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HPE Integrity MC990 X Server User Guide

Abstract

This guide provides an overview of the architecture, general operation and descriptions of the major components that comprise the HPE Integrity MC990 X Server system. It also provides the standard procedures for powering on and powering off the system, basic troubleshooting and maintenance information, Foundation Software usage information, and important safety and regulatory specifications.

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Contents

1 Integrity MC990 X system overview

This chapter provides an overview of the physical and architectural aspects of the HPE Integrity MC990 X Server system. The major components of the Integrity MC990 X system are described and illustrated.

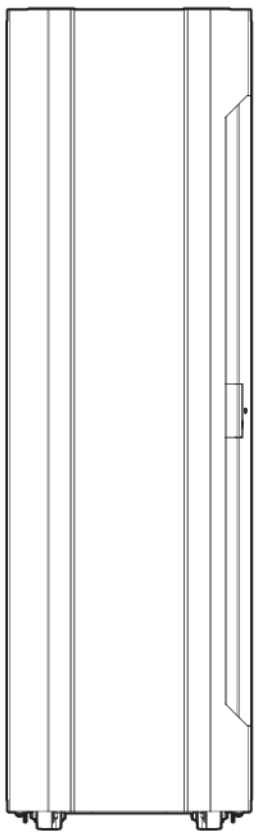
The Integrity MC990 X system is an advanced symmetric multiprocessing (SMP) computer system with 8 Intel processor sockets as a cache-coherent single system image (SSI). Each processor socket in the system houses multiple compute cores.

In an SMP system, each MC990 X server chassis contains memory that it shares with all other processors in the system. Because the Integrity MC990 X system is modular, it combines the advantages of lower entry-level cost with global scalability in processors, memory, and I/O. You can install and operate the Integrity MC990 X system in your lab or server room. One 42U rack holds one base MC990 X server chassis, one expansion MC990 X server chassis, one rack management controller (RMC) unit, power distribution units (PDU), and optional mass storage units.

This chapter consists of the following sections:

Figure 1 (page 6) shows the front view of a single-rack Integrity MC990 X system .

Figure 1 Integrity MC990 X system rack



MC990 X server chassis

The basic enclosure within the Integrity MC990 X system is the MC990 X server chassis. The MC990 X server chassis contains one four-socket motherboard connected

to support up to 28 NUMAlink ports, each with a maximum bi-directional bandwidth communication rate of up to 7.47 GB/sec.

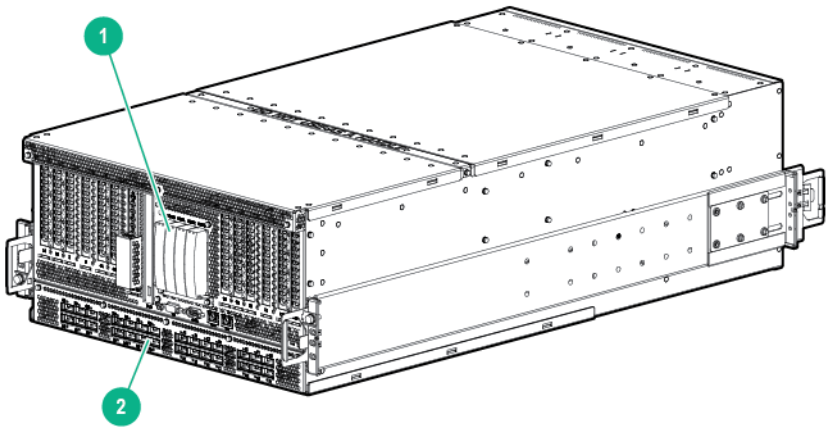
Each MC990 X server chassis has ports that are brought out to external NUMAlink connectors located on the front of the enclosure. The single rack houses two MC990 X server chassis (making up the MC990 X server), an RMC unit, and optional external storage.

Figure 2 (page 7) shows an example of a MC990 X server chassis prior to mounting in a rack.

The system requires a minimum of one rack with enough PDUs to support two MC990 X server chassis, one RMC, and any optional equipment installed in the rack.

You can also add additional PCIe expansion cards or RAID and non-RAID disk storage to your server system.

Figure 2 MC990 X server chassis



1. System drive assembly
2. NUMAlink connectors (28)

System features

The main features of the Integrity MC990 X system are discussed in the following sections:

- “Modularity and scalability” (page 7)
- “Distributed shared memory (DSM)” (page 8)
- “Rack management controller” (page 9)
- “Distributed shared I/O” (page 8)
- “Reliability, availability, and serviceability” (page 9)

Modularity and scalability

The Integrity MC990 X system is modular. The compute/memory/PCIe components are housed in two MC990 X server chassis. Additional optional mass storage may be added to the system along with additional MC990 X server chassis. You can add different types of PCIe board options to a server to achieve the desired system configuration. You can easily configure systems around processing capability, I/O capability, memory size, or storage capacity. Each air-cooled MC990 X server chassis has redundant, hot-swap fans and redundant, hot-swap power supplies. Internal drives also can be hot-swapped as long as redundant configurations are set up.

Distributed shared memory (DSM)

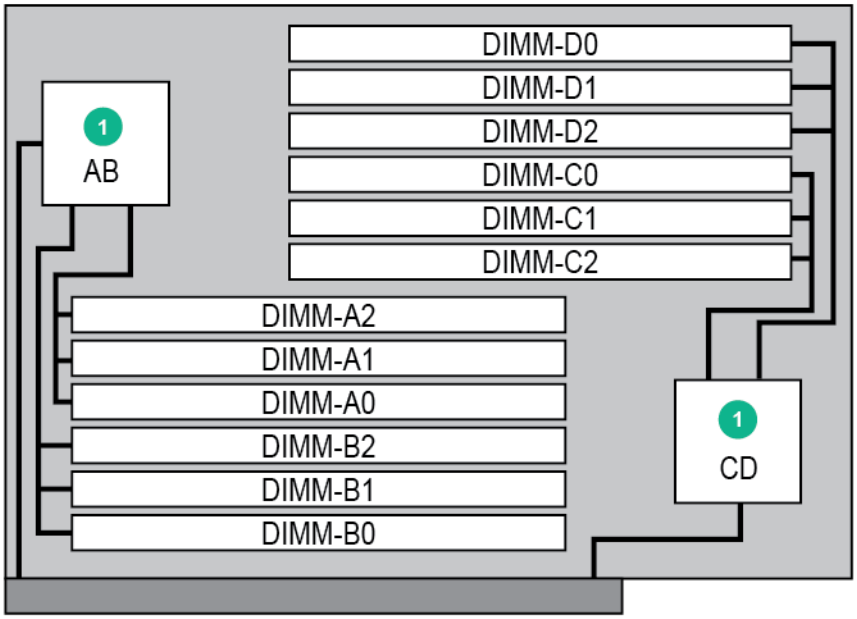
In the Integrity MC990 X system, memory is physically distributed both within and among the MC990 X server chassis (compute/memory/I/O); however, it is accessible to and shared by all NUMAlinked devices within the SSI. This means all NUMAlinked components sharing a single Linux operating system, operate and share the memory fabric of the system. Memory latency is the amount of time required for a processor to retrieve data from memory. Memory latency is lowest when a processor accesses local memory. Note the following sub-types of memory within a system:

- If a processor accesses memory that it is connected to on a MC990 X server chassis motherboard, the memory is referred to as the processor local memory. Figure 3 (page 8) shows a conceptual block diagram of the motherboard memory riser board pathways.
- If processors access memory located in another NUMAlinked MC990 X server chassis motherboard within the system, the memory is referred to as remote memory.
- The total memory within the NUMAlinked Integrity MC990 X system is referred to as global memory.

Physical memory riser

Physical memory nodes are memory risers and each is made up of two board assemblies: memory riser board and power board. Eight memory riser assemblies plug into each MC990 X server chassis motherboard. The memory riser power board receives power directly from the motherboard. A maximum of 12 DDR4 memory DIMMs are supported in each memory riser.

Figure 3 MC990 X server chassis memory riser block diagram



1. Memory controller

Distributed shared I/O

Like DSM, I/O devices are distributed within the MC990 X server chassis. Each BaseIO riser is accessible by all compute nodes within the SSI through the NUMAlink interconnect fabric.

Rack management controller

Each Integrity MC990 X system has a rack management controller (RMC) generally located directly above or below the MC990 X server chassis in a rack. The RMC supports powering up and down of the system motherboards and environmental monitoring of all Integrity MC990 X system units within the SSI. In addition, the RMC provides the top layer of system control for Integrity MC990 X system. Through the use of an internal 24-port Ethernet switch, a single RMC can provide system control for up to 16 MC990 X server chassis in an expanded Integrity MC990 X system.

One GigE port from each MC990 X server chassis motherboard connects to the RMC via Cat-5 cable.

Reliability, availability, and serviceability

The Integrity MC990 X system components have the following features to increase the reliability, availability, and serviceability (RAS) of the systems.

- Power and cooling:
  - MC990 X server chassis power supplies are redundant and can be hot-swapped.
  - MC990 X server chassis have overcurrent protection at the motherboard and power supply level.
  - MC990 X server chassis fans are redundant and can be hot-swapped.
  - MC990 X server chassis fans run at multiple speeds. Speed increases automatically when temperature increases or when a single fan fails.
- System monitoring:
  - System controllers monitor the internal power and temperature of the MC990 X server chassis components, and can automatically shut down an enclosure to prevent overheating.
  - All main memory has Intel Single Device Data Correction to detect and correct 8 contiguous bits failing in a memory device. Additionally, the main memory can detect and correct any two-bit errors coming from two memory devices (8 bits or more apart).
  - All high speed links including Intel Quick Path Interconnect (QPI), Intel Scalable Memory Interconnect (SMI), and PCIe have cyclic redundancy check (CRC) check and retry.
  - The NUMAlink interconnect network is protected by CRC.
  - Each MC990 X server chassis installed has status LEDs that indicate the server operational condition; LEDs are viewable at the front of the unit.
- Power-on and boot:
  - Automatic testing occurs after you power on the system. These power-on self-tests or POSTs are also referred to as power-on diagnostics or PODs.
  - Processors and memory are automatically disabled when a self-test failure occurs.
  - Boot times are minimized.

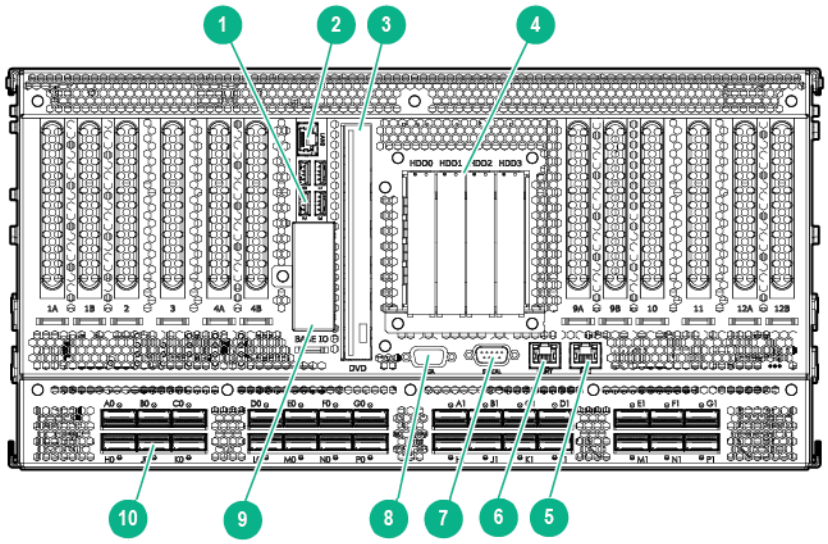
- Further RAS features:
  - Systems can report status inventory information, provide hardware logs of out-of-range conditions, or perform recovery procedures via remote commands.
  - All system faults are logged in files.
  - Memory can be scrubbed using error checking code (ECC) when a single-bit error occurs.

System components

The Integrity MC990 X system includes the following major components:

- **42U rack**—These racks are used for the MC990 X server chassis, RMC, and optional external storage in the Integrity MC990 X system. Up to three MC990 X systems can be installed in each 42U rack.
- **Server chassis**—The Integrity MC990 X system includes one base server chassis and one expansion server chassis. Each 5U-high server chassis contains four power supplies, one four-processor compute/memory board, and other optional riser enabled drives and boards for the Integrity MC990 X system. The base server chassis also has a BaseIO riser not present in the expansion server chassis. Figure 4 (page 10) shows the MC990 X server chassis front panel components.
- **Motherboard**—Holds four processor sockets and 8 memory risers with up to 12 DIMMs per memory riser for a maximum of 96 DIMMs per motherboard. Each motherboard can be ordered with risers that enable the base MC990 X server chassis to support up to four full-height x16 PCIe cards and up to eight full-height x8 PCIe cards.

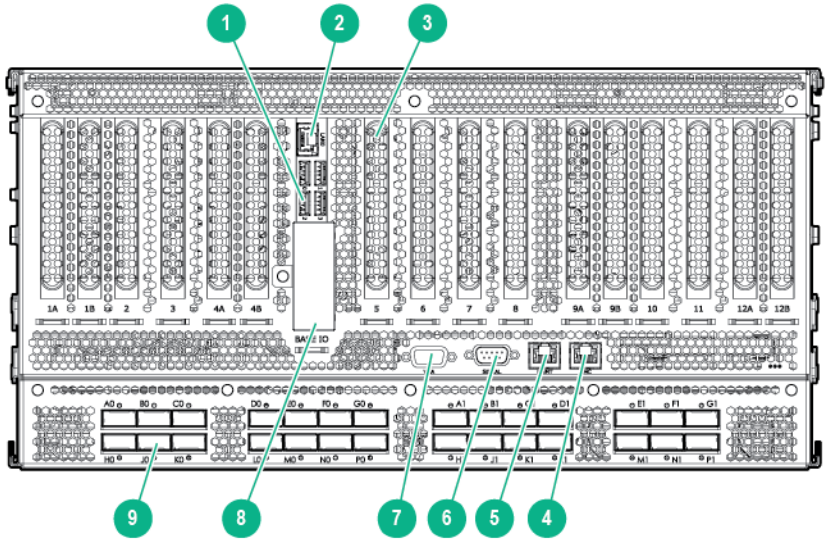
Figure 4 MC990 X base server chassis front components



1. USB ports (4)
2. ETH0
3. DVD drive
4. Disk or SS drives (4)
5. RMC port
6. MGMT port
7. Serial port
8. VGA port
9. Optional 1.8-inch SSD drive bays
10. NUMAlink ports (28)

- **Drives**—Each MC990 X base server chassis has a drive tray that supports one optional slim-line SATA DVD drive and four 2.5-inch hard disk or solid state drives. An MC990 X expansion server chassis does not require a drive assembly and can accommodate four additional PCIe cards.

Figure 5 MC990 X expansion server chassis front components



1. USB ports (4)
2. ETH0
3. PCIe card slots (16)
4. RMC port
5. MGMT port
6. Serial port
7. VGA port
8. Optional 1.8-inch SSD drive bays
9. NUMAlink ports (28)

- **Internal PCIe enabled slots**—The MC990 X server chassis and motherboard support the following types of PCIe option boards:
  - Four full-height, half-length, Gen3 x8 PCIe slots
  - Four full-height, 10.5-inch length, Gen3 x8 PCIe slots
  - Four full-height, double-wide, 10.5-inch length, Gen3 x16 PCIe slots

  NOTE: The x16 PCIe slots support cards with a maximum power consumption of 300 watts.

