

# Implementing HP ProLiant ML/DL/SL Servers

Rev. 11.41 - Course #: 00378825  
Part Number: 00378825S1108



Student guide  
HP Partner Learning

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### Objectives

After completing this module, you should be able to:

- Identify server lines and series
- Describe the firmware upgrade process
- Explain how to configure HP ProLiant server hardware components





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# HP ProLiant server family

The HP ProLiant family offers Intel- and AMD-based servers designed for a wide range of uses and provides many innovative advantages. HP positions ProLiant servers by two criteria—line and series—to help customers choose the server that best fits their requirements.

- **Line**—The ProLiant family servers include four lines—ProLiant ML, DL, SL, and BL. The ML, DL, SL, or BL prefix indicates the type of customer environment for which the server is best suited.
- **Series**—The ProLiant ML and DL lines are divided into four series scaled in terms of availability and performance—100 series, 300 series, 500 series, 700 series, and 900 series. The DL line also offers multinode servers such as the HP ProLiant DL2000 server.

## ProLiant lines

» BladeSystem	» ProLiant DL	» ProLiant ML	» ProLiant SL
			
<ul style="list-style-type: none"> <li>• An industry-standard server featuring all-in-one storage and server infrastructure</li> <li>• Allows immediate consolidation and virtualization, resulting in greater savings in power, time and money</li> </ul>	<ul style="list-style-type: none"> <li>• Density optimized for flexibility and manageability</li> <li>• Ideal for multi-server deployments and available in both rack and cluster models</li> </ul>	<ul style="list-style-type: none"> <li>• The ideal industry-standard server solution for remote and branch offices to data centers</li> <li>• Provides maximum internal storage and I/O flexibility</li> <li>• Available in tower and rack deployment options</li> </ul>	<ul style="list-style-type: none"> <li>• Designed for extreme scale-out, high performance computing, and power- and space-constrained data centers</li> <li>• Flexible, modular server configs with shared power and cooling, enabling increased server density, enhancing performance per watt/sq. foot</li> </ul>

ProLiant portfolio

This topic describes the characteristics and the types of customer environments for which the four ProLiant family server lines—ML, DL, SL, and BL—are best suited. Each of the families has unique features that can help to solve a customer problem or business issue.

## ProLiant ML line



ML110 G7 front view

The ProLiant ML server line is maximized for internal system expansion. ML servers are designed to allow you to maximize their computing power by adding components such as PCI expansion cards and disk drives inside the chassis. Both rack and tower models are available. The flexible, configurable design of the ML line enables their use in different customer environments, including remote sites, branch offices, and data centers. ML servers provide high-availability features to ensure maximum uptime, as well as price and performance flexibility for the customer.

## ProLiant DL line



DL385 G7 front view

The ProLiant DL server line is density-optimized for stacking in rack-mount environments. The DL line incorporates embedded components that provide a rich feature set in a compact chassis size. These servers are ideal in dense, space-constrained, and multiserver environments.

The DL servers provide the following features:

- Maximum computing power in small, space-saving designs
- Integrated and embedded options that can be maximized per unit of space
- Efficient platform for clustering

## ProLiant SL line



SL front view

The HP ProLiant SL Extreme Scale-Out server family was built to enable massive compute environments. With its modular architecture based on an ultra-efficient design philosophy, the SL family reduces the number of components and cuts energy use compared to traditional server designs.

The SL6000 Scalable System family (2U chassis) consists of four models:

- HP ProLiant SL160z G6
- HP ProLiant SL165z G7
- HP ProLiant SL170z G6
- HP ProLiant SL2x170z G6

The SL6500 Scalable System family (4U chassis) consists of five members:

- HP ProLiant SL160s G6
- HP ProLiant SL165s G7
- HP ProLiant SL170s G6
- HP ProLiant SL335s G7
- HP ProLiant SL390s G7



Ultimately, this purpose-built architecture, designed for thousands of nodes, helps customers create a competitive advantage by making every dollar, watt, and square foot count. By using SL systems, customers can save on space in the data center, power and cooling costs, and other maintenance costs.

The SL6000 and SL6500 server solutions are optimized for scale-out customers and provide the following benefits:

- Designed to greatly reduce costs
- Optimized for power efficiency, by sharing power supplies and fans
- Designed to maintain total flexibility

## ProLiant BL line



BL680c G7 front view

The ProLiant BL server line consists of ultra-dense server blades optimized for rapid deployment. The BL line is designed to help corporate customers and service providers adapt to changing requirements. Its tool-free modularity conserves limited human and technology resources, maximizes efficiencies, and enables rapid response to customers in a dynamic business climate. BL server blades enable rapid deployment while simplifying and standardizing multiserver deployments.

Individual components of the HP ProLiant BladeSystem, and how those components work together to allow multiple server blades to function independently, represent a significant departure from traditional servers. Server blades are the fastest growing segment in the industry, and HP continues to be the industry-standard leader.

Standard features of HP BladeSystem solutions include:

- Optimized for dynamic, space-constrained, scaled-out environments
- Designed to easily adapt to changing workloads
- Used for industry-standard, fabric-based computing
- Intelligent, fault-resilient power, redundant NICs, integrated RAID, and optional hot-plug drives
- Offered as servers, workstations, and blade PCs (Consolidated Client Infrastructure [CCI])

### HP BladeSystem c-Class



c7000 enclosure

The HP BladeSystem c-Class solution is based on the following components:

- **Enclosure**—HP offers two types (c7000 and c3000) of the enclosure for server blades and other solution components. Both types have integrated power and cooling and management options.
- **Interconnects**—HP BladeSystem solutions support a wide portfolio of interconnects including Ethernet, Fibre Channel, and InfiniBand solutions. Customers can choose between switches, pass-thru modules, or HP Virtual Connect devices.

- **Power and cooling**—The power and cooling subsystem is integrated within the c7000 or c3000 enclosure. Both enclosures offer redundancy and both are optimized for maximum efficiency and cost savings.
- **HP Onboard Administrator**—This central management module enables you to manage the whole enclosure, including the power, cooling, and server blades.
- **Server blades**—Customer can choose between AMD, Intel, or Intel Itanium-based servers. You can install up to 16 half-height server blades or up to 8 full-height server blades in a single c7000 enclosure. The servers are equipped for two to eight physical processors, with a multicore option to ensure the appropriate performance level.
- **Storage blades**—Customers can extend the storage capacity of a single server blade by using storage blades (like the HP SB40c or D2200sb). The HP Ultrium Tape Blades are ideal for HP BladeSystem c-Class customers who need an integrated data protection solution. A shared storage solution is also available in the form of 3Gb SAS switches connected to an HP Storage 2000sa Modular Smart Array (MSA2000sa) or HP Storage 600 Modular Disk System (MDS600).

### HP Workstation Blades



HP WS460c G6 Workstation Blade

The HP ProLiant Workstation Blades provide greater density without compromising power efficiency, performance, features, and choices. Currently, HP offers one model, the WS460c G6 Workstation Blade.

An HP Workstation Blade can be installed in any c-Class enclosure and can be mixed with servers and other components within the same enclosure.

## HP Blade PCs



HP BladeSystem bc2800 Blade PC

The HP Blade PC solution centralizes desktop computer and storage resources into easily managed, highly secure data centers using blade PCs, while providing the convenience and familiarity of a traditional desktop environment. CCI enables users on thin clients to connect to, and work from, application servers such as the ProLiant bc2200 or bc2800 Blade PC.

## ProLiant series

ProLiant ML, DL, and SL lines are divided into series. Each series is defined by performance level and server availability.

