 4 bits. The link allows a maximum of 9.6 gigabytes per second in each direction, for a total bandwidth of 19.2 gigabytes per second. If an application requests data from the memory of another processor, the QPI uses high-bandwidth inter-processor communication to retrieve the data. The communication between processors within the same blade server is twice as fast when compared to the communications through the Integrity Blade Link.
Figure 5 shows the HP Integrity BL860c i2 server blade QPI links implementation.

**Figure 5:** HP Integrity BL860c i2 server blade QPI Links Interconnectivity Diagram. Notice the blade link connector to allow multiple server blades interconnect. QPI links connected through the blade link connector are half width.

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**Thermal logic technologies**

Itanium processor 9300 series provides enhanced power and thermal management. Enhanced demand-based switching (DBS) where voltage and frequency are modulated enable better energy efficiency. Voltage and frequency settings are adjusted dynamically to provide best performance without exceeding maximum power. Performance is improved by monitoring 120 events in each core and adjusting the core voltage and frequency every 6µs (micro-seconds). This function can be used in conjunction with DBS to fine tune performance versus power.

**Reliability, availability, and serviceability (RAS) technologies**

**Processor RAS improvements**

Itanium processor 9300 series extends the mainframe-class reliability, availability, and serviceability features from previous Itanium processors. The Itanium processor 9300 series incorporate extensive capabilities for detecting, correcting, and reporting processor soft and hard errors.
Major core structure improvements include:

- **Soft Errors**: High energy particles striking a processor may cause a logic gate to switch state, resulting in a “soft” error. Itanium processor 9300 series circuit topologies were designed to improve resistance to soft errors in latches by up to 100 times from any regular latch. Registers are also 80 times less susceptible than standard registers to soft errors.
- **Error Correction Code or Parity**: All major structures on the Itanium processor 9300 series are protected via ECC or parity error protection.
- **Intel® Cache Safe technology**: Heuristics are used to monitor the number of errors per cache index and map out bad cache lines. Cache data is also automatically scrubbed to correct single bit errors. Itanium processor 9300 series protect the second and third-level cache arrays. Previous Itanium processors only protected the third-level cache.
- **Advanced Machine Check Architecture (AMCA)**: This enables coordinated error handling across the hardware, firmware, and operating systems. The coordinated handling greatly reduces the likelihood of data corruption. It also improves the reliability of the system since firmware and OS participate on the system recovery, from otherwise uncorrectable errors.

**Memory RAS features**

Extensive RAS features are integrated to detect and correct errors on the memory subsystem.

- **DRAM ECC**: By using memory DIMMs whose base DRAM x4 bits wide, the subsystem corrects single (SDDC) and double device data correction (DDDC). This means that the memory subsystem can map out two failed devices and continue correcting single bit errors. There is no performance penalty for mapping out the devices.
- **Memory Scrubbing**: Accumulated memory DIMM errors can result in multi-bit errors that cannot be corrected and can result in data corruption. Memory scrubbing finds memory errors before they accumulate. Corrected data is rewritten back to the appropriate memory location.
- **SMI Memory Channel Protection**: Cyclic Redundancy Check is used to detect errors in the Scalable Memory Interconnect channels. Upon errors, the transactions are retried several times. If required, the channel could be re-initialized on the fly. Upon problem persistence, the affected memory channel is mapped out.

**Intel® QuickPath Interconnect RAS features**

Extensive RAS features are integrated to detect and correct errors on the memory subsystem.

- **Error Detection and Correction**: Cyclic Redundancy Check (CRC) is used to detect errors—transactions can be retried multiple times, the channel can be physically reset on the fly by the link layer, and bad lanes can be failed over.
- **Clock Failover**: Accumulated memory DIMM errors can result in multi-bit errors that cannot be corrected and can result in data corruption. Memory scrubbing finds memory errors before they accumulate. Corrected data is rewritten back to the appropriate memory location.
- **Lane Failover**: During operation, failed lanes would cause CRCs that would trigger a “on the fly” link retraining where the bad lane are mapped. Operations are resumed with a reduced width link. Although mapping out lanes may affect the performance by reducing a full-width link to half or half-to-quarter, it does enable uninterrupted operation and protection against most multi-bit hard errors.
Processor socket technology

Itanium processor 9300 series uses a processor socket technology called Land Grid Array. The processor package designs no longer have pins. Instead, the processor package has pads of gold-plated copper that touch processor socket pins on the motherboard.