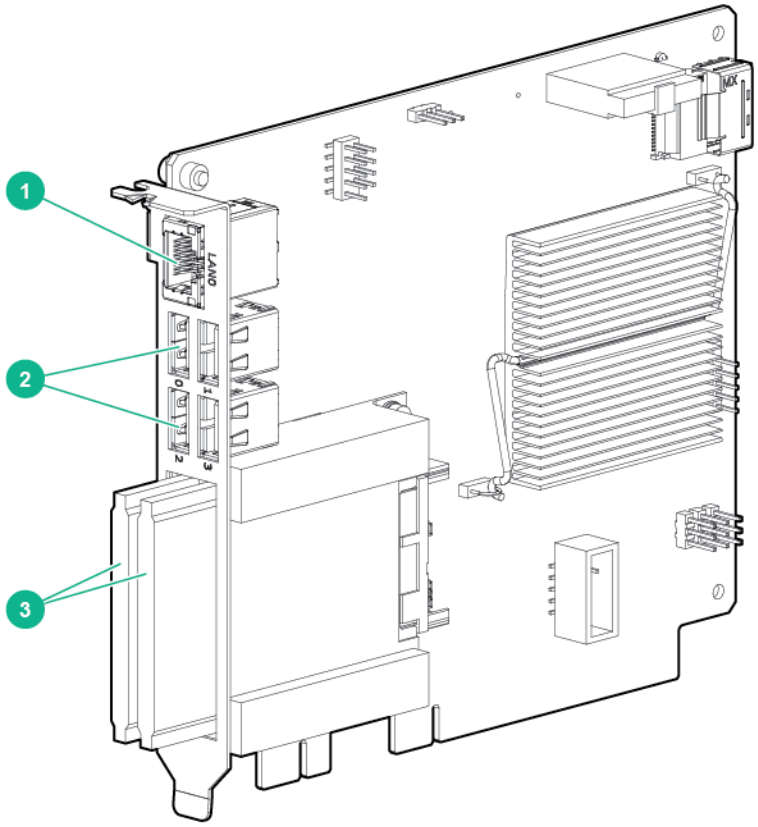
- **NUMAlink Connectors**—The external NUMAlink connectors are located on the lower-front portion of each MC990 X server chassis.
- **BaseIO board**—Optional I/O riser board (connected directly to the motherboard) that supports base system I/O functions including one Gbit Ethernet connector (top), four USB ports, and bays for two optional external 1.8-inch solid state drives (SSDs).

  Internally, the BaseIO board supports:
  - Four internal 3GB/s SATA ports (for the four 2.5-inch disk drives in the MC990 X server chassis chassis)
  - Two internal 6GB/s SATA ports (for the two optional mini 1.8-inch SSDs)

- One internal USB 2.0 port (for the internal DVD)

NOTE: Each Integrity MC990 X system (or SSI within a system) requires one BaseIO board. Figure 6 (page 12) shows the front components of the BaseIO board. The SSD drives (bottom) are enclosed with a metal cover.

Figure 6 BaseIO board front panel components



1. Ethernet port
2. USB ports (4)
3. Solid State Drives (2)

Unit numbering

Bays in the racks are numbered using standard units. A standard unit (U) is equal to 1.75 inches (4.445 cm). Because the chassis occupy multiple units, locations within a rack are identified by the bottom unit (U) in which the chassis resides. For example, in a 42U rack, an MC990 X server chassis positioned in U01 through U05 is identified as U01.

Rack numbering

Each rack is numbered with a three-digit number sequentially beginning with 001. A rack contains two MC990 X server chassis, one RMC, optional mass storage enclosures, and other optional components. In a single rack system, the rack number is always 001.

2 Operational procedures

This chapter provides an overview on how to operate your new system in the following sections:

Precautions

Before operating your system, familiarize yourself with the safety information in the following sections:

ESD precaution

CAUTION: Observe all ESD precautions. Failure to do so can result in damage to the equipment.

HPE recommends wearing an approved wrist strap when you handle any ESD-sensitive device to eliminate possible ESD damage to equipment. Connect the wrist strap cord directly to earth ground.

Safety precautions

WARNING! Before operating or servicing any part of this product, read the “Safety information” (page 60).

WARNING! Keep fingers and conductive tools away from high-voltage areas. Failure to follow these precautions will result in serious injury or death. The high-voltage areas of the system are indicated with high-voltage warning labels.

WARNING! If a lithium battery is installed in your system as a soldered part, only qualified service personnel should replace this lithium battery. For a battery of another type, replace it only with the same type or an equivalent type recommended by the battery manufacturer, or an explosion could occur. Discard used batteries according to the manufacturer instructions.

CAUTION: Power off the system only after the system software has been shut down in an orderly manner. If you power off the system before you halt the operating system, data may be corrupted.

System control network

All MC990 X server chassis use an RMC which communicates with the chassis board level BMCs within each SSI. These components in concert are generically known as the system control network.

The Integrity MC990 X system control network provides control and monitoring functionality for each motherboard, power supply, and fan assembly in each MC990 X server chassis in the system.

The RMC network provides the following functionality:

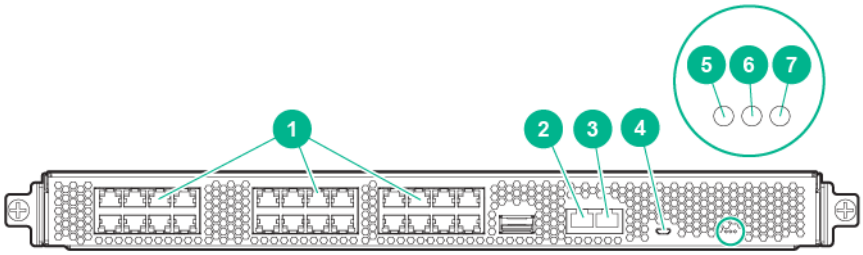
- Powering the entire system up and down.
- Powering individual MC990 X server chassis up and down.
- Monitoring the environmental state of the system, including voltage levels.
- Monitors and controls status LEDs on the enclosure.
- Supports entry of controller commands to monitor or change particular system functions within a particular MC990 X server chassis. See the *HPE Integrity MC990 X Server RMC Software User Guide* for a complete list of command line interface (CLI) commands.
- Provides access to the system OS console allowing you to run diagnostics and boot the system.
- Provides the ability to flash system BIOS.

Accessing the system control network

Access to the system control network is accomplished by the following methods:

- A LAN connection to the RJ-45 WAN port on the RMC, (see Figure 7 (page 14)).
- A USB-to-micro-USB serial connection to the “Console” port (see CNSL in Figure 7 (page 14)) on the RMC front panel example.

Figure 7 RMC front panel connections



1. Network ports (24)
2. WAN port
3. AUX port
4. CNSL port
5. RST button
6. PG (Power Good) LED indicator
7. HB (Heart Beat) LED indicator

Connecting to the system control network

The Ethernet connection is the preferred method of accessing the system console.

Administrators can perform one of the following options for connectivity:

- A portable system console can be directly connected to the RMC micro-USB connect port, (labeled CNSL). See Figure 7 (page 14). This requires connecting from a laptop or workstation that is physically located near the system.
- A LAN connection is used to communicate directly with the RMC, using the IPMI 2.x protocols. This LAN connection must be made to the RJ-45 WAN port on the RMC. This connection can be used with a local or remote IPMI-enabled console device.

Communicating with the system

The two primary ways to communicate with and administer the MC990 X system are through the RMC interface command line interface (CLI) or through an IPMI 2.x LAN interface.

The command line interface

The Integrity MC990 X system CLI is accessible by logging directly into a RMC.

Log in to the RMC as **root** with the default password “root”. As in this example:

```
asylum$ ssh root@mc990x-rmc
root@mc990x-rmc's password: root
MC990 X RMC, Rev. 1.1.xx [Bootloader  1.1.x]
RMC:r001i01c> help
```

NOTE: HPE recommends changing all default logins and passwords.

Once a connection to the RMC is established, system control commands can be entered. See “Example CLI commands used” (page 15) for some examples.

See “Powering up and down from the command line interface” (page 16) for additional specific examples of using the CLI commands.

Example CLI commands used

The following is a list of some available CLI commands:

`auth`	authenticate SSN/APPWT change
`bios`	perform bios actions
`bmc`	access BMC shell
`rmc`	access RMC shell
`config`	show system configuration
`console`	access system consoles
`help`	list available commands
`hel`	access hardware error logs
`hwcfg`	access hardware configuration variable
`leds`	display system LED values
`log`	display system controller logs
`power`	access power control/status

Type **<cmd> --help** for help on individual commands.

Powering the system up and down

This section explains how to power up and power down individual units, or your entire Integrity MC990 X system, as follows:

- “Preparing to power up” (page 15)
- “Powering up and down from the command line interface” (page 16)
- “Booting directly from an RMC” (page 17)

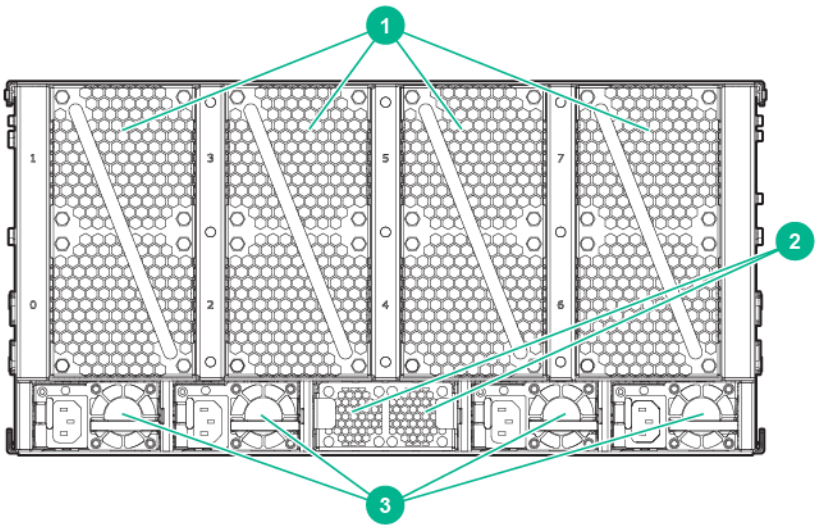
Using an RMC connection, you can power up and power down an individual MC990 X server chassis, or the entire system.

Preparing to power up

To prepare to power up your system, follow these steps:

1. Check to ensure that the power connector on the cable between the rack PDUs and the wall power-plug receptacles are securely plugged in.
2. For each individual MC990 X server chassis that you want to power up, make sure that the power cables are plugged into all the chassis power supplies correctly, see the example in Figure 8 (page 16). Setting the circuit breakers on the PDUs to the (On) position will apply power to the individual MC990 X server chassis and will start the RMC if it is plugged into the same PDU. Turn (Off) the PDU breaker switch on the PDU(s) that supply power to the MC990 X server chassis or RMC power supplies if you want to remove all power from a particular unit.

Figure 8 MC990 X server chassis power supply cable location



1. Enclosure fan assembly (4)
2. HARP fan assembly
3. Enclosure power supply with power input connector (4)

3. If you plan to power up an Integrity MC990 X system that includes optional mass storage enclosures, make sure that the power switch on the rear of each PSU/cooling module (one or two per enclosure) is in the (On) position.
4. Make sure that all PDU circuit breaker switches (see the examples in the following subsection) are turned (On) to provide power to the server when the system is powered up.

Powering up and down from the command line interface

The Integrity MC990 X system CLI is accessible by logging into the RMC as “root”.

Commands issued at the CLI of a local console prompt typically only affect the local SSI or a part of the system. Depending on the directory level you are logged in at, you may power up an entire SSI, a single rack, or a single MC990 X server chassis. In CLI command console mode, you can obtain only limited information about the overall system configuration. An RMC has information about all the MC990 X server chassis in its rack or SSI. Each MC990 X server chassis has information about its internal motherboard and options, and also (if other enclosures are attached via NUMAlink to the unit) information about those MC990 X server chassis units.

Booting directly from an RMC

Use a USB-to-micro USB cable to administer your system locally from the RMC.

Connect the cable from your administrative laptop or other device directly to the port labeled CNSL on the RMC. Note that the RMC will not (by default) require a password when you login via the CNSL port.

The console type and how these console types are connected to the Integrity MC990 X system is determined by what console option is chosen. Establish either a serial connection and/or network/Ethernet LAN connection to the RMC.

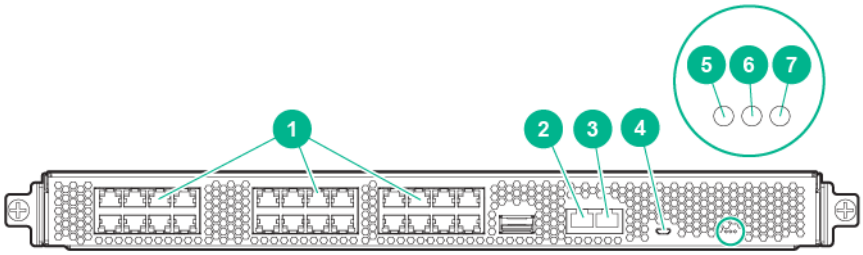
USB-connected console hardware requirements

The local USB-connected terminal should be set to the following functional modes:

- Baud rate of 115,200
- 8 data bits
- One stop bit
- No parity
- No hardware flow control (RTS/CTS)

The physical console is located on the MC990 X server chassis that has the BaseIO board installed.

Figure 9 RMC Ethernet LAN (WAN port) location



1. Network ports (24)
2. WAN
3. AUX port
4. CNSL
5. RST button
6. PG LED indicator
7. HB LED indicator

Remote LAN connection to the RMC

If you have an Integrity MC990 X system and wish to use a remote or local system to administer the system via LAN, you can connect via Ethernet cable to the RMC node WAN port identified in Figure 9 (page 17).

- The terminal should be set to the operational modes described in the previous subsection.
- If you intend to use a LAN-connected administrative server to communicate with the RMC, the RMC will either need to be assigned a DHCP IP address, or you will need to configure it with a static IP address. See the following subsections for more information.

Establishing RMC IP hardware connections

For IP address configuration, there are two options: DHCP or static IP. The following subsections provide information on the setup and use of both.

NOTE: Both options require the use of the RMC micro-USB serial port, refer to Figure 7 (page 14).

LAN Network (LAN RJ-45) connections to the RMC are always made via the WAN port.

For DHCP, you must determine the IP address that the RMC has been assigned; for a static IP, you must also configure the RMC to use the desired static IP address.

To use the serial port connection, you must attach and properly configure a micro-USB interface cable to the RMC CNSL port. Configure the serial port as described in “USB-connected console hardware requirements” (page 17).

When the serial port session is established, the console will show an RMC login, and the user can login to the RMC as user "root". Note that there is not (by default) a password required to access the RMC via the CNSL port.

Using DHCP to establish an IP address

To obtain and use a DHCP generated IP address, plug the RMC external RJ-45 network port (WAN) into a network that provides IP addresses via DHCP; the RMC can then acquire an IP address.

To determine the IP address assigned to the RMC, you must first establish a connection to the RMC serial LAN port (as indicated in the section “USB-connected console hardware requirements” (page 17)), and run the command "`ifconfig eth1`". This will report the IP address that the RMC is configured to use.

NOTE: Running the RMC with DHCP is not recommended as the preferred option for Integrity MC990 X systems. The nature of DHCP makes it difficult to determine the IP address of the RMC, and it is possible for that IP address to change over time, depending on the DHCP configuration usage. The exception would be a configuration where the system administrator is using DHCP to assign a "permanent" IP address to the RMC.