### 100 series (1P and 2P)

The 100 series offers an affordable server optimized for:

- Clustered solutions for high-performance technical computing applications that support demanding workloads
- Entry-level, general-purpose servers

### 300 series (1P and 2P)

The servers in the 300 series are best suited for applications such as:

- File/print and domain servers
- Web server functions
- Small databases and infrastructure applications

### 500 series (4P)

Increased availability and performance make the 500 series servers ideal for:

- Complex web applications
- Large databases
- Critical file server applications
- Multi-application tasks and server consolidation

### 700 series (up to 8P)

The scalable ProLiant 700 series servers support up to eight processors with quad-core processing power. They deliver outstanding flexibility, scalability, and performance for customers' growing enterprise-class database, consolidation, and virtualization environments. They are excellent in running the following types of applications:

- High performance computing (HPC)
- Electronic design automation (EDA)/Semiconductor
- Financial
- Large database applications
- Enterprise resource planning (ERP) and customer resource management (CRM)
- Petrochemical
- Life science and material science
- Video rendering

## 900 series (4P or 8P)

The ProLiant 900 series is an example of a scale-up x86 workhorse because it is designed for superior performance and improved server efficiency and utilization. It is the ideal choice for enterprise-class database, consolidation, and virtualization environments that need:

- Outstanding performance, flexibility, and scalability
- Easy integration and management, with all the familiar industry-leading ProLiant tools

## ProLiant DL2000 Multi Node Server (1P and 2P)

The DL2000 Multi Node Server was designed to double the density to maximize data center floor space, increase performance while lowering energy consumption, and provide flexible configurations that fit into existing industry-standard racks.

The DL2000 solution consists of up to four independent DL170e G6 servers in the 2U HP ProLiant e2000 G6 chassis. The servers share power supplies and fans, providing greater power and cooling efficiencies. The DL170e G6 server is optimized for efficiency, density, and flexibility, and it can be serviced individually without impacting the operation of other server nodes sharing the same chassis.

Features include:

- Flexible design for integrated solutions
- 4-in-1 efficiency
- Double the density in an industry-standard design

## Other ProLiant model numbering conventions

The BL series follows similar logic with model numbering within a class, where the numbering reflects the performance scalability features.

The naming conventions for ProLiant servers indicate whether the server uses Intel or AMD processors. Servers with a zero as the last number in the name (xx0) are based on Intel processors. Servers with a five as the last number in the name (xx5) are based on AMD processors.

## HP ProLiant MicroServer



HP ProLiant MicroServer front view

The HP ProLiant MicroServer is a general purpose server that can provide a platform to organize and safeguard the business information of a customer, enable effective communication with customers, and make the most of existing office equipment and resources.

The HP MicroServer is a cost-effective starter server for businesses with fewer than 10 clients.

The ProLiant MicroServer supports one AMD Athlon II processor, up to 8GB of memory, and 4 LFF SATA drives connected to integrated 4-port SATA RAID.

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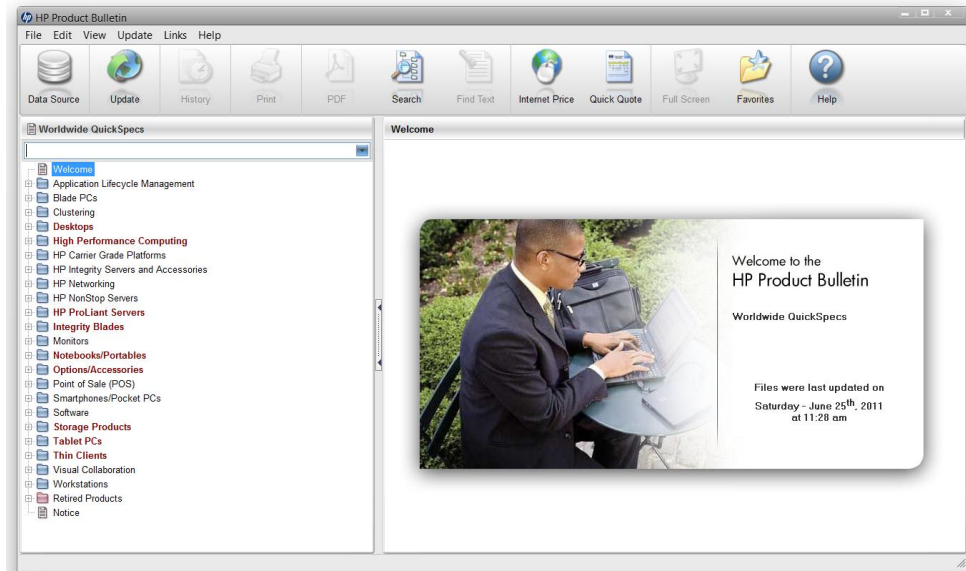
**INTERNET**

To access more information about the ProLiant MicroServer, go to:

<http://h10010.www1.hp.com/wwpc/us/en/sm/WF05a/15351-15351-4237916-4237918-4237917-4248009.html>

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## Information resources



HP Product Bulletin main page

The HP Product Bulletin is an application that provides technical overviews and specifications for HP hardware and software products. Information is provided in a QuickSpecs format. You can access HP Product Bulletin in two ways:

- By installing this application on your computer
- Online, through a web browser (Internet connectivity is required)

**INTERNET**

To access the HP Product Bulletin online, go to:

<http://h18006.www1.hp.com/products/quickspecs/ProductBulletin.html#intro>

Data in the HP Product Bulletin is updated every day. The Product Bulletin is the best source of hardware and software specifications, part numbers, supported options, and other information.



# Firmware upgrade process

For proper operation of ProLiant servers, the latest drivers and firmware are required. HP often releases a new firmware version to remove known problems and, even more often, to enhance the functionality of a specific component.

## Identifying the installed ROM version

Before configuring a ProLiant server, you must verify that the system and option ROMs are the latest version. If they are not, you should upgrade them. The methods described below will be useful when updating a single component. Verifying the firmware version for multiple components can be labor-intensive and other tools, like the Firmware Maintenance CD, can be used.

You can identify the system ROM family and version for your server in several ways:

- **Offline**—The operating system is not running.
  - Restarting the server (power-on self-test [POST] information includes the ROM family and the ROM version)
  - Using the SmartStart CD (system information is displayed on the SmartStart Home page)
  - Using the ROM-Based Setup Utility (RBSU) (press **F9** when prompted during the POST)
  - Using the ROM-Based Inspect Utility (press **F10** when prompted during the POST to access the System Partition Utilities)
  - Using the HP Insight Diagnostics Offline Edition from the SmartStart CD (available from the Maintain menu)
- **Online**—The operating system is running.
  - Using the System Management Homepage
    - ◆ Using the HP Insight Diagnostics Online Edition
    - ◆ Using the HP Version Control Agent
  - Using HP Systems Insight Manager (HP SIM)
  - Using HP integrated Lights-Out (active and redundant ROM date)

Flashing the ROM is the process of upgrading system, array controller, or option firmware on a target server with a new ROM image that supports new features or has been modified to fix problems in the previous version. You can flash the ROM in either offline or online mode.



**Important**

Do not restart the target server while the ROM upgrade is in progress. When the flash upgrade is complete, you must restart the target server for system and option ROM upgrades to take effect.