Technicians must be careful when installing processors to avoid damaging the delicate processor socket pins. If installing a new CPU Field-Replaceable Unit (FRU), first install the ararat/processor assembly through the processor socket guiding posts, followed by the heat sink installation. This is a simple procedure without any tools. (Figure 6)

I/O technologies

HP Integrity server blades support PCI Express (PCIe), serial attached SCSI (SAS), Multi-function 1 Gb or 10 Gb Ethernet, 4 Gb and 8 Gb Fibre Channel. Future releases are expected to provide supports for more IO cards and protocols.
PCI Express technology

The PCIe serial interface provides point-to-point connections between the chipset I/O controller hub and I/O devices. Each PCIe serial link consists of one or more dual-simplex lanes. Each lane contains a send pair and a receive pair to transmit data at the signaling rate in both directions simultaneously (Figure 7). PCIe 1.0 has a signaling rate of 2.5 Gbps per direction per lane. PCIe 2.0 doubles the per-lane signaling rate of PCIe 1.0 from 2.5 Gbps to 5 Gbps. This flexibility allows slower devices to transmit on a single lane with a relatively small number of pins while faster devices can transmit on more lanes as required.

PCIe 2.0 is backward compatible with PCIe 1.0: A PCIe 2.0 device can be used in a PCIe 1.0 slot and a PCIe 1.0 device can be used in a PCIe 2.0 slot. For best performance, however, each card should be used in a slot that supports its logical link size.

![Figure 7: PCIe bandwidth](image)

HP Smart Array controllers

HP Integrity server blades support internal hard drives through integrated or optional HP Smart Array controllers. The embedded Smart Array P410i controller supports SAS SFF drives.

An optional battery-backed write cached (BBWC) Smart Array controller is available to interface with the MDS600 disk array. A battery-backed write cache (BBWC) is also available as an option for the Smart Array controllers. The battery prevents information in the buffer from being lost in case of an unexpected system shutdown. In the case of a complete system failure, IT administrators can move the controller and disks to a different server where the controller flushes out the cache to the disks after power is restored. In the case of a controller failure, administrators can move the cache module and disks to a working controller where the cache is flushed out to the disks. The battery lasts up to two days without receiving any power from the computer.

Serial Attached SCSI technology

Serial attached SCSI (SAS) is a serial communication protocol for direct-attached storage devices such as SAS and SATA Small Form Factor (SFF) disk drives. It is a point-to-point architecture in which each device connects directly to a SAS port rather than sharing a common bus, as parallel SCSI devices do. Point-to-point links increase data throughput and improve the ability to locate and fix disk failures. More importantly, SAS architecture solves the parallel SCSI problems of clock skew and signal degradation at high signaling rates.
Optional mezzanine cards

HP Integrity BL860c i2 server blades use two types of mezzanine cards to connect to the various interconnect fabrics such as Fibre Channel, Ethernet, serial-attached SCSI, or InfiniBand. Type I and Type II mezzanine cards differ only in the amount of power allocated to them by the server and in the physical space they occupy on the server blade. Type I mezzanine cards have slightly less power available to them and are slightly smaller. Type I mezzanine cards are compatible with all mezzanine connectors in BL860c i2 and ProLiant server blades. Type II mezzanine cards are compatible with Mezzanine 2 or 3 connectors in full-height c-Class server blades. Type II mezzanine cards are also compatible with Mezzanine 2 connectors in half-height c-Class server blades.

Both types of mezzanine cards use a 450-pin connector, enabling up to eight lanes of differential transmit and receive signals. Because the connections between the device bays and the interconnect bays are hard-wired through the signal midplane, the mezzanine cards must be matched to the appropriate type of interconnect module. For example, a Fibre Channel mezzanine card must be placed in the mezzanine connector that connects to an interconnect bay holding a Fibre Channel switch. Check for mezzanine cards supported by your system before purchasing. For the most up-to-date information about the c-Class mezzanine card options, go to the HP website: http://h18004.www1.hp.com/products/blades/components/c-class-interconnects.html

Networking technology

Multifunction 1 Gb or 10 Gb Ethernet network adapters integrated on all c-Class server blades provide several advantages:

- Receive-side Scaling (RSS) in Microsoft Windows Server 2008 R2 resolves the single-processor bottleneck by allowing the receive side network load from a network adapter to be shared across multiple processors. RSS enables packet receive-processing to scale with the number of available processors.
- iSCSI Acceleration (available on some integrated network adapters) offloads some of the work in creating iSCSI packets from the processor onto the network controller, freeing up the processor for other work (check OS driver support).
- HP Virtual Connect (VC) and Flex-10 provide up to 16 FlexNICs across four ports to simplify server connection setup and administration.