To switch from a static IP back to DHCP, the configuration file `/etc/sysconfig/ifcfg-eth1` on the RMC must be modified. To edit this file, see additional instructions in the “Using a static IP address” (page 18) section. The file must contain the following line to enable use of DHCP:

```
BOOTPROTO=dhcp
```

Using a static IP address

To configure the RMC to use a static IP address, the user/administrator must edit the configuration file `/etc/sysconfig/ifcfg-eth1` on the RMC. The user can use the `vi` command (i.e. "`vi /etc/sysconfig/ifcfg-eth1`") to modify the file.

The configuration file should be modified to contain these lines:

```
BOOTPROTO=static
IPADDR=<IP address to use>
NETMASK=<netmask>
GATEWAY=<network gateway IP address>
HOSTNAME=<hostname to use>
```

NOTE: The "GATEWAY" and "HOSTNAME" lines are optional.

After modifying the file, save, and write it using the `vi` command "**`:w!`**", and then exit `vi` using "**`:q`**". Then reboot the RMC using the `reboot` command. After reboot, it will be configured with the specified IP address.

Power up the system using the RMC network connection

You can use a network connection to power on your Integrity MC990 X system as described in the following steps:

1. You can use the IP address of the RMC to perform an SSH login, as follows:

   `ssh` **`root@<IP-ADDRESS>`**

   Typically, the default LAN password for the RMC set out of the factory is “root”.

   The following example shows the RMC prompt:

   ```
   MC990 X RMC, Rev. 1.1.xx [Bootloader  1.1.x]
   RMC:r001i01c>
   ```

   This refers to rack 1, RMC 1.

   NOTE: HPE recommends changing all default logins and passwords.

2. Power up your Integrity MC990 X system using the power on command, as follows:

   `RMC:>` **`power on`**

The system will take time to fully power up (depending on size and options). Larger systems take longer to fully power up. Information on booting Linux from the shell prompt is included at the end of the next section (“Monitoring power up” (page 19)). The following command options may be used with the RMC CLI:

Example 1 Power up

Usage: `power [-vcow] on|up [TARGET]`—turns power on

```
-v, --verbose             verbose output
-c, --clear               clear EFI variables (system and partition targets
 only)
-o, --override            override partition check
-w, --watch               watch boot progress
```

Example 2 Power down

Usage: `power [-vo] off |down [TARGET]`—shuts power down

Example 3 Reset system

Usage: `power [-vchow] reset [TARGET]`—resets the system power

Example 4 Power status check

Usage: `power [-vl0ud] status [TARGET]`—checks power-on status

To monitor the power-on sequence during boot, see the next section “Monitoring power up” (page 19), the `-uvpower` option must be included.

Monitoring power up

Establish another connection to the RMC and use the `uvcon` command to open a system console and monitor the system boot process. Use the following steps:

```
RMC:> uvcon
     uvcon: attempting connection to localhost...
```

```
     uvcon: connection to RMC (localhost) established.
     uvcon: requesting baseio console access at r001i01b00...
     uvcon: tty mode enabled, use 'CTRL-]' 'q' to exit
     uvcon: console access established
     uvcon: RMC <--> BASEIO connection active
**********************************************
******* START OF CACHED CONSOLE OUTPUT *******
**********************************************
******** [20100512.143541] BMC r001i01b10: Cold Reset via NL
broadcast reset
******** [20100512.143541] BMC r001i01b07: Cold Reset via NL
broadcast reset
******** [20100512.143540] BMC r001i01b08: Cold Reset via NL
broadcast reset
******** [20100512.143540] BMC r001i01b12: Cold Reset via NL
broadcast reset
******** [20100512.143541] BMC r001i01b14: Cold Reset via NL
broadcast reset
******** [20100512.143541] BMC r001i01b04: Cold Reset via NL....
```

NOTE: Use **CTRL-]-q** to exit the console when needed.

Depending on the size of your system, it can take 5 to 10 minutes for the Integrity MC990 X system to boot to the EFI shell. When the `shell>` prompt appears, enter **`fs0:`** as in the following example:

```
shell>  fs0:
```

At the `fs0:` prompt, enter the Linux boot loader information, as follows:

```
fs0:>  /efi/suse/elilo.efi
```

The ELILO Linux Boot loader is called and various configuration scripts are run and the SUSE Linux Enterprise Server 12 Service Pack *x* installation program appears.

Power down the system

To power down the MC990 X system, use the `power off` command, as follows:

```
RMC:>  power off
==== r001i01c (PRI) ====
```

You can also use the `power status` command, to check the power status of your system:

```
RMC:>  power status
==== r001i01c (PRI) ====

on: 0, off: 16, unknown: 0, disabled: 0
```

3 System control

This chapter describes the general interaction and functions of the overall Integrity MC990 X system control. System control parameters depend on the overall size and complexity of the Integrity MC990 X system but will generally include the following three areas:

- The RMC (one per Integrity MC990 X system)
- The individual MC990 X server chassis-based board management controllers (BMC)—report to the RMC

Levels of system control

The system control network configuration of your server will depend on the size of the system and control options selected. Typically, an Ethernet LAN connection to the system controller network is used. This Ethernet connection is made from a local or remote PC, server or workstation connected to the RMC.

The RMC is a separate stand-alone controller installed in the Integrity MC990 X system rack. The RMC acts as a gateway and buffer between the Integrity MC990 X system control network and any other public or private local area networks or systems used to communicate with the Integrity MC990 X system SSI.

IMPORTANT: The Integrity MC990 X system control network is a private, closed network. It should not be reconfigured in any way to change it from the standard Integrity MC990 X system factory installation. It should not be directly connected to any other network. The Integrity MC990 X system control network is not designed for, and does not accommodate additional network traffic, routing, address naming (other than its own schema), or DCHP controls (other than its own configuration). The Integrity MC990 X system control network also is not security hardened, nor is it tolerant of heavy network traffic, and is vulnerable to Denial of Service attacks.

System management overview

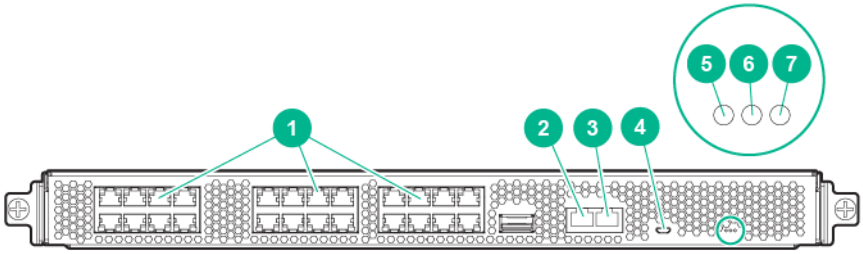
An Ethernet connection directly from the RMC (Figure 10 (page 22)) to a local private or public LAN allows the system to be administered directly from a local or remote console. Note that there is no direct inter-connected system controller function in any optional expansion or storage modules.

The system control network is designed into all MC990 X server chassis motherboards. Controllers within the system report and share status information via the RMC Ethernet interconnect cables. This maintains controller configuration and topology information between all controllers in an SSI. Figure 11 (page 22) shows an example system control network using an optional and separate (remote) workstation to monitor a single-rack Integrity MC990 X system. It is also possible to connect an optional PC or server directly to the RMC via USB, see Figure 11 (page 22) for an example diagram of RMC system management.

NOTE: External mass storage enclosures are not specifically monitored by the system controller network. Most optional mass storage enclosures have their own internal microcontrollers for monitoring and controlling all elements of the disk array. See the user guide for your mass storage option for more information on this topic.

For information on software commands used for administering network connected Integrity MC990 X systems using the RMC, see the *HPE Integrity MC990 X Server RMC Software User Guide*.

Figure 10 RMC front panel



1. Network ports (24)
2. WAN/LAN connector
3. AUX port
4. CNSL micro-USB connector
5. RST button
6. PG (Power Good) LED indicator
7. HB (Heart Beat) LED indicator

RMC overview

The RMC system for the Integrity MC990 X system manages power control and sequencing, provides environmental control and monitoring, initiates system resets, stores identification and configuration information, and provides console/diagnostic and scan interface.

The RMC provides the top layer of system control for the Integrity MC990 X system. This controller is a stand alone 1U high rack mount chassis.

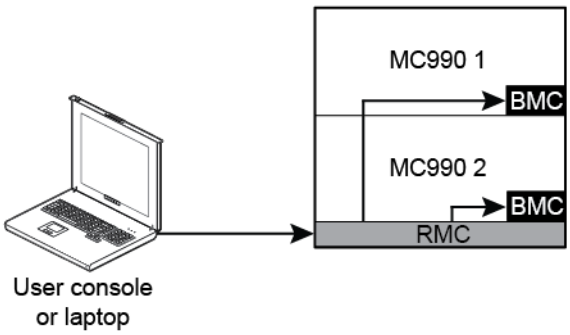
NOTE: Physical placement of the RMC is above or below the MC990 X server chassis in a rack. The RMC slides out the front of the rack only.

The RMC uses an internal 24-port Ethernet switch, which can provide system control for up to 16 MC990 X server chassis in an expanded system. The RMC accepts direction via IPMI 2.x-enabled protocol software and supports powering-up and powering-down individual motherboards and environmental monitoring of all units within the MC990 X server chassis.

The RMC sends operational requests to the BMC on each compute/memory motherboard installed. The RMC and the BMC are active whenever power is applied to the system and are not dependent on the Integrity MC990 X system having the operating system booted and operational.

The RMC in a system distributes its inquiries and information to all the MC990 X server chassis motherboards within the SSI.

Figure 11 RMC functionality



BMC overview

Each system motherboard has a baseboard management controller. The BMC is a built-in specialized microcontroller hardware component that monitors and reports on the functional health status of the motherboard. The BMC provides a key functional element in the overall Intelligent Platform Management Interface (IPMI) architecture.

The BMC acts as an interface to the higher levels of system control such as the RMC node and the higher level control system used in the optional system management node. The BMC can report any on-board sensor information that it has regarding temperatures, power status, operating system condition and other functional parameters that may be reported by the motherboard. When any of the preset limits fall out of bounds, the information will be reported by the BMC and an administrator can take some corrective action. This could entail a chassis shutdown, reset (NMI) or power cycling of the MC990 X server chassis.

The individual motherboard BMCs do not have information on the status of other motherboards within the SSI. This function is handled by the RMC and reported to an administrative console/server. Note that motherboards equipped with an optional BaseIO riser board have a dedicated BMC Ethernet port.

System controller interaction

In all MC990 X server chassis, the RMC and BMC system controllers communicate with each other in the following ways:

- System control commands and communications are passed between the administration node and the RMC via LAN or a local USB interface cable.
- The RMC communicates directly with the BMC in each installed MC990 X server chassis via a dedicated internal Gigabit Ethernet network.
- Each MC990 X server chassis has a dedicated RMC interface connector on the front of the system chassis.

System controllers

Each Integrity MC990 X system must have at least one RMC installed. “RMC functions” (page 23) describe the basic features and functions of the BMC controllers.

NOTE: For additional information on controller commands, see the *HPE Integrity MC990 X Server RMC Software User Guide*.

RMC functions

The following list summarizes the control and monitoring functions that the RMC performs:

- Supports a Gigabit Ethernet interface
- Supports a limited (IPMI 2.x) interface for power control
- Controls powering up/down of the MC990 X server chassis in the system
- Supports Time Sync by providing synchronous Ethernet to each node BMC
- Provides a platform from which system data can be captured on failure
- Provides a platform from which various firmware updates can be initiated
- Provides inventory of system components as well various firmware revisions currently flashed
- Monitors and reports issues with the RMC related to power, fans, temperature, free memory and disk space

- Provides RJ45 ports for connections to the MC990 X server chassis BMC

The following connectors and LEDs are also located on the front panel of the RMC:

- **Stack connector**—38 circuit ipass connector used to expand the system management network by connecting to a second RMC
- **WAN port**—RJ45 port used to connect to the customer's LAN or an in-rack administration node
- **AUX port**—RJ45 port currently is non-functional (reserved for future use)
- **CNSL port**—micro USB B port used for a local console/server connection
- **RST switch**—recessed push button switch used for reset of the RMC. The switch is accessed by inserting a small screw driver or similar device through an opening in the front panel.
- **PG LED**—green power good LED is illuminated when the correct power levels are present in the RMC.
- **HB LED**—green heart beat LED flashes when the RMC is functioning normally

4 Using the Foundation Software

Foundation Software (FS) includes automatic boot-time optimization utilities, reliability features, and technical support tools. Designed for high-performance computing, these tools help maximize system performance and availability.

While many FS utilities and tools work in the background to optimize program performance, other tools require configuration information from the system administrator. The FS components that this guide addresses are:

Monitoring main memory health

About main memory health monitoring

The MEMlog utility monitors the overall system health of each DIMM on your system. The MEMlog utility is configured for your system when the Foundation Software is installed.

To verify that MEMlog utility is running, enter the following command:

```
# service memlog status
```

Retrieving main memory health information

HPE recommends that you check your computer system periodically to determine whether the MEMlog utility has reported any hardware errors.

The MEMlog utility verifies and diagnoses problems with the DIMMs. The utility’s messages appear in /var/log/messages.

The following explains how to access information from the MEMlog utility through the monitoring tools or by using commands:

Accessing MEMlog messages with commands

There are two ways to use commands to retrieve information about memory problems or memory health:

- Scan the system log for entries that contain the string `MEMLOG`. If problems arise with any of the DIMMs on your system, the MEMlog utility writes a message to `/var/log/messages`. To retrieve these messages, enter the following command:

  ```
  # grep MEMLOG /var/log/messages
  r1i0n0:Dec 9 07:29:45 r1i0n0 MEMLOG[4595]: Read ECC P1-DIMM1A Rank 0 DRAM U9 DQ4 Temp = 21C
  r1i0n0:Dec 9 07:30:00 r1i0n0 MEMLOG[4595]: P1-DIMM1A has a failed DRAM and must be replaced
  soon.
       Exposure to Uncorrected Error is high
  r1i0n0:Dec 9 07:30:00 r1i0n0 MEMLOG[4595]: Read ECC P1-DIMM1A Rank 0 Bank 0 Row 0x0 Col 0x8
  Temp = 21C
  r1i0n0:Dec 9 07:30:00 r1i0n0 MEMLOG[4595]: Read ECC P1-DIMM1A Rank 0 DRAM U9 DQ4 Temp = 21C
  r1i0n0:Dec 9 07:30:12 r1i0n0 MEMLOG[4595]: Read ECC P1-DIMM3A Rank 0 Temp = 22C
  r1i0n0:Dec 9 07:30:12 r1i0n0 MEMLOG[4595]: Read ECC P1-DIMM3A Rank 0 DRAM U9 DQ4 Temp = 22C
  r1i0n0:Dec 9 07:30:25 r1i0n0 MEMLOG[4595]: P1-DIMM3A has a failed DRAM and must be replaced
  soon.
       Exposure to Uncorrected Error is high
  r1i0n0:Dec 9 07:30:25 r1i0n0 MEMLOG[4595]: Read ECC P1-DIMM3A Rank 0 Bank 0 Row 0x0 Col 0x8
  Temp = 22C
  ```

- Use the `memlog` command to retrieve a report. The report lists all the DIMMs in the system and contains an error summary for each DIMM. To obtain this report, enter the following command:

  ```
  rli0no: # memlogd –c
  ```

  ```
  user config match for X9DRT-Dakota
  found 2 sockets, highest socket number 1, deviceID Ivybridge, mem ctlrs/socket 1.
    P1-DIMM1A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 405031E4 Part
  HMT31GR7EFR4C-RD 1867
  Tue Dec 9 07:28:48 2014 Rank 0 Dram U9 Bank 0 Row 0x0 Col 0x8 multiaddress C DQ4 Temp = 21C
  hits 19
  Tue Dec 9 07:31:31 2014 Rank 1 Dram U9B Bank 0 Row 0x0 Col 0x0 single DQ4 Temp = 21C hits 1
    P1-DIMM2A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 409031CA Part
  HMT31GR7EFR4C-RD 1867
    P1-DIMM3A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 405031DE Part
  HMT31GR7EFR4C-RD 1867
  Tue Dec 9 07:30:12 2014 Rank 0 Dram U9 Bank 0 Row 0x0 Col 0x8 multiaddress C DQ4 Temp = 22C
  hits 2
    P1-DIMM4A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 40C031C7 Part
  HMT31GR7EFR4C-RD 1867
    P2-DIMM1A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 402031AA Part
  HMT31GR7EFR4C-RD 1867
    P2-DIMM2A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 407031A8 Part
  HMT31GR7EFR4C-RD 1867
    P2-DIMM3A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 407031E7 Part
  HMT31GR7EFR4C-RD 1867
    P2-DIMM4A Size 8192MB Width 4 Rank 2 Row 15 Col 11 Bank 8 Serial 40C031E8 Part
  HMT31GR7EFR4C-RD 1867
  ```

  The preceding example output includes 8 DIMMs. Note the following in this output:

  - Information about the first DIMM, P1-DIMM1A, is on the first line. The two lines that follow are the DIMM repair tag, which shows that this DIMM has been encountering corrected errors.
  - The third DIMM, P1-DIMM3A, has also encountered corrected errors.
  - The last number on each line of inventory is 1867. This number is the channel speed that the memory controller set at boot time for that DIMM.