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## Firmware update methods

To update firmware on an HP ProLiant server, two different methods can be used:

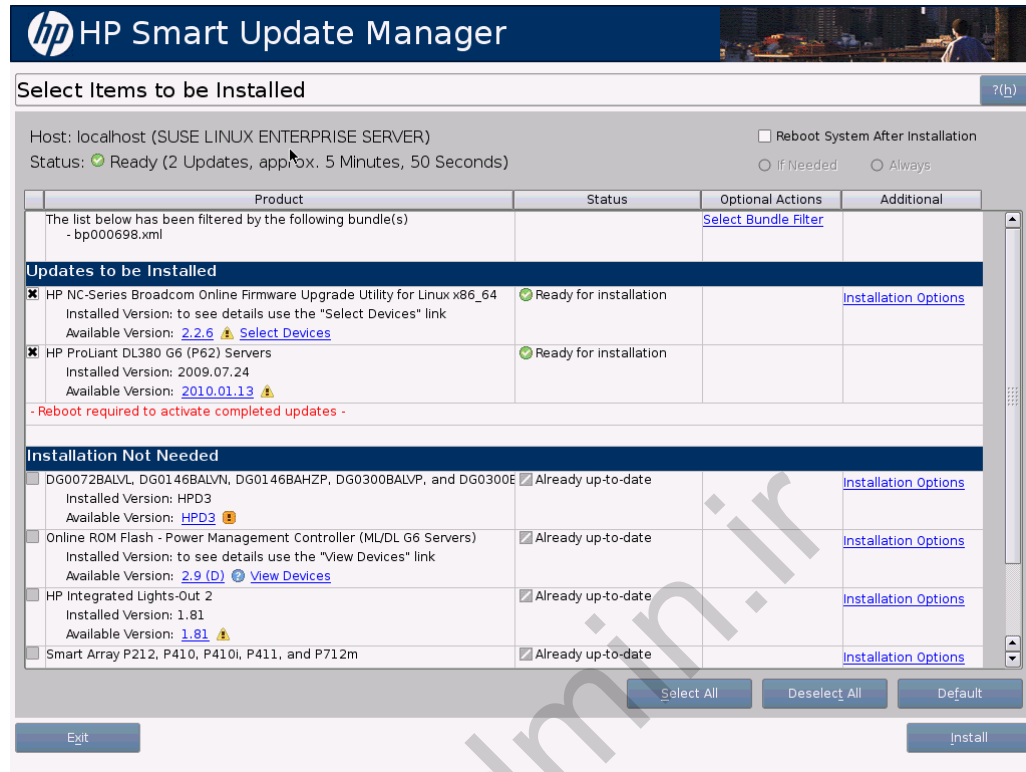
- **Offline method**—The operating system is not working and the system is booted for media containing firmware updates (DVD or USB). When all required updates are applied, the system will be rebooted.
- **Online method**—The server must be booted to the operating system. All updates are performed with the operating system loaded and working. A restart might be required for the new firmware to work.

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## Offline method

For offline firmware updates, you can use the HP Smart Update Manager or a ROMPaq.

### HP Smart Update Manager



HP Smart Update Manager in offline mode

Beginning with the Firmware Maintenance CD 7.50, the HP Smart Update Manager utility has enabled the deployment of firmware components from a single, easy-to-use interface that is supported in both Microsoft Windows and Linux environments. The utility enables legacy support of existing firmware components while simplifying the firmware deployment process.

Currently, the Firmware Maintenance CD is being replaced with the HP Smart Update Firmware DVD. This DVD provides not only the latest firmware but also installation logic and version control that automatically checks for dependencies, installing only the correct updates for optimal system configuration.

The Firmware Maintenance DVD can be run either online or offline. When performing an offline deployment, the server can be booted from the Firmware Maintenance DVD or a USB drive key that contains the Firmware Maintenance DVD contents. The HP Smart Update Manager supports offline deployments of all ROM flash components including system, hard drive, array controller, QLogic and Emulex Fibre Channel host bus adapter (HBA), and Lights-Out Management ROM flash components.

The current version of the HP Smart Update DVD supports automatic deployment mode, where no user interaction is required. The following firmware types can be upgraded in automatic mode:

- System ROM
- iLO 2
- Broadcom NIC
- Smart Array Controllers
- SAS and SATA hard drive firmware behind Smart Array Controllers
- Emulex, QLogic, and Brocade Fibre Channel HBAs
- Tape Blade
- PowerPIC

When performing an offline deployment, you can also access a removable device such as a USB drive key or the HP Smart Update Firmware DVD that contains supplemental updates.

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**INTERNET**

To download the HP Smart Update Firmware DVD, go to:  
<http://h18004.www1.hp.com/products/servers/management/core-management-100.html>

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## ROMPaq firmware upgrade



This Flash Update Enhanced SoftPaq contains utilities and images that can be used to restore or upgrade the system ROM on Hewlett-Packard ProLiant Servers. Several methods for changing the ROM version on your server may be chosen. Included are the various ways to perform the update. Each folder provided has self-contained files to perform the ROM update and any unwanted folders may be deleted.

**IMPORTANT NOTE:** All files contained within and created by this Enhanced SoftPaq are specific to this ProLiant Server. Files are not interchangeable with other ProLiant Server families.

- [Create a bootable ROMPaq diskette](#)
- [Create a bootable ROMPaq USB Key](#)
- [Create a bootable ROMPaq USB Key of Floppy Format](#)
- [Create a bootable ROMPaq CD](#)
- [ROMPaq Diskette Flat Files](#)
- [Create a label for the ROMPaq diskette.](#)
- [Network ROM Flashing Capabilities](#)

- [General Descriptions](#)
- [View revision history](#)
- [Web browser notes](#)

### ROMPaq welcome screen

A firmware update can be performed manually (for a single component only) using ROMPaq packages. When the appropriate ROMPaq is downloaded from the HP website and extracted, the ProLiant Flash Update page will open in a web browser. From this page, you can create various bootable media that later can be used to update specific components. The media choices include:

- **ROMPaq diskette**—Creates a bootable 1.44 diskette, using a 32- or a 64-bit operating system that can be used to locally restore or update the system ROM.
- **ROMPaq USB key**— Provides a Windows-based utility to locally partition, format, and copy necessary files to a USB flash media device (such as an HP Drive Key) through the Windows environment. The created USB flash media device is made bootable and ready to locally restore or update the system ROM.
- **ROMPaq USB key floppy format**— Provides a Windows-based utility to locally partition, format, and copy necessary files to a USB flash media device (such as an HP Drive Key) through the Windows environment. The USB key is formatted to simulate floppy diskette features such as capacity. The HPQUFF utility is intended to be used on systems that exhibit the "Unsupported Processor" case or systems that support the "Disaster Recovery" feature.

- **ROMPaq CD**—Creates a bootable CD that can be used to locally restore or update the system ROM.
- **ROMPAQ flat files**—Provides flat files of the ROMPaq diskette that can be used for network system ROM restore and upgrade. Preboot Execution Environment (PXE) is one method to accomplish this task.
- **Diskette Label**—This program creates a ROMPaq 1.44 diskette label that can be printed and used to label your ROMPaq diskette.
- **Network ROM Flashing**—This document provides information for the different methods that can be used to flash a ProLiant server through the network.

## Online mode

Online ROM Flash technology consists of a combination of components that enable system administrators to upgrade system or option ROM images across a wide range of HP servers and server options. The ROM upgrades are performed locally or across a network from a single point of execution, and they are flashed individually or grouped together to perform multiple ROM upgrades in a single step.

The two types of ROM components are:

- System ROM flash components
- Option ROM flash components

These ROM flash components are also known as Smart Components. Smart Components enable customers to perform system and option ROM updates from a remote system with no physical presence at the server being flashed. Smart Components for ROM Flash use online ROM Flash technology and are operating-system dependent.

Smart Components for ROM Flash include installation logic that automatically checks for hardware, firmware, and operating system dependencies, installing only the correct ROM upgrades required by each target server.

Some deployment tools, such as Insight Rapid Deployment Software, enable you to build jobs to flash the system and options firmware. These methods use the SmartStart Scripting Toolkit (SSST) and typically require additional programming.

## System ROMs

Smart Components for system ROMs are self-installable components and are ROM-family dependent. A system restart is required for a ROM upgrade to take effect. For disaster recovery or ROM downgrade purposes, backups of the most current ROM image are available in one of the following ways:

- **Automatic backup**—If the target server ROM family supports online ROM flash, the Smart Component for ROM Flash automatically makes a backup copy of the existing ROM image on the target server subdirectory before replacing it with the updated version.
- **Redundant ROM**—The ROM image acts as two separate ROMs. One section of the ROM contains the most current ROM version and the other section of the ROM contains a previous version.