Virtual Connect

Virtual Connect technology is a set of interconnect modules and embedded software for c-Class enclosures that simplifies the setup and administration of server connections. HP Virtual Connect includes the following components:

- HP 1/10 Gb Virtual Connect Ethernet Module
- HP 1/10 Gb-F Virtual Connect Ethernet Module
- HP Virtual Connect Flex-10 10 Gb Ethernet Module
- HP Virtual Connect 4 Gb Fibre Channel Module
- HP Virtual Connect 8 Gb 24-Port Fibre Channel Module
- HP Virtual Connect Manager
Virtual Connect implements server-edge virtualization so that server administrators can upgrade, replace, or move server blades within their enclosures without changes being visible to the external LAN and SAN environments. HP recommends using Virtual Connect or managed switches to reduce cabling and management overhead.

Like other Ethernet and Fibre Channel switches, Virtual Connect modules slide into the interconnect bays of c-Class enclosures. To support the Virtual Connect Fibre Channel module, the enclosure must have at least one Virtual Connect Ethernet module, because the Virtual Connect Manager software runs on a processor that resides on the Ethernet module.

When the LAN and SAN connect to the pool of servers, the server administrator uses Virtual Connect Manager to define a server connection profile for each server. The Virtual Connect Manager creates bay-specific profiles, assigns unique MAC addresses and WWNs to these profiles, and administers them locally. Network and storage administrators can establish all LAN and SAN connections once during deployment. If servers are later deployed, added, or changed, no connection changes are needed because Virtual Connect keeps the profile for that LAN and SAN connection constant.

To help administrators fully utilize the 10 GbE connection bandwidth, HP introduced Flex-10 technology in the BladeSystem c-Class architecture. Using Flex-10, administrators can partition the bandwidth of a single 10 Gb pipeline into multiple FlexNICs. In addition, administrators can regulate the bandwidth for each partition by setting it to a user-defined portion of the total 10 Gb connection. Administrators can set speeds from 100 Mb per second to 10 Gb per second in 100 Mb increments.

There are advantages to partitioning a 10 GbE pipeline:

- More NIC connections per server, which is especially important in a virtual machine environment
- Ability to match bandwidths to the network function, such as management console or production data

Flex-10 technology uses two hardware components:

- The HP Virtual Connect Flex-10, 10 Gb Ethernet Module
- Either the 10 Gb Flex-10 LAN-on-motherboard (LOM) or the HP NC532m Flex-10, 10 GbE Network Adapter mezzanine card

The Virtual Connect Flex-10 Ethernet Module is required to manage the 10 GbE server connections to the data center network. The 10 Gb Flex-10 LOM and mezzanine cards are NICs, each with two 10 Gb ports. Each 10 Gb port can be configured from one to a maximum of four individual FlexNICs. The server ROM and the operating system or hypervisor recognize each FlexNIC as an individual NIC.

Full details about Flex-10 technology are available in the technology brief titled “HP Flex-10 technology” on the HP technology website:


Full details about Virtual Connect technology are available in the technology brief titled “HP Virtual Connect technology implementation for the HP BladeSystem c-Class” on the HP technology website:

Configuration and management technologies

BladeSystem Onboard Administrator (OA)

The heart of c-Class enclosure management is the BladeSystem Onboard Administrator (OA) module located in the enclosure. It performs four management functions for the entire enclosure:

- Detecting component insertion and removal
- Identifying components and required connectivity
- Managing power and cooling
- Controlling components

The BladeSystem OA works with the Integrity Integrated Lights-Out 3 (iLO 3) management processor on each server blade to form the core of the management architecture for HP BladeSystem c-Class.

To identify a component, the BladeSystem OA reads a Field-Replaceable Unit (FRU) Electrically Erasable Programmable Read-Only Memory (EEPROM) that contains specific factory information about the component, such as product name, part number, and serial number. The BladeSystem OA accesses server blade FRU EEPROMs through their iLO 3 management processors.