Monitoring system performance

This section includes the following topics:

About the system monitoring software

You can use Linux utilities, FS utilities, and open source utilities to monitor system performance.

The Linux utilities include `w(1)`, `ps(1)`, `top(1)`, `vmstat(8)`, `iostat(1)`, and `sar(1)`. You can use Linux system monitoring utilities on all MC990 X platforms, including Integrity MC990 X systems and Integrity MC990 X for SAP HANA TDI appliances.

The FS utilities include `hubstats`, `linkstat`, `nodeinfo`, and `topology`. HPE supports these utilities on all MC990 X platforms, including Integrity MC990 X for SAP HANA TDI appliances.

hubstats command

The hubstats command monitors NUMAlink traffic, directory cache operations, and global reference unit (GRU) traffic statistics on MC990 X systems. It is useful as a performance monitoring tool and as a tool to help you to diagnose and identify faulty hardware. The uvstats library supplies the hubstats command with statistics from the MC990 X dashboard.

linkstat command

The linkstat command monitors NUMAlink traffic on MC990 X systems. The linkstat command returns information about packets and Mbytes sent/received on each NUMAlink in the system. It is useful as a performance monitoring tool and as a tool to help you to diagnose and identify faulty hardware. The uvstats library supplies the linkstat command with statistics from the MC990 X dashboard.

gr_systat command

The gr_systat command monitors CPU and memory activity on x86 systems. It's graphical output display includes information about CPU utilization, I/O wait times, IRQs, and memory utilization, both for the system as a whole and for each node. The gr_systat command is a useful performance monitoring tool.

nodeinfo command

nodeinfo is a tool for monitoring per-node NUMA memory statistics on MC990 X systems. The nodeinfo tool reads /sys/devices/system/node/*/meminfo and /sys/devices/system/node/*/numastat on the local system to gather NUMA memory statistics.

Sample memory statistics from the nodeinfo command are:

```
MC990X-sys:~ # nodeinfo
Memory Statistics Tue Oct 26 12:01:58 2010
MC990X-sys
      ---------------------- Per Node KB ------------ ----- Preferred Alloc ----- --
Loc/Rem--
node     Total      Free    Used Dirty    Anon   Slab    hit miss foreign interlv local
 remote
   0  16757488  16277084  480404    52   34284  36288  20724    0       0       0 20720
      4
   1  16777216  16433988  343228    68    6772  17708   4477    0       0       0
3381   1096
   2  16777216  16438568  338648    76    6908  12620   1804    0       0       0
709   1095
   3  16760832  16429844  330988    56    2820  16836   1802    0       0       0
708   1094
   4  16777216  16444408  332808    88   10124  13588   1517    0       0       0
417   1100
   5  16760832  16430300  330532    72    1956  17304   4546    0       0       0
3453   1093
   6  16777216  16430788  346428    36    3236  15292   3961    0       0       0
2864   1097
   7  16760832  16435532  325300    44    1220  14800   3971    0       0       0
2877   1094
 TOT 134148848 131320512 2828336   492   67320 144436  42802    0       0       0 35129
   7673
Press "h" for help
```

From an interactive nodeinfo session, enter **h** for a help statement. For example:

```
Display memory statistics by node.
        q   quit
        +   Increase starting node number. Used only if more nodes than
            will fit in the current window.
        -   Decrease starting node number. Used only if more nodes than
            will fit in the current window.
        b   Start output with node 0.
        e   Show highest node number.
        k   show sizes in KB.
```

```
        m   show sizes in MB.
        p   show sizes in pages.
        t   Change refresh rate.
        A   Show/Hide memory policy stats.
        H   Show/Hide hugepage info.
        L   Show/Hide LRU Queue stats.

Field definitions:
        hit - page was allocated on the preferred node
        miss - preferred node was full. Allocation occurred on THIS node
               by a process running on another node that was full
        foreign - Preferred node was full. Had to allocate somewhere
                  else.
        interlv - allocation was for interleaved policy
       local - page allocated on THIS node by a process running on THIS node

        remote - page allocated on THIS node by a process running on ANOTHER
 node
(press any key to exit from help screen)
```

`topology` command

The `topology` command provides topology information about your system. Application programmers can use the `topology` command to help optimize execution layout for their applications.

The `topology` command includes many options. For more information, enter **`topology --help`** on the command line.

Example 5 `topology` command showing the system summary

```
mc990x-sys:~ # topology
System type: MC990 X
System name: harp34-sys
Serial number: MC-00000034
Partition number: 0
       2 Compute chassis
       8 CPUs
       2 Nodes
   30.00 GB Memory Total
   15.00 GB Max Memory on any Node
       1 BASE I/O Riser
       2 Network Controllers
       2 Storage Controllers
       2 USB Controllers
       1 VGA GPU
```

Example 6 `topology` command requests system summary and shows node and CPU information

```
mc990x-sys:~ # topology --summary --nodes --cpus
System type: MC990 X
System name: harp34-sys
Serial number: MC-00000034
Partition number: 0
       2 Compute chassis
       8 CPUs
       2 Nodes
   30.00 GB Memory Total
   15.00 GB Max Memory on any Node
       1 BASE I/O Riser
       2 Network Controllers
       2 Storage Controllers
       2 USB Controllers
       1 VGA GPU

Index      ID         NASID  CPUS   Memory
```

```
-------------------------------------------
    0 r001i11b00h0       0     4    15316 MB
    1 r001i11b00h1       2     4    15344 MB

CPU      Compute PhysID CoreID APIC-ID Family Model Speed L1(KiB) L2(KiB)
L3(KiB)
-------------------------------------------------------------------------------

  0 r001i11b00h0     00     00       0      6    45  2599 32d/32i     256
 20480
  1 r001i11b00h0     00     01       2      6    45  2599 32d/32i     256
 20480
  2 r001i11b00h0     00     02       4      6    45  2599 32d/32i     256
 20480
  3 r001i11b00h0     00     03       6      6    45  2599 32d/32i     256
 20480
  4 r001i11b00h1     01     00       8      6    45  2599 32d/32i     256
 20480
  5 r001i11b00h1     01     01      10      6    45  2599 32d/32i     256
 20480
  6 r001i11b00h1     01     02      12      6    45  2599 32d/32i     256
 20480
  7 r001i11b00h1     01     03      14      6    45  2599 32d/32i     256
 20480
```

Example 7 `topology` command showing IRQs assigned to devices

```
mc990x-sys:~ # topology --irq

Index Location   NASID  PCI Address        IRQ(s)  Device
-------------------------------------------------------------------
    0 r001i01s00     0  0000:00:1f.2           519 Intel SATA RAID Controller
    .          .     .  0000:02:00.0     1529-1532 Intel I210 Gigabit Network Connection
    .          .     .  0000:06:00.0           255 Matrox G200eR2
    4 r001i06s01     8  0001:01:00.0  56,1511-1526 LSI SAS2308 Fusion-MPT SAS-2
    4 r001i06s02     8  0001:02:00.0  64,1480-1510 Intel P3700 Non-Volatile Memory Controller
    4 r001i06s03     8  0001:03:00.0  66,1527,1533-1562 Intel P3700 Non-Volatile Memory Controller

    5 r001i06s05    10  0002:02:00.0  88,1563-1593 Intel P3700 Non-Volatile Memory Controller
    5 r001i06s06    10  0002:03:00.0  90,1594-1624 Intel P3700 Non-Volatile Memory Controller
    6 r001i06s07    12  0003:01:00.0 104,1625-1655 Intel P3700 Non-Volatile Memory Controller
    6 r001i06s08    12  0003:02:00.0 106,1656-1686 Intel P3700 Non-Volatile Memory Controller
    7 r001i06s10    14  0004:01:00.0 128,1687-1717 Intel P3700 Non-Volatile Memory Controller
    7 r001i06s11    14  0004:02:00.0 130,1718-1748 Intel P3700 Non-Volatile Memory Controller
   12 r001i16s01    24  0005:01:00.0 152,2493-2508 LSI SAS2308 Fusion-MPT SAS-2
   12 r001i16s02    24  0005:02:00.0 160,1749-1779 Intel P3700 Non-Volatile Memory Controller
   12 r001i16s03    24  0005:03:00.0 162,1780-1810 Intel P3700 Non-Volatile Memory Controller
   13 r001i16s05    26  0006:02:00.0 184,1811-1841 Intel P3700 Non-Volatile Memory Controller
   13 r001i16s06    26  0006:03:00.0 186,1842-1872 Intel P3700 Non-Volatile Memory Controller
   14 r001i16s07    28  0007:01:00.0 200,1873-1903 Intel P3700 Non-Volatile Memory Controller
   14 r001i16s08    28  0007:02:00.0 202,1904-1934 Intel P3700 Non-Volatile Memory Controller
   15 r001i16s10    30  0008:01:00.0 224,1935-1965 Intel P3700 Non-Volatile Memory Controller
   15 r001i16s11    30  0008:02:00.0 226,1966-1996 Intel P3700 Non-Volatile Memory Controller
   20 r001i28s01    40  0009:01:00.0          2558 NVIDIA GK110BGL [Tesla K40m]
   20 r001i28s02    40  0009:02:00.0 256,1997-2027 Intel P3700 Non-Volatile Memory Controller
   20 r001i28s03    40  0009:03:00.0 258,2028-2058 Intel P3700 Non-Volatile Memory Controller
   21 r001i28s04    42  000a:01:00.0          2557 NVIDIA GK110BGL [Tesla K40m]
   21 r001i28s05    42  000a:02:00.0 280,2059-2089 Intel P3700 Non-Volatile Memory Controller
   21 r001i28s06    42  000a:03:00.0 282,2090-2120 Intel P3700 Non-Volatile Memory Controller
   22 r001i28s07    44  000b:01:00.0 296,2121-2151 Intel P3700 Non-Volatile Memory Controller
   22 r001i28s08    44  000b:02:00.0 298,2152-2182 Intel P3700 Non-Volatile Memory Controller
   22 r001i28s09    44  000b:03:00.0          2560 NVIDIA GK110BGL [Tesla K40m]
   23 r001i28s10    46  000c:01:00.0 320,2183-2213 Intel P3700 Non-Volatile Memory Controller
   23 r001i28s11    46  000c:02:00.0 322,2214-2244 Intel P3700 Non-Volatile Memory Controller
   23 r001i28s12    46  000c:03:00.0          2559 NVIDIA GK110BGL [Tesla K40m]
   28 r001i38s01    56  000d:01:00.0 344,2509-2524 LSI SAS2308 Fusion-MPT SAS-2
   28 r001i38s02    56  000d:02:00.0 352,2245-2275 Intel P3700 Non-Volatile Memory Controller
   28 r001i38s03    56  000d:03:00.0 354,2276-2306 Intel P3700 Non-Volatile Memory Controller
   29 r001i38s05    58  000e:02:00.0 376,2307-2337 Intel P3700 Non-Volatile Memory Controller
   29 r001i38s06    58  000e:03:00.0 378,2338-2368 Intel P3700 Non-Volatile Memory Controller
   30 r001i38s07    60  000f:01:00.0 392,2369-2399 Intel P3700 Non-Volatile Memory Controller
   30 r001i38s08    60  000f:02:00.0 394,2400-2430 Intel P3700 Non-Volatile Memory Controller
   31 r001i38s10    62  0010:01:00.0 416,2431-2461 Intel P3700 Non-Volatile Memory Controller
   31 r001i38s11    62 0010:02:00.0 418,2462-2492 Intel P3700 Non-Volatile Memory Controller
```

Example 8 `topology` command showing interrupt count info with `–v` option

```
mc990x-sys:~ # topology --irq -v

Index Location NASID  PCI Address       IRQ(s)   INTCNT Device
-------------------------------------------------------------------------------
    0 r001i01s00   0 0000:00:1f.2          519   703608 Intel SATA RAID Controller
```

```
    .          .   . 0000:02:00.0    1529-1532 11088420 Intel I210 Gigabit Network Connection
    .          .   . 0000:06:00.0          255        0 Matrox G200eR2
    4 r001i06s01   8 0001:01:00.0 56,1511-1526        0 LSI SAS2308 Fusion-MPT SAS-2
    4 r001i06s02   8 0001:02:00.0 64,1480-1510        0 Intel P3700 Non-Volatile Memory Controller

    4 r001i06s03   8 0001:03:00.0 66,1527,1533-1562   0 Intel P3700 Non-Volatile Memory Controller

    5 r001i06s05  10 0002:02:00.0 88,1563-1593        0 Intel P3700 Non-Volatile Memory Controller

    5 r001i06s06  10 0002:03:00.0 90,1594-1624        0 Intel P3700 Non-Volatile Memory Controller

    6 r001i06s07  12 0003:01:00.0 104,1625-1655       0 Intel P3700 Non-Volatile Memory Controller
```

Example 9 `topology` command showing local CPU and node info for each device

You can use the output from this command to help you place applications close to their I/O device for better direct memory access performance.

```
mc990x-sys:~ # topology --io -v --nox

Index Location NASID  PCI Address Node      Local CPUS Device
-------------------------------------------------------------------------
    0 r001i01s00   0 0000:00:1f.2    0    0-14,480-494 Intel SATA RAID Controller
    .          .   . 0000:02:00.0    0    0-14,480-494 Intel I210 Gigabit Network Connection
    .          .   . 0000:06:00.0    0    0-14,480-494 Matrox G200eR2
    4 r001i06s01   8 0001:01:00.0    4   60-74,540-554 LSI SAS2308 Fusion-MPT SAS-2
    4 r001i06s02   8 0001:02:00.0    4   60-74,540-554 Intel P3700 Non-Volatile Memory Controller

    4 r001i06s03   8 0001:03:00.0    4   60-74,540-554 Intel P3700 Non-Volatile Memory Controller

    5 r001i06s05  10 0002:02:00.0    5   75-89,555-569 Intel P3700 Non-Volatile Memory Controller

    5 r001i06s06  10 0002:03:00.0    5   75-89,555-569 Intel P3700 Non-Volatile Memory Controller

    6 r001i06s07  12 0003:01:00.0    6  90-104,570-584 Intel P3700 Non-Volatile Memory Controller

    6 r001i06s08  12 0003:02:00.0    6  90-104,570-584 Intel P3700 Non-Volatile Memory Controller

    7 r001i06s10  14 0004:01:00.0    7 105-119,585-599 Intel P3700 Non-Volatile Memory Controller

    7 r001i06s11  14 0004:02:00.0    7 105-119,585-599 Intel P3700 Non-Volatile Memory Controller

   12 r001i16s01  24 0005:01:00.0   12 180-194,660-674 LSI SAS2308 Fusion-MPT SAS-2
   12 r001i16s02  24 0005:02:00.0   12 180-194,660-674 Intel P3700 Non-Volatile Memory Controller

   12 r001i16s03  24 0005:03:00.0   12 180-194,660-674 Intel P3700 Non-Volatile Memory Controller

   13 r001i16s05  26 0006:02:00.0   13 195-209,675-689 Intel P3700 Non-Volatile Memory Controller

   13 r001i16s06  26 0006:03:00.0   13 195-209,675-689 Intel P3700 Non-Volatile Memory Controller

   14 r001i16s07  28 0007:01:00.0   14 210-224,690-704 Intel P3700 Non-Volatile Memory Controller

   14 r001i16s08  28 0007:02:00.0   14 210-224,690-704 Intel P3700 Non-Volatile Memory Controller

   15 r001i16s10  30 0008:01:00.0   15 225-239,705-719 Intel P3700 Non-Volatile Memory Controller

   15 r001i16s11  30 0008:02:00.0   15 225-239,705-719 Intel P3700 Non-Volatile Memory Controller

   20 r001i28s01  40 0009:01:00.0   20 300-314,780-794 NVIDIA GK110BGL [Tesla K40m]
```

Enabling CPU frequency scaling

About CPU frequency scaling

CPU frequency scaling allows the operating system to scale the processor frequency automatically and dynamically. HPE configures the CPU frequency scaling setting on all MC990 X computer systems before the computer system leaves the factory. The default setting is assumed to be correct for most implementations. The CPU frequency scaling setting lets your system take advantage of the Intel Turbo Boost technology that is built into each processor.