Systems with redundant ROM display a message during POST that identifies the version of the active ROM image and verifies that a valid backup ROM exists. Servers with redundant ROM maintain a backup ROM image and cannot automatically back up the ROM image during the ROM flash process.

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## Option ROMs

Smart Components for option ROMs provide for transparent administration of option ROM upgrades. Types of option ROMs include:

- Array controller ROMs
- Integrated Lights-Out (iLO) ROMs

Option ROM upgrades do not back up the current ROM image. In a disaster-recovery scenario, an option ROM upgrade is backed up with an older version of the Smart Component or with a ROMPaq.

## Online deployment

When performing an online deployment, the server must be booted from the operating system. HP Smart Update Manager, available in the HP Smart Update Firmware DVD, supports online deployments of all ROM flash components for both Windows and Linux, including the Onboard Administrator for HP c-Class BladeSystem, HP Virtual Connect modules, hard-drives (SAS and SATA), array-controllers, and Lights-Out Management ROM flash components.

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## Recovering from a failed ROM upgrade

A ROM upgrade can fail for a variety of reasons, such as:

- **A power failure, operating system lockup, or other catastrophic event occurs during the system ROM upgrade process.** When this occurs, the ROM upgrade does not complete, and the ROM image on the target server is corrupted.
- **The ROM upgrade process is interrupted for any other reason.** The upgrade process must be complete for the ROM upgrade to be successful.

## Recovering from a failed system ROM upgrade

Recovery from a system ROM upgrade failure can be accomplished by using the redundant ROM feature of a server or by using a ROMPaq.

### Redundant ROM recovery

On servers with the redundant ROM feature, the ROM acts as two separate ROMs. In the standard implementation, one side of the ROM contains the current ROM version while the other side of the ROM contains the backup version, enabling you to switch easily to the backup version. This feature protects the previous ROM version, even if a power failure occurs while flashing the ROM.

When the server boots, the system identifies if the current ROM bank is corrupt. If a corrupt ROM is detected, the system boots from the backup ROM and alerts the user through POST that the ROM bank is corrupt.

If the RBSU is inaccessible, you can change the ROM images by changing the switch settings on the system configuration switch.

If both ROM images are corrupt, use the ROMPaq recovery.

### ROMPaq recovery

The ROM upgrade process must be complete for the ROM upgrade to be successful.

Because the target server does not operate correctly when the system ROM is corrupted, you cannot implement disaster-recovery procedures by using the Smart Components for ROM Flash. Instead, use ROMPaq diskettes to restore the corrupted target server system ROM.

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**Note**

Although ROMPaq disaster recovery is supported on ProLiant servers, each server has unique directions for powering down, opening the chassis, and locating the system maintenance switch block on the server system board. For server-specific information and warnings, refer to the server user guide.

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## Recovering from a failed option ROM upgrade

To recover from an option ROM upgrade failure, use the recovery method that is appropriate to the specific option.

### Array controller ROMs

Array controllers support Recovery ROM, which is a redundancy feature that ensures continuous system availability by providing a backup ROM. During the flash process, a new version of the firmware can be flashed to the ROM while the controller maintains the last known version of the firmware. If the firmware becomes corrupt, the controller reverts back to the redundant version of the firmware and continues operating.

### Lights-Out management ROMs

Disaster recovery can be performed on iLO, iLO 2, and iLO 3.

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**INTERNET**

For the documentation for your particular Lights-Out management product, go to the Remote Management website: <http://www.hp.com/servers/lights-out>

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To recover from a failed iLO 2 firmware update, perform the following steps:

1. Copy the iLO 2 offline flash component to your USB drive key.
2. Verify that the iLO 2 security override switch is set to **disabled**.
3. Boot the USB drive key containing the iLO 2 flash component.

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**INTERNET**

To download the HP Drive Key Boot Utility and for information on how to create a boot USB key, see the HP support website at: <http://www.hp.com/go/support>

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4. After the first screen displays, switch to a text console by pressing the **Ctrl+Alt+F1** keys.
5. Switch to the directory where the flash component is stored by entering `cd/mnt/usb/components/` at the `#` prompt.
6. Remove the loaded Lights-Out driver by entering the following commands:  

```
/etc/init.d/hp-smmp-agents stop  
/etc/init.d/hp-ilo stop
```

or

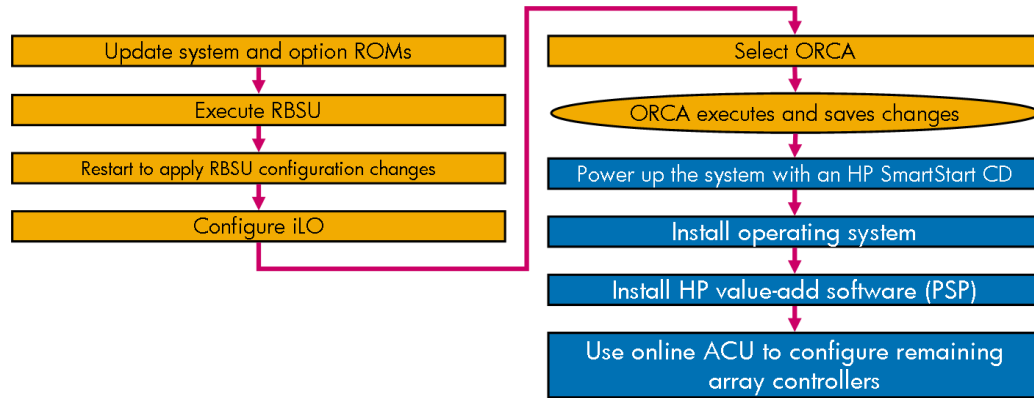
```
/etc/init.d/hpasm stop
```
7. Run the component using the `--direct` option. For example:  

```
./CP00xxxx.scexe --direct
```
8. Enter `y` at the Continue (y/n)? prompt.
9. After programming has been successfully completed, set the security override switch to **enabled** and reboot the server.

# Configuring HP ProLiant servers

Several tools are provided with ProLiant servers to simplify the setup process.

## ProLiant setup process



Setup configuration flow chart for a ProLiant server with RBSU and an array controller

To deploy a ProLiant server, perform the following tasks:

- Verify and update system and option ROMs
- Configure the BIOS
- Configure the iLO
- Configure the array controller (if not configured automatically during the boot process)
- Install the operating system
- Install HP drivers (available in the ProLiant Support Pack)

You can perform these tasks as part of a manual or an assisted installation using SmartStart. The order in which you perform these steps varies depending on your goals and the operating system you choose to install.

### Note

The setup flow or tools used might differ for certain ProLiant servers, such as for the ProLiant 100 series servers and for legacy servers. You can optionally use any of the supported HP deployment tools, such as the Insight Rapid Deployment Software.

## Defaults

The RBSU default language is English.

If the boot drive has not been formatted and the boot controller is connected to six or fewer physical drives, ORCA runs as part of the auto-configuration process when the new server is first powered up. During this auto-configuration process, the Option ROM Configuration for Arrays (ORCA) uses all of the physical drives on the controller to set up the first logical drive.

The RAID level used for the logical drive depends on the number of physical drives:

- One drive = RAID 0
- Two drives = RAID 1+0
- Three to six drives = RAID 5

If the drives have different capacities, ORCA locates the smallest drive and uses the capacity of that drive to determine how much space to use on each of the other drives. If the boot drive has been formatted, or if there are more than six drives connected to the controller, you are prompted to run ORCA manually. For more complex configurations, use the Array Configuration Utility, which has more features than ORCA and enables you to configure more parameters.

## Booting the system

After the auto-configuration process is complete or after the server restarts when exiting from the RBSU, the POST sequence runs and the boot options screen displays. This screen is visible for several seconds before the system attempts to start from a bootable CD, USB-based media, diskette, or hard drive.