The server blades contain several FRU EEPROMs: one on the server board that contains server information and embedded NIC information, and one on each of the installed mezzanine option cards. Server blade control options include auto login to the iLO 3 Web interface and remote server consoles, virtual power control, and boot order control. Server blade control options also include extensive server hardware information including iLO 3 firmware versions, server name, network adapter and option card port IDs, and port mapping. The BladeSystem OA provides easy-to-understand port mapping information for each of the server blades and interconnects modules in the enclosure. To simplify the installation of the various mezzanine cards and interconnect modules, the BladeSystem OA uses an electronic keying process to detect mismatches.

Integrity Integrated Lights-Out 3

Integrity server blades include the Integrity Integrated Lights-Out 3 (iLO 3) management processor. Each individual blade in conjoined server blades contains a physical iLO 3, but the management is aggregated into a single unified iLO 3 user interface. The c-Class enclosure includes an Ethernet management network to aggregate all iLO 3 management communications across the entire enclosure. This management network connects iLO 3 processors to the BladeSystem OA through the BladeSystem OA tray. The BladeSystem OA provides direct access to each iLO 3 through the enclosure management network. The BladeSystem OA uses this network to manage pooled enclosure power and cooling. In addition, every Integrity server blade ships with an Integrity iLO 3 Advanced license key factory installed. This key enables advanced management features of the iLO 3 such as virtual media and integration with Insight power management.
HP Insight Control for HP-UX

Insight Control for Integrity provides centralized management tools for deployment, performance analysis, power management, and health monitoring. Full Insight Control functionality is included in the HP-UX 11i v3 Operating Environments. Applications such as Software Assistant (SWA), Systems Management Homepage (SMH), and Insight Control power management (ICpm) can be run from the SIM CMS and provide an agile and resilient foundation to meet service levels continuously in an Adaptive Infrastructure.

- HP Systems Insight Manager (HP SIM) provides a single tool for managing HP Integrity, ProLiant, and HP 9000 systems.
- HP System Management Homepage (HP SMH) is a web-based interface that consolidates and simplifies single system management for HP servers.
- Software Assistant (SWA) simplifies patch and security bulletin management on HP-UX systems.
- Ignite-UX is an HP-UX administration toolset that allows simultaneous installation of HP-UX on multiple clients, creation of golden images and recovery media.
- Insight Control power management provides graphical power and thermal monitoring, power event response, and intelligent discovery of power topology.

Details on Insight Control for OpenVMS and Windows are expected to be provided when those O/S platforms are qualified on the HP Integrity server blades.

Power management technologies

Power meter

An integrated power meter in HP c-Class server blades analyzes actual server power use. The BladeSystem Onboard Administrator can access the power meter through the Integrity Integrated Lights-Out 3 (iLO 3) and can communicate through external power management software such as Insight Control power management. Insight Control power management also consolidates power data for multiple servers to a central location. IT departments can use this information to charge business units or third parties for the actual energy costs associated with workload processing. The BladeSystem Onboard Administrator provides instant and time-averaged views of the power consumption of individual servers or of all servers within a c-Class BladeSystem enclosure.

Operating system power regulation

HP-UX 11i v3 can realize a power savings of up to 45 percent of processor power on a system with the `pwr_idle_ctl` command, which determines how aggressive the OS will be in keeping a processor idle once it has become idle. Some states have been optimized to save power with practically no performance penalty. Active processors can save up to 40 percent with the `pstatectl` command. Active processors can be set to a dynamic control mode that can change performance states to match processor performance (and power consumption) with utilization requirements. A static control mode is also available which allows a processor’s performance state to be set and maintained at a tunable value.
HP Dynamic Power Capping

Future enhancements to Integrity server blades enable Dynamic Power Capping. Dynamic Power Capping can bring a server experiencing a sudden increase in workload back under its power cap in less than one-half second. This fast response prevents any surge in power demand that could cause a typical data center circuit breaker to trip. Dynamic Power Capping prevents tripping circuit breakers that have a specified trip time of three seconds or longer at 50°C and 150 percent overload.

Data security technology with Trusted Platform Module

The Trusted Platform Module (TPM) is a hardware-based system security feature that can securely store information such as passwords and encryption keys to authenticate the platform. Administrators can also use TPM to store platform measurements that help ensure that the platform remains trustworthy. The Integrity server blades support an optional TPM v1.2.