The Intel Turbo Boost Technology allows processor cores to run faster than the base operating frequency as long as they are operating below the limits set for power, current, and temperature. The CPU frequency scaling setting also affects power consumption and enables you to manage power consumption. For example,

theoretically, you can cut power consumption if you clock the processors from 2 GHz down to 1 GHz.

CPU frequency scaling for Integrity MC990 X systems

The procedures that explain how to configure CPU frequency scaling on MC990 X systems depend on whether your system includes the `intel_pstate` directory. If your MC990 X system includes the `intel_pstate` directory, then CPU frequency scaling is enabled with the Intel P State driver. The path to the `intel_pstate` directory on your system is: `/sys/device/system/cpu/intel_pstate`

NOTE: The ability to configure CPU frequency scaling is not available on MC990 X for SAP HANA TDI platforms. HPE configures this setting appropriately on MC990 X for SAP HANA TDI appliances.

After checking your MC990 X system for the presence of this directory, the following settings are available to you:

- The CPU frequency settings for MC990 X systems that include an `intel_pstate` directory are:
  - `performance` (default)
  - `powersave`
- The CPU frequency settings for MC990 X systems that do not include an `intel_pstate` directory are:
  - `conservative`
  - `ondemand` (default)
  - `performance`. This setting directs the processors to run at or near their maximum speeds.
  - `powersave`. This setting slows down the processors and might be suitable for your site during periods of low use.
  - `userspace`

Configuring the `powersave` setting on systems with the `intel_pstate` directory

By default, the CPU frequency setting on MC990 X servers that include the `intel_pstate` directory is performance. During non-peak production times, you might want to configure the `powersave` setting.

To configure the `powersave` setting:

1. Log in as root to the system you want to configure.
2. Use the `cpupower` command in one of the following formats:
   - To enable the `powersave` setting, enter the following command:

     # cpupower frequency-set -g powersave
   - To re-enable the `performance` setting, which is the default, enter the following command:

     # cpupower frequency-set -g performance
3. Enter the following command to retrieve the setting that is in effect:

   # cpupower frequency-info

Verify that the setting you specified appears in the command output in the `current policy` field.

4. (Optional) Use a text editor to edit the `/etc/init.d/after.local` file and add the following line:

   `cpupower frequency-set -g powersave`

   The preceding line ensures that after each boot, the system sets the `powersave` setting.

Enabling CPU frequency scaling systems without the `intel_pstate` directory

The procedure in this topic explains how to enable or disable CPU frequency scaling on MC990 X systems that do not include the `intel_pstate` directory.

To enable CPU frequency scaling:

1. Log in as root to the system you want to configure.
2. Use a text editor to open file `/etc/sysconfig/x86config`, and verify or change the system setting from within this file.

   This file contains the settings that enable or disable CPU frequency scaling.

   To enable CPU frequency scaling, set

   `UV_DISABLE_CPU_FREQUENCY_SCALING=no`.

   To disable CPU frequency scaling, set

   `UV_DISABLE_CPU_FREQUENCY_SCALING=yes`.
3. Enter the following command to propagate the new system setting:

   `# /usr/sbin/x86config`
4. Enter one of the following commands to restart services:

   - On RHEL 6 platforms, enter the following:

     `# service cpuspeed restart`
   - On RHEL 7 and SLES 12 platforms, enter the following:

     `# modprobe acpi_cpufreq`
   - On SLES 11 platforms, enter the following:

     `# service haldaemon restart`
5. Change the CPU frequency governor setting and configure turbo mode.

Proceed to “Changing the governor setting on systems without the `intel_pstate` directory” (page 32)

Changing the governor setting on systems without the `intel_pstate` directory

The default CPU frequency governor setting can inhibit system performance. Use the procedure in this topic to change the governor setting.

Changing the governor setting is a prerequisite to configuring turbo mode. When you enable turbo mode, you enable the CPU frequency to exceed its nominal level for short periods of time, depending on the processor, temperature, current, power, and other factors. For general information about turbo mode, see the following website:

https://www-ssl.intel.com/content/www/us/en/architecture-and-technology/turboboost/turbo-boost-technology.html

The following procedure explains how to set the CPU frequency governor appropriately and points you to the procedure that explains how to configure turbo mode

1. Make sure that CPU frequency is enabled.

   For information, see “Enabling CPU frequency scaling systems without the `intel_pstate` directory” (page 32).

2. Decide which governor setting is suitable for your site.

   `ondemand` is the default setting. HPE recommends that you change this to a site-specific setting and that you configure the governor to performance.

   The possible power governor settings are:

governor setting	Effect
`ondemand`	Dynamically switches between the available CPUs if at 95% of CPU load. Default. HPE does not recommend this setting. Consider using the performance setting.
`performance`	Runs the CPUs at the maximum frequency. HPE recommends this setting.
`conservative`	Dynamically switches between the available CPUs if at 75% of CPU load.
`powersave`	Runs the CPUs at the minimum frequency.
`userspace`	Runs the CPUs at user-specified frequencies.

3. Use one of the following platform-specific methods to change the setting:

   - On RHEL 7 platforms, complete the following steps:
     a. Enter the following command:

        # cpupower frequency-set -g *governor*

        For *governor*, specify the setting you chose in the previous step.

     b. Enter the following command and verify that the *governor* setting you specified appears in the `cpupower` command output in the `current policy` field:

        # cpupower frequency-info

     c. To ensure that the *governor* setting persists across reboots, enter the following command:

        # systemctl enable cpupower

   - On RHEL 6 platforms, complete the following steps:
     a. Open file `/etc/sysconfig/cpuspeed`.
     b. Search for the `GOVERNOR=` string.
     c. Edit the setting, adding the *governor* setting you chose in the previous step.
     d. Save and close the file.
     e. Enter the following command:

        # service cpuspeed restart

     f. To ensure that the *governor* setting persists across reboots, use a text editor to edit the `/etc/init.d/after.local` file, add the following line, and then save and close the file:

        `cpupower freqency-set -g governor`

   - On SLES 12 platforms, complete the following steps:

a. Enter the following command:

   # cpupower frequency-set -g *governor*

   For *governor*, specify the setting you chose in the previous step.

b. Enter the following command and verify that the *governor* setting you specified appears in the `cpupower` command output in the `current policy` field:

   # cpupower frequency-info

   NOTE: The remainder of the steps in this procedure for SLES 12 platforms ensure that governor setting persists across reboots.

c. Use a text editor to create file

   `/usr/lib/systemd/system/cpupower.service`, populate the file with the following content, and then save and close the file:

```
[Unit]
Description=Configure CPU power related settings
After=syslog.target

[Service]
Type=oneshot
RemainAfterExit=yes
EnvironmentFile=/etc/sysconfig/cpupower
ExecStart=/usr/bin/cpupower $CPUPOWER_START_OPTS
ExecStop=/usr/cpupower $CPUPOWER_STOP_OPTS

[Install]
WantedBy=multi-user.target
```

d. Use a text editor to create file `/etc/sysconfig/cpupower`, populate the file with the following content, and then save and close the file:

```
CPUPOWER_START_OPTS="frequency-set -g performance"
CPUPOWER_STOP_OPTS="frequency-set -g ondemand"
```

e. To ensure that the *governor* setting persists across reboots, enter the following command:

   # systemctl enable cpupower

- On SLES 11 platforms, complete the following steps:

  a. Enter the following command:

     # cpupower frequency-set -g *governor*

     For *governor*, specify the setting you chose in the previous step.

  b. Enter the following command and verify that the *governor* setting you specified appears in the `cpupower` command output in the `current policy` field:

     # cpupower frequency-info

  c. To ensure that the *governor* setting persists across reboots, use a text editor to edit the `/etc/init.d/after.local` file, add the following line, and then save and close the file:

     `cpupower freqency-set -g` *governor*

4. (Conditional) Configure turbo mode.

   Complete this step if you want to configure turbo mode.

If your goal was to configure a nondefault governor setting, you do not need to configure turbo mode.

Proceed to "Configuring turbo mode on systems without the `intel_pstate` directory" (page 35)

Configuring turbo mode on systems without the `intel_pstate` directory

The following procedure explains how to configure turbo mode.

1. Make sure that you configured a governor setting.

   For information about how to configure a governor setting, see "Changing the governor setting on systems without the `intel_pstate` directory" (page 32).

2. Use the `cat`(1) command to retrieve the list of available frequencies. For example:

   ```
   # cat /sys/devices/system/cpu/cpu0/cpufreq/scaling_available_frequencies
   3301000 3300000 3200000 3100000 3000000 2900000 2800000 2700000 2600000
   2500000 2400000 2300000 2200000 2100000 2000000 1900000 1800000 1700000
   1600000 1500000 1400000 1300000 1200000
   ```

   The preceding output shows the available frequencies, listed in order from the highest, 3301000 KHz, to the lowest, 1200000 KHz.

   On MC990 X systems, the second frequency listed is always the processor nominal frequency. This is a 3.3 GHz processor, so 3300000 KHz is the nominal frequency.

   You can also obtain the nominal frequency by entering the following command and examining the information in the model name field:

   # cat /proc/cpuinfo

3. Use the `cpupower` command to set the frequency to the nominal frequency of 3.3 GHz plus 1 MHz.

   That is, specify a frequency of 3301 MHz. For example:

   # cpupower frequency-set -u 3301MHz

   Later, if you want to disable turbo mode, enter the following command to set the maximum frequency back to the nominal frequency:

   # cpupower frequency-set -u 3300MHz

Additional Foundation Software utilities

This section includes information about additional Foundation Software commands and utilities that typically require no user involvement. HPE technical support staff members might guide you in the use of these commands when troubleshooting or tuning.

`base-configuration`	A collection of configuration scripts for MC990 X systems.
`ha-stonith-plugins-uv`	Provides STONITH agents to implement fencing on MC990 X systems through the RMC or CMC.
`irqbalance`	Controls interrupt request (IRQ) affinity on MC990 X systems. The daemon starts when a system boots. If a device generates IRQs, `irqbalance` attempts to distribute the interrupts to the CPUs that are on the same chassis (or node) upon which the interrupt originated. By default, this utility starts every two minutes. To change that interval, set `IRQBALANCE_SLEEPTIME` in `/etc/sysconfig/irqbalance` to the desired

number of seconds and restart `irqbalance` or reboot your system.

The `base-configuration` package automatically configures the `irqbalance` utility.

5 Component replacement procedures

This chapter provides information about installing and removing PCIe cards, chassis fans and system disk drives from your Integrity MC990 X system, as follows:

Maintenance precautions and procedures

This section describes how to open the system for maintenance and upgrade, protect the components from static damage, and return the system to operation. The following topics are covered:

⚠ **WARNING!** To avoid problems that could void your warranty, your HPE or other approved service provider should perform all the setup, addition, or replacement of parts, cabling, and service of your Integrity MC990 X system, with the exception of the following items that you can perform yourself:

- Using your network access workstation to enter commands and perform system functions such as powering up and powering down, as described in this guide.
- Installing, removing or replacing PCIe or GPU cards in the MC990 X server chassis
- Installing or replacing hard disk or SSD drives in the MC990 X server chassis
- Remove and replace an MC990 X server chassis fan assembly
- Remove and replace an MC990 X server chassis power supply
- Remove and replace an MC990 X server chassis BaseIO card

Be sure to observe all ESD precautions when removing or replacing these components. See “ESD precaution” (page 13).

Preparing the system for maintenance or upgrade

To prepare the system for maintenance, follow these steps:

1. If you are logged on to the system, log out. Follow standard procedures for gracefully halting the operating system.
2. Go to the section “Powering the system up and down” (page 15) if you are not familiar with power down procedures.
3. After the system is powered off, locate the PDUs in the rack and turn off the circuit breaker switches on each PDU.

Returning the system to operation

When you finish installing or removing components, return the system to operation as follows:

1. Turn each of the PDU circuit breaker switches to the (On) position.
2. Power up the system. If you are not familiar with the proper power-up procedure, review the section “Powering the system up and down” (page 15).

3. Verify that the LEDs on the system power supplies and system front components turn on and illuminate green which indicates that the power-up procedure is proceeding properly.

If your system does not boot correctly, see “Integrity MC990 X system Troubleshooting” (page 46), for troubleshooting procedures.

Removing the chassis top cover

IMPORTANT: The MC990 X server chassis cover should not be removed while the Integrity MC990 X system is powered up.

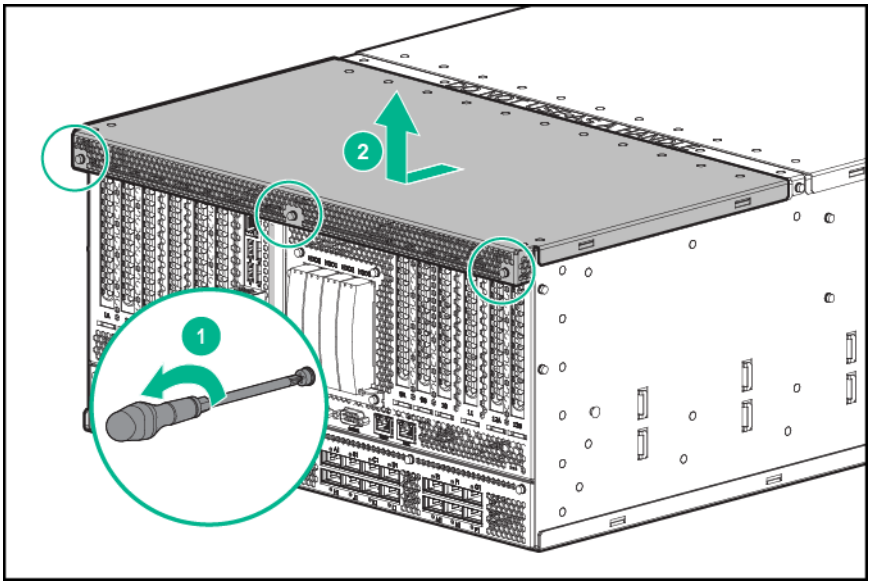
As shown in Figure 12 (page 38), the MC990 X server chassis top is a two-piece bifurcated front and rear chassis cover. The top cover does not need to be removed for system disk replacement, power supply maintenance, or system fan remove/replace. Other service actions require that you remove the front chassis cover, detailed below.