### Boot options screen

```
Press "F9" key for ROM-Based Setup Utility
Press "F10" key for System Maintenance Menu
Press "F11" key for Default Boot Override Options
Press "F12" key for Network Boot
```

Boot options screen

During the time the menu is shown on the screen, press:

- **F9** to access the ROM-Based Setup Utility screen—Makes changes to the server configuration
- **F10** to access the System Maintenance Menu—Runs ROM-based utilities
- **F11** to access Default Boot Override Options— Temporarily changes the boot order
- **F12** to access PXE boot—Converts a PXE enabled NIC into a bootable device

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**Note**

PXE allows the server to broadcast a Dynamic Host Configuration Protocol (DHCP) request to obtain an IP address, and then to obtain a boot image from a PXE server. In other words, the unconfigured server boots from a network server and prepares to receive an operating system from a network-based deployment server such as one running Insight Rapid Deployment Software.

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Optionally, you can wait until the screen clears and the server proceeds to start from the inserted operating system CD, a bootable USB-based medium, a bootable floppy disk, or the SmartStart CD.

## Default boot order

```
ROM-Based Setup Utility, Version 3.00
Copyright 1982, 2011 Hewlett-Packard Development Company, L.P.

IPL:1  CD-ROM
IPL:2  Floppy Drive (A:)
IPL:3  USB DriveKey (C:)
IPL:4  Hard Drive C: (See Boot Controller Order)
IPL:5  PCI Embedded HP NC382i PCIe DP Multifunction 1Gb Adapter Port 2

<Enter> to Select IPL Device; <F1> for Help
<↑/↓> for Different IPL Device; <ESC> to Close Menu
```

Default boot order in RBSU

If you take no action, the system attempts to start by using the default boot order before starting from the hard drive. The default boot order for most current servers is:

- CD-ROM
- Floppy drive (A:)
- USB Drive Key (C:)
- Hard drive C: (See “Boot Controller Order”)
- PXE NIC

---

**Note**

By default, most servers come without the floppy drive, although it can be added to most models.

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You can change this boot order in the RBSU to reflect the boot requirements of your environment.

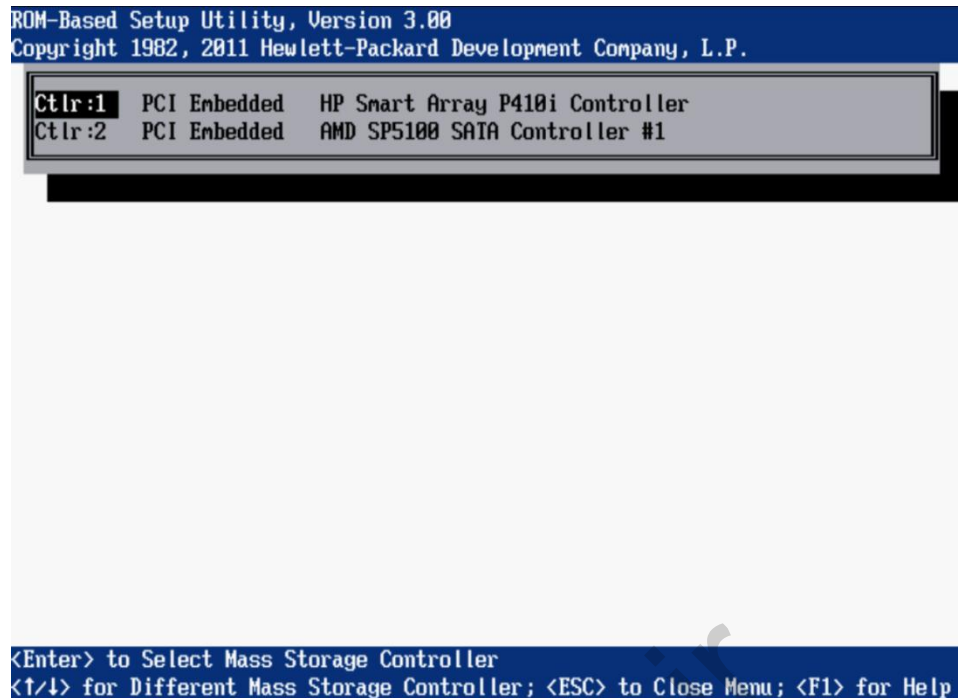
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**Note**

It is not necessary to change the default boot order to boot the server to PXE using Insight Control server deployment.

---

## Boot controller order



Boot controller order in RBSU

The Boot Controller Order option selects which installed mass storage device is used as the primary boot controller. The server attempts to boot to the operating system located on the primary boot controller. The primary boot controller is set to controller 1.

ProLiant servers can be equipped with more than one controller with the ability to boot.

### Example

A single ProLiant server can be equipped with more than one Smart Array Controller and other storage controllers like Fibre Channel cards. One of them will have bootable drives connected to it. Use the option in RBSU to put the controller with bootable drives as first on the list.

## Server ROM functionality

Server ROM is the system component that stores most of the basic server functionality. ProLiant server ROMs are either 2MB or 4MB with the following features:

- **2MB ROM**—Base functionality
  - Dynamic Setup Support (boot driver and ROM)
  - Embedded Setup Utility
- **4MB ROM**—Enhanced functionality
  - Embedded Setup Utility
  - Embedded Diagnostic Utility
  - Embedded Inspect Utility

---

**Note**

On some systems, ROM-based enhancements that automatically configure ORCA and RBSU are available. Refer to your server-specific user documentation to determine whether these features are available.

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## Dynamic Setup Support

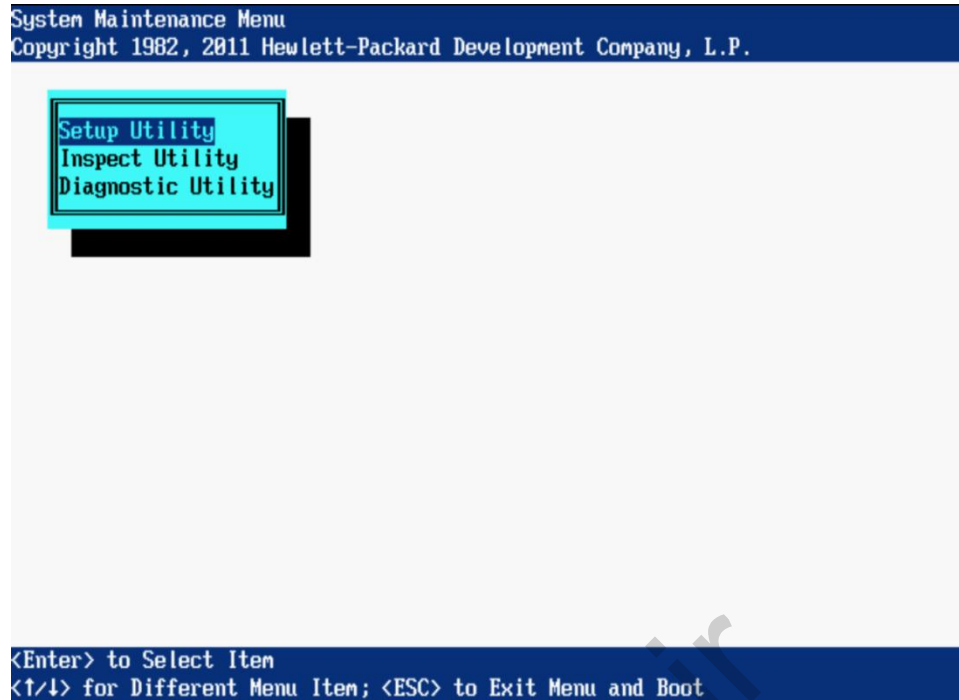
Dynamic Setup Support enables the operating system to automatically find the necessary boot drivers on the Virtual Install Disk to complete the operating system installation without user intervention. The Virtual Install Disk is a holding place within the system ROM that contains embedded boot drivers (such as SCSI or RAID controller drivers) that might be needed to complete the operating system installation.