To remove a MC990 X server chassis cover, use a T10 Torx driver with the following instructions:

1. Power down the chassis by turning off the PDU(s) providing power to the unit or by disconnecting all power supply cords from the chassis rear (or both).
2. Remove the front panel (bezel) by grasping at either end and pulling it off.
3. In a multi-chassis system, you may need to remove the NUMALink connector cables from the front of the unit. Be sure they are labeled for proper re-installation.
4. Ensure that all other rack-mounted enclosures are in place and pull the chassis out the front.
5. Using the Torx driver, remove the three front retaining screws from the top cover and carefully set them aside for re-installation after completion of the procedure.
6. Grasp the front cover and slide it forward and upward from the chassis.

CAUTION: Always re-install the chassis cover after you have accessed any internal components to ensure proper airflow and cooling for the system. Failure to re-install the cover may cause thermal over-temperature conditions and automatic shut-down of the chassis.

Figure 12 MC990 X server chassis cover removal



Adding or replacing PCIe or GPU cards

WARNING! Before installing, operating, or servicing any part of this product, read the “Safety precautions” (page 13).

This section provides instructions for adding or replacing a PCIe or GPU-based PCIe card in your Integrity MC990 X system. To maximize the operating efficiency of your cards, be sure to read all the introductory matter before beginning the installation.

CAUTION: To protect the PCIe cards from ESD damage, HPE recommends that you use a grounding wrist strap while installing a PCIe card.

Installing cards in the MC990 X server chassis

Always follow the manufacturer’s instructions or restrictions for installing their card.

IMPORTANT: Addition of a new PCIe/GPU card requires a reboot to initiate recognition and functionality. Removal (without replacement) of an existing PCIe card may cause system error messages. When installing PCIe cards, ensure that the input current rating specified on the AC input label is not exceeded.

The PCIe slots available in the MC990 X server chassis consist of the following:

- Four full-height, half-length, Gen3 x8 PCIe slots
- Four full-height, 10.5-inch length, Gen3 x8 PCIe slots
- Four full-height, double-wide, 10.5-inch length, Gen3 x16 PCIe slots

NOTE: The x16 PCIe slots support cards with a maximum power consumption of 300 watts.

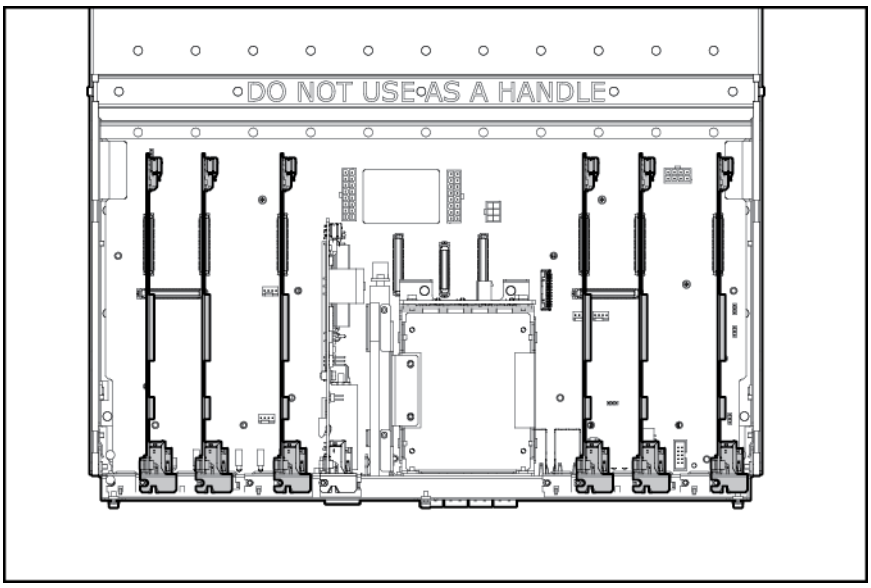
The procedure requires a T-10 Torx driver and Phillips-head screwdriver to complete. Before installing the PCIe expansion cards, be sure to remove each respective slot cover and use its screw to secure your expansion card in place. Shut down the operating system and remove all power from the chassis before starting.

1. Working from the front of the chassis, grasp the front panel on either side and pull it off the enclosure. Use the Torx driver to remove the three screws that secure the front top cover. See the section “Removing the chassis top cover” (page 38) for additional detail. Remove any NUMAlink cables and label for replacement.
2. Push the two rail release latches in and slide the chassis forward. Remove the chassis cover as detailed in “Removing the chassis top cover” (page 38).
3. Select an available slot based on the size of your PCIe card.
4. If replacing an existing PCIe card, disconnect any cables from the old card and remove its top retaining screw. If using an empty PCIe slot, remove the metal slot cover from the selected slot and retain its screw.
5. Fit the new PCIe card into the slot connector with the connector(s) extending out the front of the chassis, making sure the card’s upper tab is flush with the chassis front, and then secure the board with the screw that previously held the metal slot cover.
6. Reinstall the front top cover, push the chassis back into the rack until it latches and reconnect all cables.

NOTE: Each NUMAlink cable should be labeled with source/destination information.

IMPORTANT: After installation of a new card, be sure to re-boot your system.

Figure 13 PCIe full-height x8 and x16 card slot locations



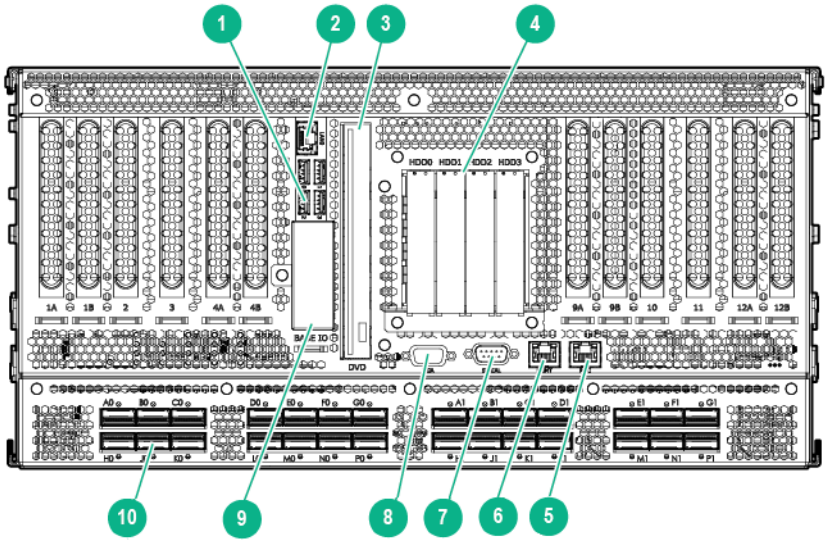
Installing or replacing a drive

The MC990 X server chassis holds up to four hard disk drives in a tray assembly at the front of the chassis. The disk riser assembly occupies the riser card 1 position on the MC990 X server chassis motherboard. It is located between the two side PCIe risers at the front of the chassis. The disk riser assembly supports both 2.5-inch solid state (SSD) and 2.5-inch spinning disks, see Figure 14 (page 41). Note that the riser also supports one optional DVD that should be installed or replaced by a trained service person. Instructions for installing/removing/replacing the DVD drive are not in this document.

The drive-tray riser interface supports five devices. You can operate the DVD and hard drives at the same time. Note that the tray assembly is not configured to support five 2.5-inch hard drives if the DVD drive slot is unused. Figure 14 (page 41) calls out the location of the 2.5-inch system drive assembly on the front of the chassis as well as showing the location of the two 1.8-inch SSD option drives.

NOTE: An MC990 X server chassis expansion chassis does not include a standard drive/riser card assembly.

Figure 14 MC990 X front drive array location



1. USB port (4)
2. Ethernet port
3. DVD drive
4. System drive assembly
5. RMC port
6. MGMT port
7. Serial port
8. VGA port
9. 1.8–inch SSD drive bays
10. NUMAlink ports (28)

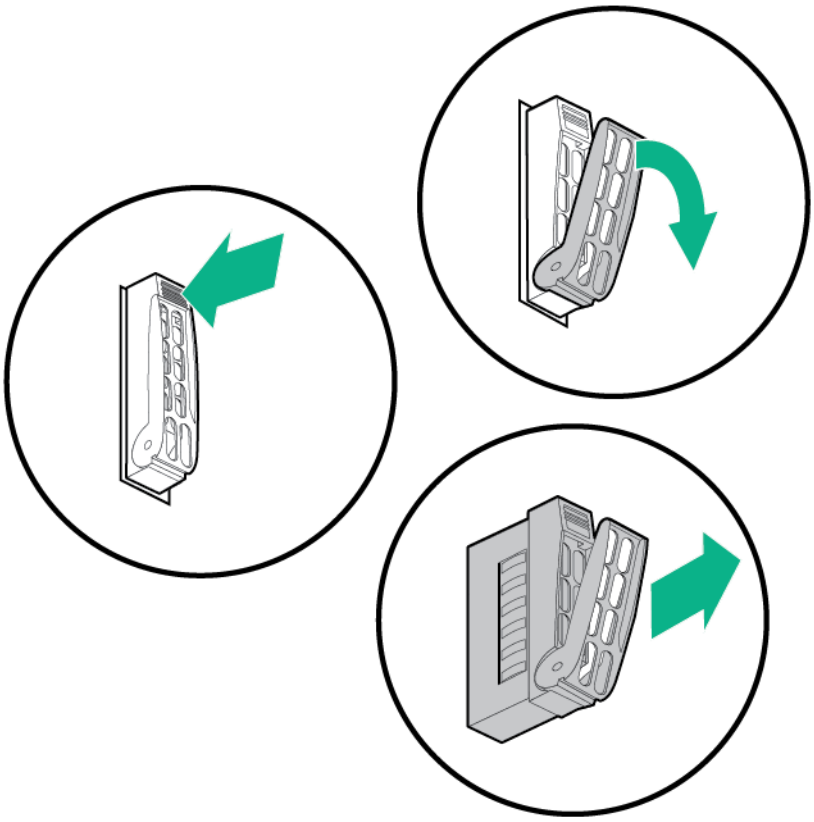
Remove or replace a 2.5-inch hard drive

Each 2.5-inch hard disk drive in the MC990 X server chassis drive tray is secured in a drive sled that slides in and out of the drive tray assembly and locks in place.

Use the following steps and illustrations to add or replace a hard disk drive in the MC990 X server chassis:

1. Shut down the Integrity MC990 X system operating system.
2. To remove power from the chassis, unplug all the MC990 X server chassis power supply cords.
3. Grasp the perforated front chassis cover at either end and pull it off the front of the unit.
4. Locate the drive you need to remove and push in its top release latch, see Figure 15 (page 42) for an example.
5. Pull the drive retention handle outward to completely unlock the drive-sled assembly.
6. Pull the drive-sled assembly straight out and lift it away from the chassis.
7. Select the tray location for the new hard disk drive. If the new drive is not equipped with a MC990 X server chassis style mounting bracket (sled), remove the old drive’s sled and install the hardware on the replacement drive. Check with your support provider if you do not have the appropriate sled hardware to install additional drives in the tray.
8. If you have disconnected power, reconnect all the chassis power supplies and restart the system. Use the instructions in “Powering the system up and down” (page 15) if you are unfamiliar with the power-up procedure.

Figure 15 Hard drive remove/replace



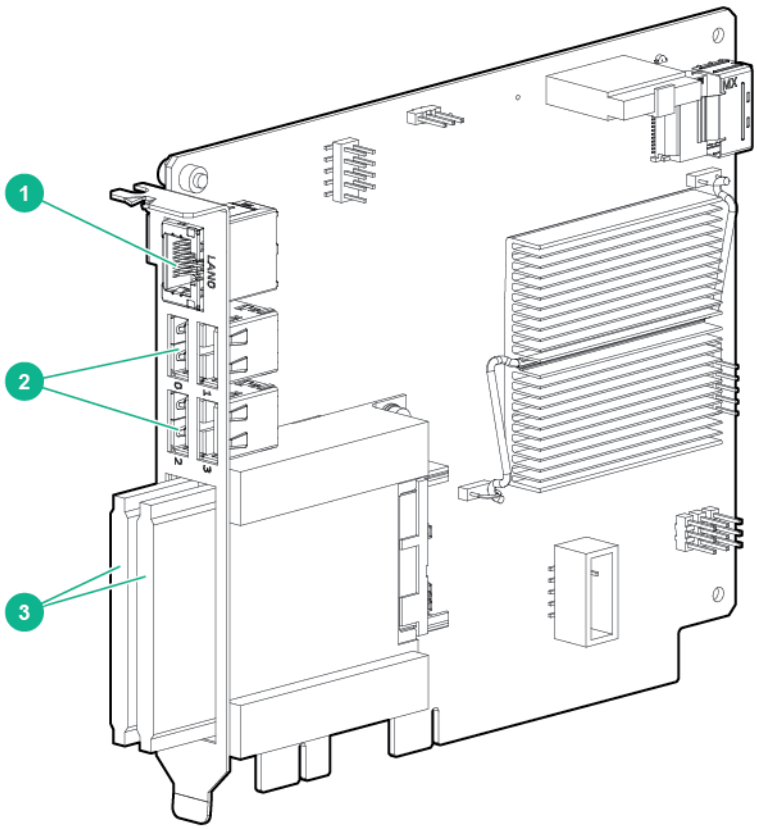
Remove or replace a 1.8-inch SSD option drive

The BaseIO card supports two optional “mini” 1.8-inch SATA solid-state-drives (SSDs) which are accessible from the front of the chassis. The two SSD slots are located directly below the BaseIO board’s USB ports. The two SSDs connect internally via a cable to two 6GB/s SATA ports. The SSDs are accessible from the front of the chassis. A metal cover used to protect the SSDs is held in place by a single T10 Torx screw. An SSD may be hot-swapped only if it is part of a RAID drive-pair. In this case you may leave the operating system running and the MC990 X server chassis in the rack.

Use the following information to remove or replace a 1.8-inch SSD in the BaseIO:

1. Access the front of the rack and remove the MC990 X server chassis front panel (bezel) by grasping at either end and pulling it off.
2. Use a T10 Torx driver to unscrew and remove the outer metal cover that protects the SSDs.
3. Extract a drive by grasping the front of the drive and pulling straight out.
4. Insert a new drive by sliding the SSD into the empty slot until it fully engages the connector.
5. Replace the BaseIO board SSD cover and secure it with the T10 Torx screw.

Figure 16 Optional 1.8-inch solid state drives



1. Ethernet port
2. USB ports (4)
3. SSD drives (2)

Replacing a MC990 X server chassis power supply

To remove and replace power supplies in an MC990 X server chassis, you do not need any tools. Under most circumstances a single power supply can be replaced without shutting down the enclosure or the complete system. In the case of a fully configured MC990 X server chassis, this may not be possible.