Typically, boot drivers that are placed on the Virtual Install Disk are either not included as part of the operating system media or are updated for new controllers. Supported operating systems automatically find these drivers, eliminating the need for user intervention. HP recommends updating these boot drivers to the latest version after the operating system installation to further optimize the system.

Since the introduction of ProLiant G4 servers, the Virtual Install Disk option is found under the Advanced Options menu and can be enabled or disabled in RBSU.



## System Maintenance menu



System Maintenance menu

The System Maintenance menu is a new utility that replaces the legacy system-partition functionality supported on some ProLiant servers. This utility is embedded in the system ROM and provides access to server diagnostics, RBSU, and the Inspect Utility. To access the System Maintenance menu, press the **F10** key when prompted from the boot option screen.

The following options are displayed on the menu:

- **Setup Utility**—Exits the System Maintenance menu and runs RBSU
- **Inspect Utility**—Runs the embedded Inspect Utility
- **Diagnostic Utility**—Runs the embedded Diagnostic Utility

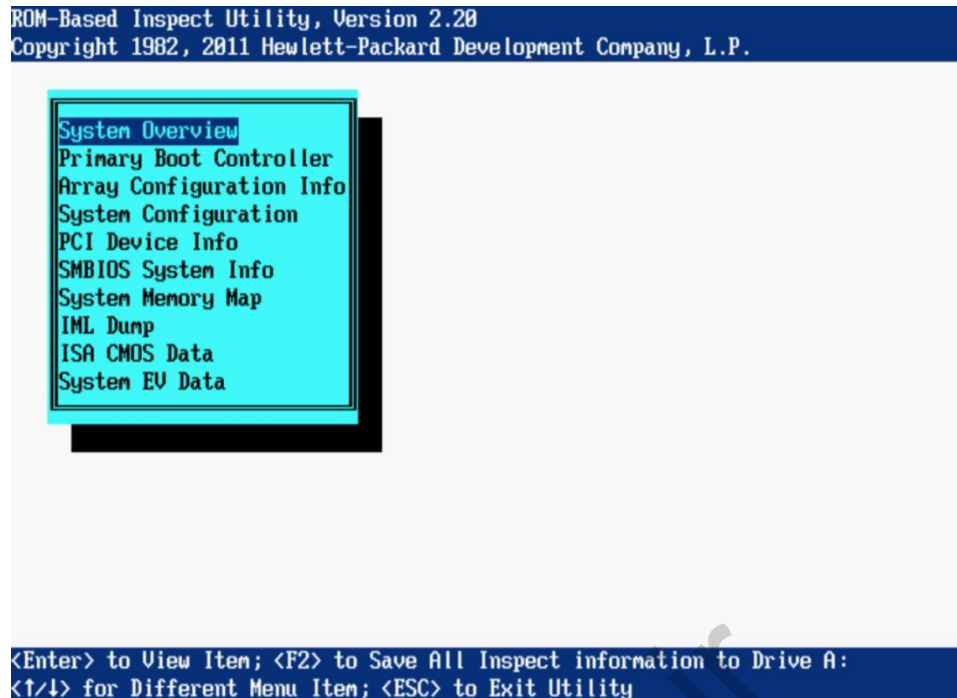
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**Note**

The System Maintenance menu is not available on ProLiant 100 series servers.

---

## Embedded Inspect Utility

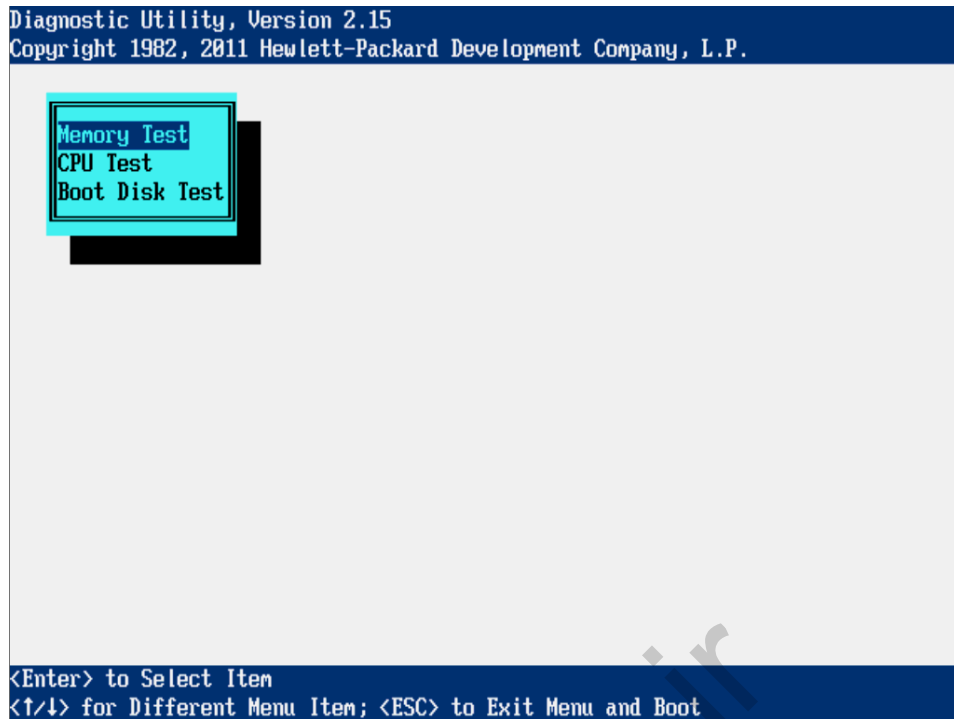


Inspect Utility main screen

The Inspect Utility is embedded in the system ROM and enables you to view system configuration information and save the information to a file on a diskette. Press the **F2** key to copy all Inspect information on a diskette.

This utility replaces the version of the Inspect Utility that is a part of the legacy system-partition functionality supported on some HP servers. If the server has the Inspect Utility feature, select **Inspect Utility** from the System Maintenance menu.

## Embedded Diagnostic Utility



Diagnostic Utility selection screen

The Diagnostic Utility is embedded in the system ROM and provides a preboot method for quickly checking the validity of the three major subsystems of the server that are needed to boot an operating system. A complete server diagnostic is available on the SmartStart CD. All three of these tests should pass if a bootable operating system is installed on the server. If any test fails, there might be a problem booting the server. To run the Diagnostic Utility, select **Diagnostic Utility** from the System Maintenance menu.

### Memory diagnostic test

The memory diagnostic test uses all the processors installed in the server to test all installed memory. The DIMMs that are installed are displayed by the cartridge and socket (or the bank and socket) in which they are located, and errors are reported with a reference to the failed DIMM. To run the memory diagnostic test, select **Memory Test** from the Diagnostic Utility menu.

### CPU diagnostic test

The CPU diagnostic test checks the registers and multi-processor capability of each processor. The test first checks all 16-bit and 32-bit registers and then it checks all the flags for all processors. If no errors are found, OK is displayed in the Status column for each processor. If errors are found, X is displayed in the Status column for each processor with errors. The CPU diagnostic menu option is not available on all ProLiant servers.

### Boot disk diagnostic test

The boot disk diagnostic test verifies the presence and readiness of a primary boot controller. If a controller is present and ready, the test checks for a valid operating system boot sector. To run the Boot Disk Diagnostic Test, select **Boot Disk Test** from the Diagnostic Utility menu.

## ROM-Based Setup Utility

The purpose of the RBSU is to help you configure server hardware settings and prepare a server for an operating system installation. RBSU enables you to:

- View and establish server configuration settings during the initial system startup
- Modify the server configuration settings after the server has been configured

RBSU performs a wide range of configuration activities that could include:

- Configuring system devices and installed options
- Displaying system information
- Selecting the primary boot controller
- Configuring memory options
- Selecting a language

The ROM on the ProLiant servers currently being shipped contains the functionality provided by the system partition utilities on legacy ProLiant servers. RBSU replaces the System Configuration Utility (SCU) that shipped on legacy ProLiant servers. RBSU provides the same functions, eliminating the need for a system partition on the primary drive and the use of boot diskettes.

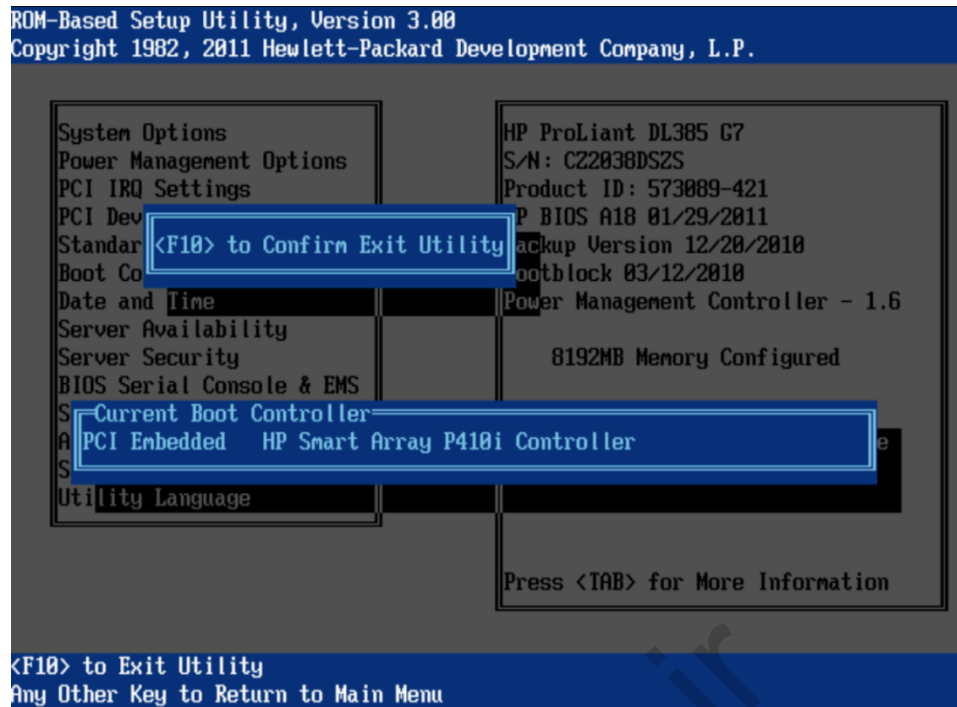
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**Note**

You can access RBSU directly by pressing **F9** on most ProLiant servers or by pressing **F10** to access RBSU through the System Maintenance menu.

---

## Starting and exiting RBSU

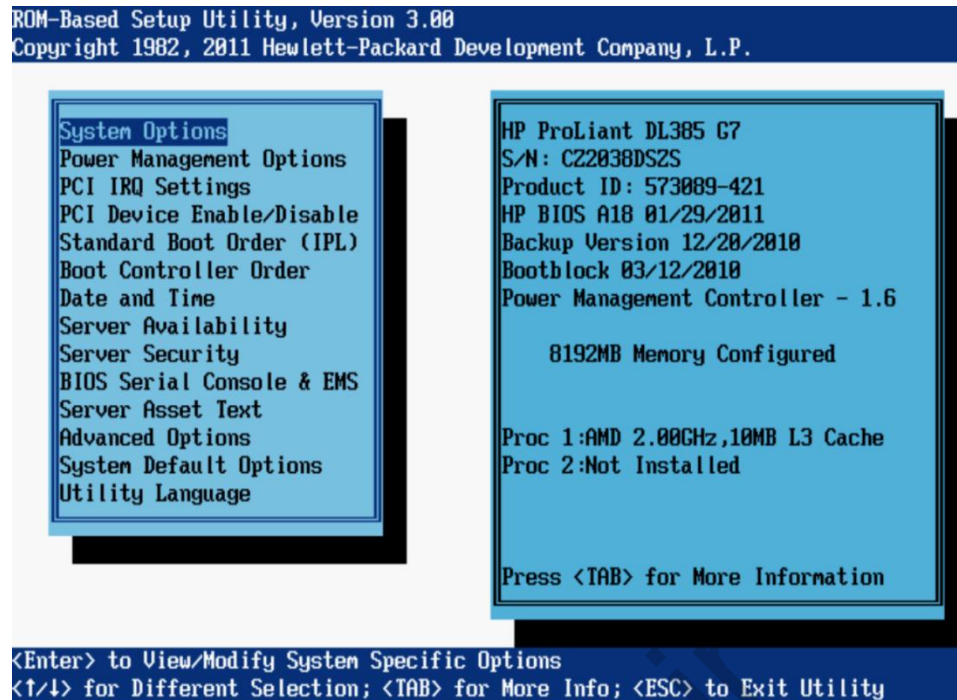


RBSU exit screen

RBSU automatically saves settings when you press the **Enter** key. The utility does not prompt you for confirmation of settings before you exit the utility.

- Press **F9** to access RBSU when prompted during the POST sequence to modify component configuration settings. RBSU configures the server automatically if the server is in an unconfigured or erased state. After configuring the server, you must exit RBSU to restart the server with the new settings.
- Press **Esc** at the main menu to display a confirmation to exit. The current boot controller is also displayed for reference purposes.
- Press **F10** to exit. The server starts with the new configuration settings.

## RBSU menu



RBSU main menu

The RBSU main menu selections can lead directly to configuration functions or to submenus that expand the available choices. Pressing **F1** when any menu option is highlighted displays a description of it.

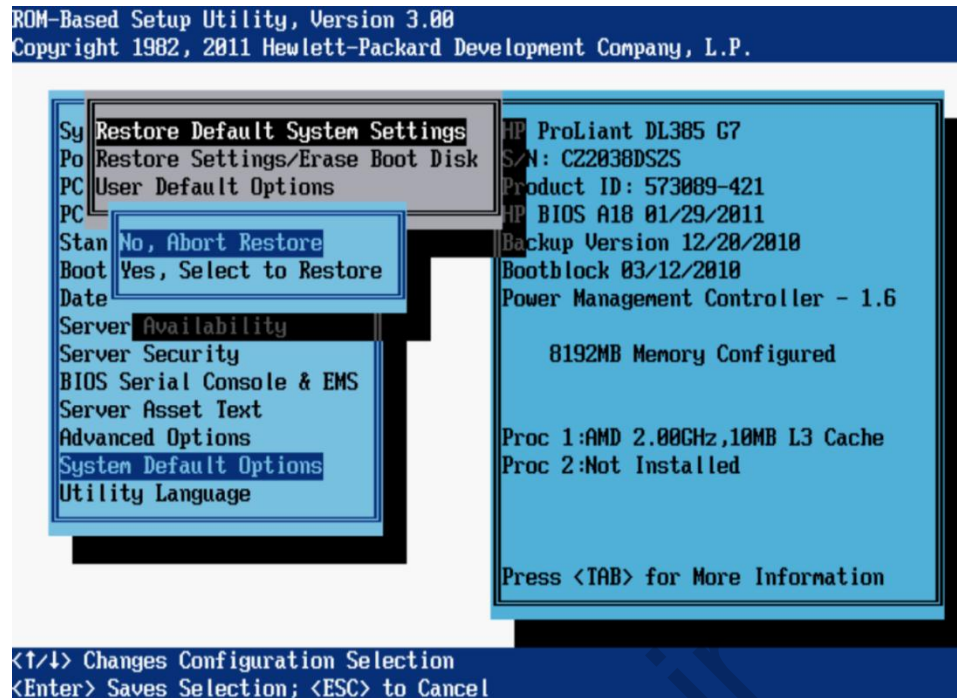
Be aware that RBSU can look different on different servers. Different versions of the system ROM can also affect the RBSU display.