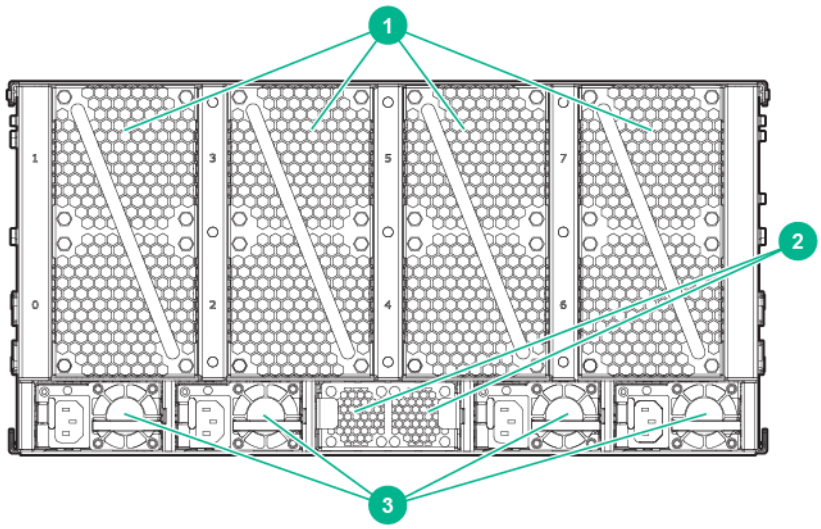
△ **CAUTION:** The body of the power supply may be hot; allow time for cooling and handle with care.

Use the following steps to replace a power supply in the MC990 X server chassis:

1. Open the rear door of the rack and locate the power supply that needs replacement. The power supplies are located along the bottom section of each MC990 X server chassis, see Figure 17 (page 44) for an example.
2. Disengage the power-cord retention clip and disconnect the power cord from the power supply that needs replacement.
3. Press the retention latch of the power supply toward the power connector to release the supply from the chassis.
4. Using the power supply handle, pull the power supply straight out until it is partly out of the chassis. Use one hand to support the bottom of the supply as you fully extract it from the enclosure. Note that each supply is 10.4-inches (26.4 cm) long and weighs 2.65 lb (1.2 kg).
5. Align the rear of the replacement power supply with the chassis opening.

6. Slide the power supply into the chassis until the retention latch engages; you should hear an audible click.
7. Reconnect the power cord to the supply and engage the retention clip.

Figure 17 MC990 X server chassis power supply and fan locations



1. Enclosure fan assembly (4)
2. HARP fan assembly
3. Enclosure power supplies (4)

Replacing a MC990 X server chassis fan assembly

Chassis cooling for each MC990 X server chassis is provided by four rear-mounted fan assemblies (as seen in Figure 17 (page 44)). Each chassis cooling fan unit is made up of two stacked 80mm fans.

If one fan assembly fails, the remaining fans will ramp up to full speed and the overheat/fan fail/info LED on the front control panel will illuminate (the system can continue to run with a single failed fan assembly).

Note that each power supply in the system is cooled by an individual internal cooling fan.

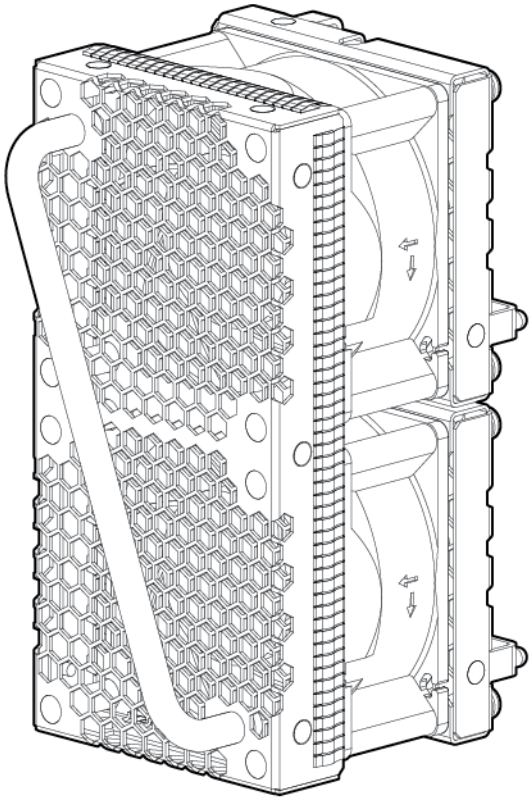
You will need to access the rack from the back to remove and replace a fan assembly.

Note that under most circumstances a fan can be replaced while the system is operating. You will not need any tools to complete the replacement procedure.

Use the following steps to replace a MC990 X server chassis fan assembly:

1. Open the rack rear door and identify the fan assembly that has failed.
2. Grasp the handle of the failed cooling fan assembly and pull the unit straight out. See Figure 18 (page 45) for an example of the chassis fan assembly.
3. Slide a new fan assembly completely into the open slot until the fan-interconnect engages and the new unit is flush with the rear of the chassis.
4. Confirm that the new fan assembly is operational and close the rack rear door.

Figure 18 MC990 X server chassis rear fan assembly



6 Integrity MC990 X system Troubleshooting

This chapter provides the following sections to help you troubleshoot your system:

- “Troubleshooting chart” (page 46)
- “LED status indicators” (page 46)

Troubleshooting chart

Table 1 (page 46) lists recommended actions for problems that can occur.

Table 1 Troubleshooting chart

Problem Description	Recommended Action
The system will not power on.	Ensure that the power cords of the MC990 X server chassis are seated properly in all power receptacles. Ensure that the PDU circuit breakers are on and properly connected to the wall source. If the power cords are plugged in and the circuit breaker is on, contact your support provider.
An individual chassis will not power on.	Ensure all the power cables of the chassis are plugged in. Confirm the PDU(s) supporting the chassis are on.
The system will not boot the operating system.	Contact your authorized support organization.
An amber LED illuminates on a motherboard.	See Table 2 (page 47) for a description of the status message.
The amber (yellow) status LED of a power supply is lit or the LED is not lit at all. See Table 2 (page 47).	Ensure the power cable to the supply is firmly connected at both ends and that the PDU is turned to on. Check and confirm the supply is fully plugged into it’s slot. If the green LED does not light, contact your support engineer.
The PWR LED of a populated PCIe slot is not illuminated.	Reseat the PCIe card.
The Fault LED of a populated PCIe slot is illuminated (on).	Reseat the card. If the fault LED remains on, replace the card.
The amber or red LED of a disk drive is on.	Replace the disk drive.

LED status indicators

There are a number of LEDs on the MC990 X server chassis that can help you detect, identify and potentially correct functional interruptions in the system. The following subsections describe these LEDs and ways to use them to understand potential problem areas.

Power supply LEDs

Each power supply installed in a MC990 X server chassis has a bi-color status LED. The LED will either light green or amber (yellow), or flash green or yellow to indicate the status of the individual supply. See Table 2 (page 47) for a complete list of the MC990 X server chassis power supply LED states.

Table 2 MC990 X server chassis power supply LED states

Power supply status	Green LED	Amber LED
No AC power to the supply	Off	Off
Power supply has failed	Off	On
Power supply problem warning	Off	Blinking
AC available to supply (standby) but chassis system power is off	Blinking	Off
Power supply on (system is on)	On	Off

The system RMC unit uses two power supplies and two cables. Each supply in the RMC uses a blue LED to indicate normal function and a red LED for errors. See Table 3 (page 47) for RMC power supply status indicators.

Table 3 RMC power supply LED states

Power supply status	Blue LED	Red LED
No AC power to either supply	Off	Off
A power supply has failed	Off	On
No AC power to one supply	Off	Blinking
Power supply on (system is on)	On	Off

System motherboard status LEDs

Each MC990 X server chassis motherboard installed in a chassis has a total of 23 LED indicators visible from the front of the unit. Note that the LEDs are located behind the perforated front-panel sheet metal and may not be clearly visible except when lit:

Starting from the left side of the motherboard:

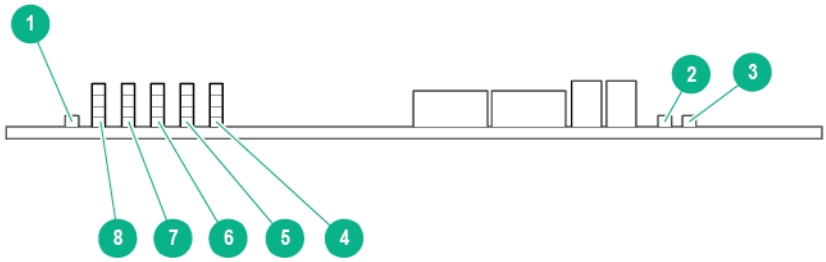
- There is a single red over-current LED
- A 4-stack of green 12V power good LEDs
- A 4-stack of green CPU (0-3) power good LEDs
- One green 3.3V auxiliary power LED and one 3.3V power good LED
- One green 5V auxiliary power LED and one green 5V power good LED
- 12V auxiliary power and 12V main power green LEDs
- Power supply OK and system power OK green LEDs
- An amber sleep state and platform reset LEDs
- Power good for HARP ASIC 0 and 1 green LEDs

On the far right side of the board are:

- Unit identifier blue/white LED
- A green BMC heartbeat LED

If the system motherboard is powered on and there is no LED activity showing on the unit, it must be replaced. Figure 19 (page 48) shows the locations of the motherboard LEDs.

Figure 19 System motherboard status LED locations and functions



1. 12V overcurrent
2. Unit ID
3. PMC heartbeat

4. Power Good P12V A	Power Good P12V B	Power Good P12V C	Power Good P12V D
5. Power Good CPU 0	Power Good CPU 1	Power Good CPU 2	Power Good CPU 3
6. Power Good P3V3 Aux	Power Good P2V3	Power Good PSV Aux	Power Good PSV
7. Power Good P12V Aux	Power Good P12V E	Power Supply Power OK	System Power OK
8. Sleep A state	Platform Reset	Power Good HARP 0	Power Good HARP 1

7 Support and other resources

Accessing Hewlett Packard Enterprise Support

- For live assistance, go to the Contact Hewlett Packard Enterprise Worldwide website:

  www.hpe.com/assistance

- To access documentation and support services, go to the Hewlett Packard Enterprise Support Center website:

  www.hpe.com/support/hpesc

Information to collect

- Technical support registration number (if applicable)
- Product name, model or version, and serial number
- Operating system name and version
- Firmware version
- Error messages
- Product-specific reports and logs
- Add-on products or components
- Third-party products or components

Accessing updates

- Some software products provide a mechanism for accessing software updates through the product interface. Review your product documentation to identify the recommended software update method.
- To download product updates, go to either of the following:
  - Hewlett Packard Enterprise Support Center **Get connected with updates** page:

    www.hpe.com/support/e-updates

  - Software Depot website:

    www.hpe.com/support/softwaredepot

- To view and update your entitlements, and to link your contracts, Care Packs, and warranties with your profile, go to the Hewlett Packard Enterprise Support Center **More Information on Access to Support Materials** page:

  www.hpe.com/support/AccessToSupportMaterials

IMPORTANT: Access to some updates might require product entitlement when accessed through the Hewlett Packard Enterprise Support Center. You must have an HP Passport set up with relevant entitlements.

Websites

Website	Link
Hewlett Packard Enterprise Information Library	**www.hpe.com/info/enterprise/docs**
Hewlett Packard Enterprise Support Center	**www.hpe.com/support/hpesc**
Contact Hewlett Packard Enterprise Worldwide	**www.hpe.com/assistance**
Subscription Service/Support Alerts	**www.hpe.com/support/e-updates**
Software Depot	**www.hpe.com/support/softwaredepot**
Single Point of Connectivity Knowledge (SPOCK) Storage compatibility matrix	**www.hpe.com/storage/spock**
Storage white papers and analyst reports	**www.hpe.com/storage/whitepapers**

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A Technical specifications and pinouts

This appendix contains technical specification information about your system, as follows:

Integrity MC990 X system specifications

Table 4 (page 51) summarizes the Integrity MC990 X system configuration ranges. Note that while each MC990 X server chassis motherboard houses four processor sockets; each socket holds multiple processor cores. The number of cores supported will change based on customer selection and processor availability.

Table 4 Integrity MC990 X system configuration ranges

Category	Minimum	Maximum
Processors per server chassis	4 processors (1 motherboard)[1]	4 processors
Cores per Processor	4	18
Server chassis	2 per system	2 per system
Motherboards	1 per server	1 per server
Memory risers on motherboard	2 per motherboard	8 per motherboard
Motherboard DIMM capacity	32 DIMMs per board	96 DIMMs per board
Memory capacity per DIMM	8GB	32GB
RMC units	1 per system	1 per system
Number of BaseIO riser boards	One per SSI	One per SSI

[1] The quad-socket MC990 X server chassis motherboard supports 4 processors using multi-processor cores.

Integrity MC990 X system physical specifications

Table 5 (page 51) shows the physical specifications of the rack-mounted Integrity MC990 X system.

Table 5 MC990 X server chassis and 42U rack physical specifications

Feature	Specification
Dimensions for single MC990 X server chassis	Height: 5U 8.64 inches (22 cm) Width: 17.5 inches (44.5 cm) Depth: 31.8 inches (80.8 cm)
Weight of single MC990 X server chassis (fully configured)	136 lb. (62 kg)
Dimensions for a single 24-inch wide 42U rack, including doors and side panels	Height: 78.75 in. (200 cm) Width: 28 in. (70.1 cm) Depth: 45.5 in. (115.6 cm)

Table 5 MC990 X server chassis and 42U rack physical specifications *(continued)*

Feature	Specification
Shipping dimensions (single rack)	Height: 88.8 in. (225.8 cm) Width: 44 in. (111.8 cm) Depth: 62.75 in. (159.4 cm)
Single rack shipping weight (max)	2,070 lb. (939 kg) air cooled (approximate)
Single rack system weight installed (max)	1,579 lb. (716 kg) air cooled (approximate) *Empty rack weight is approximately 391 lb. (177 kg)
42U rack access requirements:	Front: 48 in. (121.9 cm) Rear: 48 in. (121.9 cm) Top: 18 in. (45.7 cm)

Integrity MC990 X system environmental specifications

Table 6 (page 52) lists the environmental specifications of the Integrity MC990 X system.

Table 6 Environmental specifications

Feature	Specification
Temperature tolerance (operating)	+5 °C (41 °F) to +35 °C (95 °F) (up to 1500 m / 5000 ft.) +5 °C (41 °F) to +30 °C (86 °F) (1500 m to 3000 m /5000 ft. to 10,000 ft.) De-rate max ambient temperature by 1.8 °F (1 °C) per 1000 ft. (305 m) of altitude above 5000 ft. (1525 m)
Temperature tolerance (non-operating)	-40 °C (-40 °F) to +60 °C (140 °F)
Relative humidity	20% to 80% operating (no condensation) 8% to 80% non-operating (no condensation)
Heat dissipation to air	Approximately 17.74 kBTU/hr (1.48 tons)
Cooling requirement	Ambient air or optional water cooling
Single chassis air-flow: intake (front), exhaust (rear)	650 CFM Max (1104 m3/hr) 475 CFM typical (407 m3/hr)
Maximum altitude	10,000 ft. (3,049 m) operating 40,000 ft. (12,195 m) non-operating
Acoustic sound pressure	Approximately 77 dBA (at rear of rack)

Integrity MC990 X system electrical specifications

Table 7 (page 52) shows the power specifications for the MC990 X system.

Table 7 MC990 X system electrical specifications

Feature	Specification
Server chassis power supply (4 per chassis)	12-Volt, 1600 Watt (Platinum) [200-240 VAC]

Table 7 MC990 X system electrical specifications *(continued)*

Feature	Specification
	12-Volt, 1000 Watt (Platinum) [100-120 VAC]
Server chassis power cords	Four 8-ft (2.4 m) drop cables
Server chassis power requirements	
Voltage	100-120V (90-140 VAC min/max) 200-240V (180-264 VAC min/max)
Frequency	50-60 Hz (47-63 Hz min/max)
Power (maximum per MC990 X server chassis)	5.33 kVA (5.22kW) per chassis
Hold-up time	10 ms
Single-phase PDU power requirements	
Voltage	180-264 VAC
Frequency	50-60 Hz
Three-phase PDU power requirements	
Voltage	180-264 VAC (North America) 312-457 VAC (International)
Frequency	50-60 Hz
Total harmonic distortion	Less than 10% at full load

The Integrity MC990 X system RMC power and technical specifications are provided in Table 8 (page 53).

Table 8 RMC specifications

Feature	Specification
Height	1.72 inches (44 mm)
Width	17.2 inches (43.7 cm)
Depth	29.84 inches (75.8 cm)
Weight	20 lb. (9.1 kg)
RMC power supply	Two per RMC
RMC power cords	Two 8-ft (2.4 m) drop cables
RMC power requirements	
Voltage	100-120V (90-132 VAC min/max) 200-240V (180-264 VAC min/max)
Frequency	50-60 Hz (47-63 Hz min/max)
Power	(50W) per supply
Hold-up time	20 ms
Air flow (front to back)	Maximum = 35 CFM (60 m3) per hour
Acoustical noise	Approximately 68 dBA
Heat dissipation to air	Approximately 171 BTU (0.02 tons) per hour

I/O port specifications

This section contains specifications and port pinout information for the base I/O ports of your system, as follows:

- “Motherboard VGA port information” (page 54)
- “Ethernet port” (page 55)
- “Serial port” (page 55)
- “USB port” (page 56)

Motherboard VGA port information

The 15-pin VGA port on the motherboard (see Figure 20 (page 54)) has the following features:

- Server-class 2D hardware acceleration support with integrated 24-bit RAMDAC
- Display resolution up to 1600 x 1200 @ 60Hz
- Up to 128 Mbytes DDRII memory interface support
- A USB keyboard/mouse can be supported by the BaseIO blade connectors

The motherboard VGA interface (see Table 9 (page 54)) can be used for all basic interaction with your Integrity MC990 X system. Note that it does *not* provide a direct interconnect to the system RMC.

Figure 20 VGA port connector

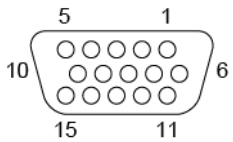


Table 9 VGA port pin functions

Pin	Function
1	Red
2	Green
3	Blue
4	N/C
5	Ground
6	Ground
7	Ground
8	Ground
9	Ground
10	Ground
11	N/C
12	DDCDAT
13	HSYNC

Table 9 VGA port pin functions *(continued)*

Pin	Function
14	VSYNC
15	DDCCLK

Ethernet port

The system auto-selects the Ethernet port speed and type (duplex vs. half-duplex) when the server is booted, based on what it is connected to. Figure 21 (page 55) shows the Ethernet port.

Figure 21 Ethernet port connector

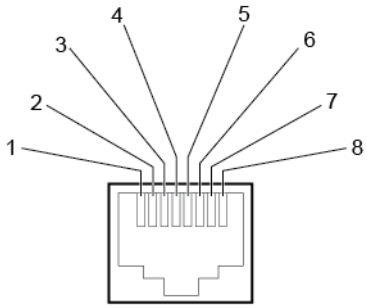


Table 10 (page 55) shows the cable pinout assignments for the Ethernet port operating in 10/100-Base-T mode and also operating in 1000Base-T mode.

Table 10 Ethernet port pinouts

Ethernet 10/100Base-T Pinouts		Gigabit Ethernet Pinouts	
Pins	**Assignment**	**Pins**	**Assignment**
1	Transmit +	1	Transmit/Receive 0 +
2	Transmit –	2	Transmit/Receive 0 –
3	Receive +	3	Transmit/Receive 1 +
4	NU	4	Transmit/Receive 2 +
5	NU	5	Transmit/Receive 2 –
6	Receive –	6	Transmit/Receive 1 –
7	NU	7	Transmit/Receive 3 +
8	NU	8	Transmit/Receive 3 –

NU = Not used

Serial port

The system motherboards have 9-pin serial interface connectors. These ports provide serial access to the individual chassis and are capable of transferring data at rates as high as 230 kbps. Other features of the ports include the following:

- Programmable data, parity, and stop bits
- Programmable baud rate and modem control

Figure 22 (page 56) shows a serial port.

Figure 22 Serial port connector

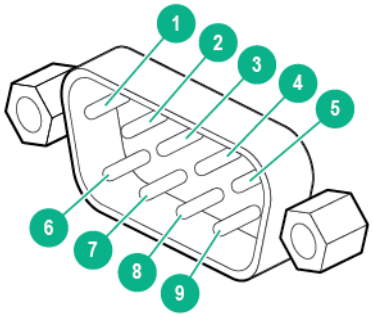


Table 11 (page 56) shows pinout assignments for the 9-pin male DB-9 connector.

Table 11 Serial port pinout

Pin	Assignment	Description
1	DCD	Data carrier detect
2	RXD	Receive data
3	TXD	Transmit data
4	DTR	Data terminal ready
5	GND	Signal ground
6	DSR	Data set ready
7	RTS	Request to send
8	CTS	Clear to send
9	RI	Ring indicator

USB port

Figure 23 (page 56) shows the USB type A connector provided on the BaseI/O that supports general USB applications and optional keyboard and mouse configurations.

Table 12 (page 56) lists the pin assignments for the USB type A connector.

Figure 23 USB type A port connector

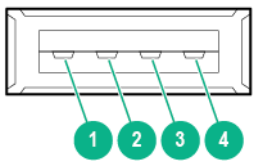


Table 12 Pin assignments for USB type A connector

Pin	Signal	Wire color
1	VCC	Red
2	-Data	White
3	+Data	Green
4	Ground	Black

B System technical information

System architecture

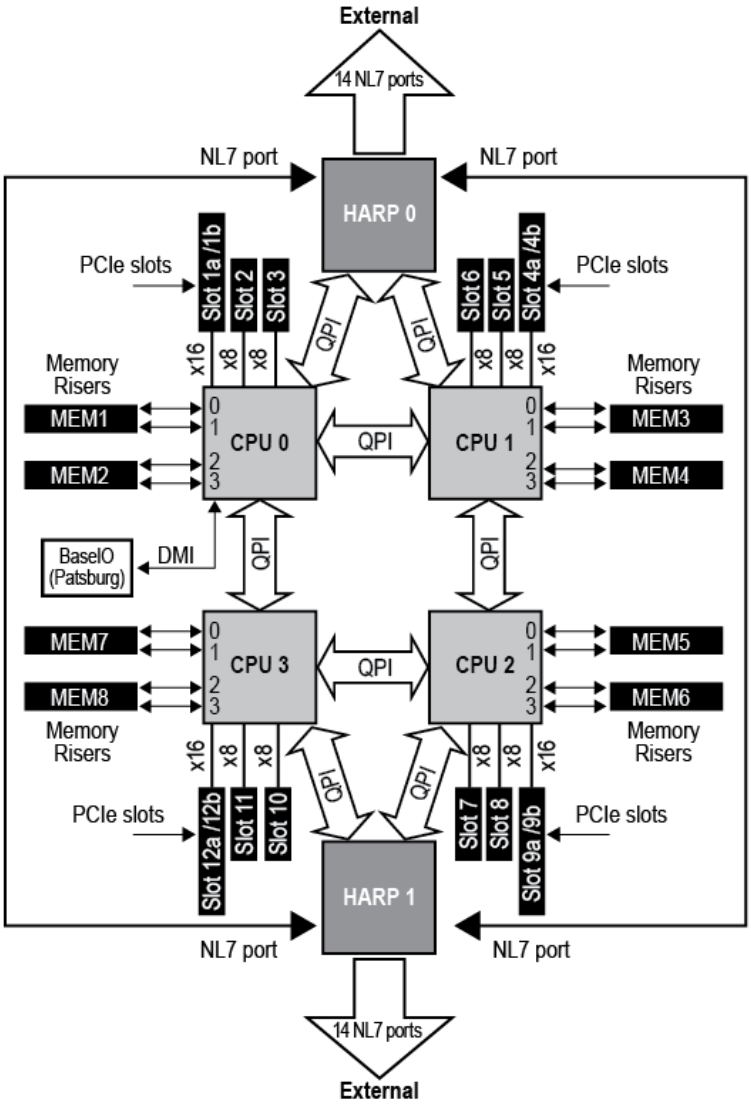
The Integrity MC990 X system is based on a cache-coherent non-uniform memory access architecture. Because it is modular, the Integrity MC990 X system architecture combines the advantages of lower entry cost with the ability to scale processors, memory, and I/O independently.

The system interconnect architecture for the Integrity MC990 X system is a seventh-generation NUMAlink SMP architecture known as NUMAlink 7. In the NUMAlink 7 architecture, all processors and memory can be tied together into a single logical system. This combination of processors, memory, and internal switches constitute the interconnect fabric called NUMAlink within each Integrity MC990 X system SSI.

The basic expansion building block for the NUMAlink interconnect is the MC990 X server chassis. Each chassis uses two HARP ASICs and four Intel processors with multiple cores and on-chip secondary caches. Each HARP ASIC supports two internal communication hubs and each of the chassis Intel processors are connected to a hub via one 8.0GT/s quick path interconnect channel.

The HARP ASIC is the heart of the MC990 X server chassis technology. This specialized ASIC acts as a crossbar between the processors and remote DRAM memory. The ASIC enables any processor to access the memory of all processors in the SSI. Figure 24 (page 58) shows a functional block diagram of the MC990 X server chassis.

Figure 24 MC990 X server chassis motherboard functional block diagram



ccNUMA architecture

As the name implies, the cache-coherent non-uniform memory access (ccNUMA) architecture has two parts, cache coherency and nonuniform memory access, which are discussed in the sections that follow.

Cache coherency

The Integrity MC990 X system server uses caches to reduce memory latency. Although data exists in local or remote memory, copies of the data can exist in various processor caches throughout the system. Cache coherency keeps the cached copies consistent.

To keep the copies consistent, the ccNUMA architecture uses directory-based coherence protocol. In directory-based coherence protocol, each block of memory (128 bytes) has an entry in a table that is referred to as a directory. Like the blocks of memory that they represent, the directories are distributed among the compute/memory blade nodes. A block of memory is also referred to as a cache line.

Each directory entry indicates the state of the memory block that it represents. For example, when the block is not cached, it is in an unowned state. When only one processor has a copy of the memory block, it is in an exclusive state. And when more than one processor has a copy of the block, it is in a shared state; a bit vector indicates which caches may contain a copy.

When a processor modifies a block of data, the processors that have the same block of data in their caches must be notified of the modification. The Integrity MC990 X system uses an invalidation method to maintain cache coherence. The invalidation method purges all unmodified copies of the block of data, and the processor that wants to modify the block receives exclusive ownership of the block.

Non-uniform memory access (NUMA)

In DSM systems, memory is physically located at various distances from the processors. As a result, memory access times (latencies) are different or non-uniform. For example, it takes less time for a processor blade to reference its locally installed memory than to reference remote memory.

C Safety and regulatory information

This appendix provides safety information and regulatory specifications for your system in the following sections:

For additional important safety, environmental, and regulatory information, see *Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products*, available at **http://www.hpe.com/support/Safety-Compliance-EnterpriseProducts**.

Safety information

Read and follow these instructions carefully:

1. Follow all warnings and instructions marked on the product and noted in the documentation included with this product.
2. Unplug this product before cleaning. Do not use liquid cleaners or aerosol cleaners. Use a damp cloth for cleaning. Do not use this product near water.
3. Do not place this product or components of this product on an unstable cart, stand, or table. The product may fall, causing serious damage to the product.
4. Slots and openings in the system are provided for ventilation. To ensure reliable operation of the product and to protect it from overheating, these openings must not be blocked or covered. This product should never be placed near or over a radiator or heat register, or in a built-in installation, unless proper ventilation is provided.
5. This product should be operated from the type of power indicated on the marking label. If you are not sure of the type of power available, consult your dealer or local power company.
6. Do not allow anything to rest on the power cord. Do not locate this product where people will walk on the cord.
7. Never push objects of any kind into this product through cabinet slots as they may touch dangerous voltage points or short out parts that could result in a fire or electric shock. Never spill liquid of any kind on the product.
8. Do not attempt to service this product yourself except as noted in this guide. Opening or removing covers of node and switch internal components may expose you to dangerous voltage points or other risks. Refer all servicing to qualified service personnel.
9. Unplug this product from the wall outlet and refer servicing to qualified service personnel under the following conditions:
   - When the power cord or plug is damaged or frayed.
   - If liquid has been spilled into the product.
   - If the product has been exposed to rain or water.
   - If the product does not operate normally when the operating instructions are followed. Adjust only those controls that are covered by the operating instructions. Improper adjustment of other controls may result in damage.
   - If the product has been dropped or the cabinet has been damaged.
   - If the product exhibits a distinct change in performance, indicating a need for service.

△ **CAUTION:** Slide/rail mounted equipment is **not** to be used as a shelf or a workspace.

Figure 25 Slide rail equipment warning

10. If a lithium battery is a soldered part, only qualified service personnel should replace this lithium battery. For other types, replace it only with the same type or an equivalent type recommended by the battery manufacturer, or the battery could explode. Discard used batteries according to the manufacturer's instructions.
11. Use only the proper type of power supply cord set (provided with the system) for this unit.
12. Do not attempt to move the system alone. Moving a rack requires at least two people.
13. Keep all system cables neatly organized in the cable management system. Loose cables are a tripping hazard that cause injury or damage the system.

Regulatory information

For important safety, environmental, and regulatory information, see *Safety and Compliance Information for Server, Storage, Power, Networking, and Rack Products*, available at **http://www.hp.com/support/Safety-Compliance-EnterpriseProducts**.

This product contains a laser that is classified as a Class 1 laser device.

CMN number

The MC990 X server chassis CMN model number is: CMN061

The RMC chassis CMN model number is: CMN062

Each model number listed above is marked on the regulatory label which is affixed to each chassis during the production process. The regulatory labels are placed as near as possible to the power supply AC inputs.

Glossary

ACPI	Advanced Configuration and Power Interface
APPWT	Average Peak Performance in Weighted Teraflops
BMC	Baseboard Management Controller
CLI	Command Line Interface
CNSL	Console abbreviation
CRC	Cyclic Redundancy Check
DSM	Distributed Shared Memory
ECC	Error Checking Code
EFI	Extensible Firmware Interface
FQDN	Fully Qualified Domain Name
GPU	Graphic Processing Unit
IPMI	Intelligent Platform Management Interface
KVM	Keyboard, video, mouse
MCS	Multi-Category Security
MLS	Multi-Level Security
NMI	Nonmaskable Interrupt
NTP	Network Time Protocol
NUMA	Non-Uniform Memory Access
PDU	Power Distribution Unit
QPI	Quick Path Interconnect
RAS	Reliability, Availability, Serviceability
RMC	Rack Management Console
RS	Remote Solutions
SAS	Serial Attached SCSI
SEL	System Error Log
SELinux	Security Enhanced Linux
SID	SAP HANA System Identifier
SMI	Scalable Memory Interconnect
SMN	System Management Node
SMP	Symmetric Multiprocessing
SSD	Solid State Drive
SSI	Single System Image
TDI	Tailored Datacenter Integration
UID	Unit IDentifier
YaST	Yet another Setup Tool

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