At the left of the screen, the main menu lists the configuration settings that you can view or modify, including:

- System Options
- Power Management Options
- PCI IRQ Settings
- PCI Device Enable/Disable
- Standard Boot Order (IPL)
- Boot Controller Order
- Date and Time
- Server Availability
- Server Security
- BIOS Serial Console & EMS
- Server Asset Text
- Advanced Options
- System Default Options
- Utility Language

At the right of the screen, a window displays information about the server. This information includes the server model, serial number, BIOS version, backup BIOS version, memory, and processors installed.

## System Default Options menu



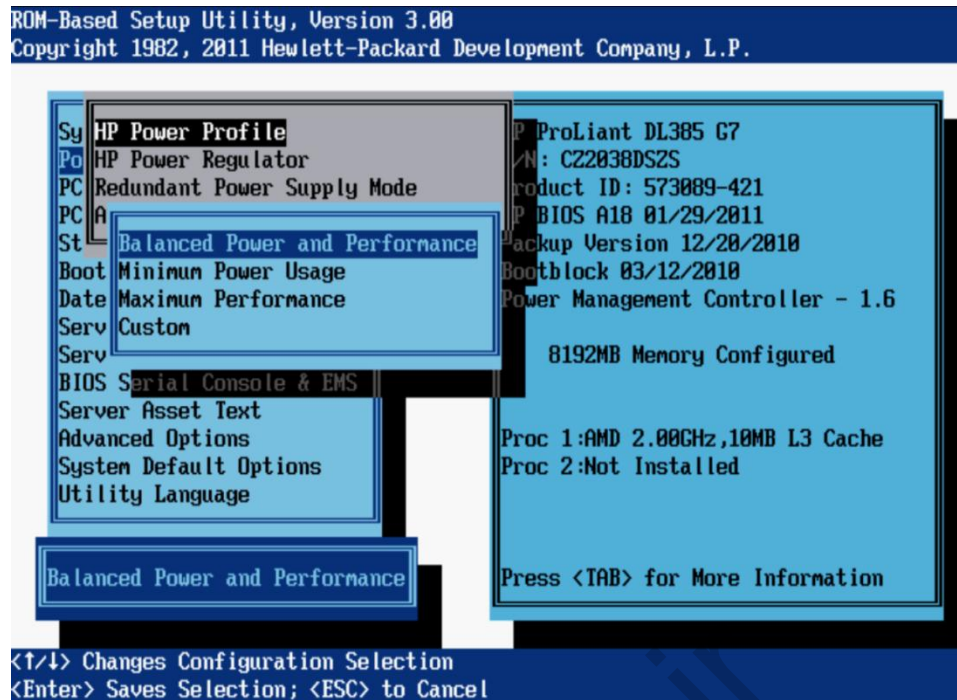
System default options menu

The System Default Options menu offers three choices:

- **Restore Default System Settings**—Resets all configuration settings to their default values. All RBSU changes that have been made are lost.
- **Restore Settings/Erase Boot Disk**—Resets the date, time, and all configuration settings to default values. Data on the boot disk drive is erased, and changes that have been made are lost.
- **User Default Options**—Enables the user to define custom default configuration settings. When the default configuration settings are loaded, the user-defined default settings are used instead of the factory defaults. To save the configuration as the default configuration, configure the system and then enable this feature.



## Power Management Options menu



Power Management Options screen

The Power Management Option menu has the following options:

- HP Power Profile
- HP Power Regulator
- Redundant Power Supply Mode
- Advanced Power Management Options

### HP Power Profile

This option enables the user to select the appropriate power profile based on power and performance characteristics. The following options are available:

- **Balanced Power and Performance**—Provides the optimum settings to maximize power savings with minimal performance impact for most operating systems and applications.
- **Minimum Power Usage**—Enables power reduction mechanisms that could negatively affect performance. This mode guarantees a lower maximum power usage by the system.
- **Maximum Performance**—Disables all power management options that could negatively affect performance.
- **Custom**— Combination of user settings that do not match the three pre-set options

## HP Power Regulator

This feature configures the Power Regulator for ProLiant support. The following options are available:

- HP Dynamic Power Savings Mode
  - Automatically varies processor speed and power usage based on processor use.
  - Reduces overall power consumption with little or no impact to performance.
  - Does not require operating system support.
- HP Static Low Power Mode
  - Reduces processor speed and power usage.
  - Guarantees a lower maximum power usage for the system.

---

**Note**

The impact on performance is greater for environments with higher processor utilization.

---

- HP Static High Performance Mode

Processors run in the maximum power and performance state, regardless of the operating system power management policy.
- Operating System Control Mode

Processors run in the maximum power and performance state, unless the operating system enables a power management policy.

## Redundant Power Supply Mode

This feature enables the user to configure how the system handles redundant power supply configurations.

- Balanced Mode shares the power delivery equally between all installed power supplies.
- All High Efficiency Mode options provide the most power-efficient operation with redundant power supplies by keeping half of the power supplies in standby mode at lower power usage levels.
- The High Efficiency Mode options enable the user to choose which power supply is placed in standby.
- To achieve a semi-random distribution with a group of systems, Auto chooses between the odd or even power supply based on the serial number of the server.

## Advanced Power Management Options

The Advanced Power Management Options menu configures the following features:

- Intel QPI Link Power Management
- Minimum Processor Idle Power State
- Maximum Memory Bus Frequency
- Memory Interleaving
- PCI Express Generation 2.0 Support
- Dynamic Power Savings Mode Response

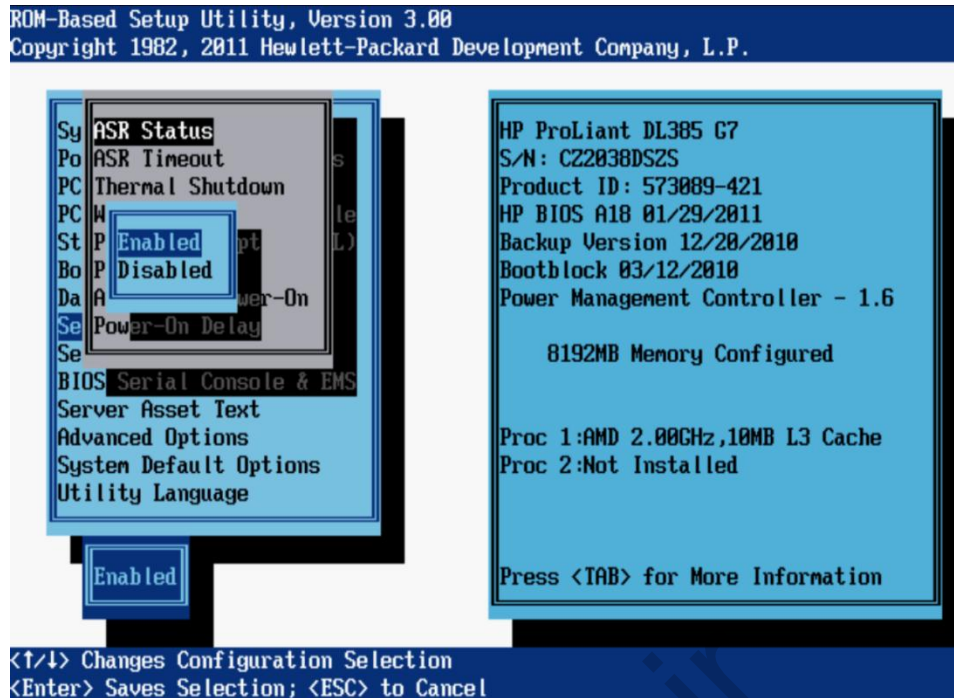
For more information about these features, refer to the *HP ROM-Based Setup Utility User Guide* at the HP website.

## Server Availability submenu

The Server Availability menu includes options that configure the Automatic Server Recovery (ASR) features:

- ASR Status
- ASR Timeout
- Thermal Shutdown
- Wake-On LAN
- POST F1 Prompt
- Power Button
- Automatic Power-On
- Power-On Delay

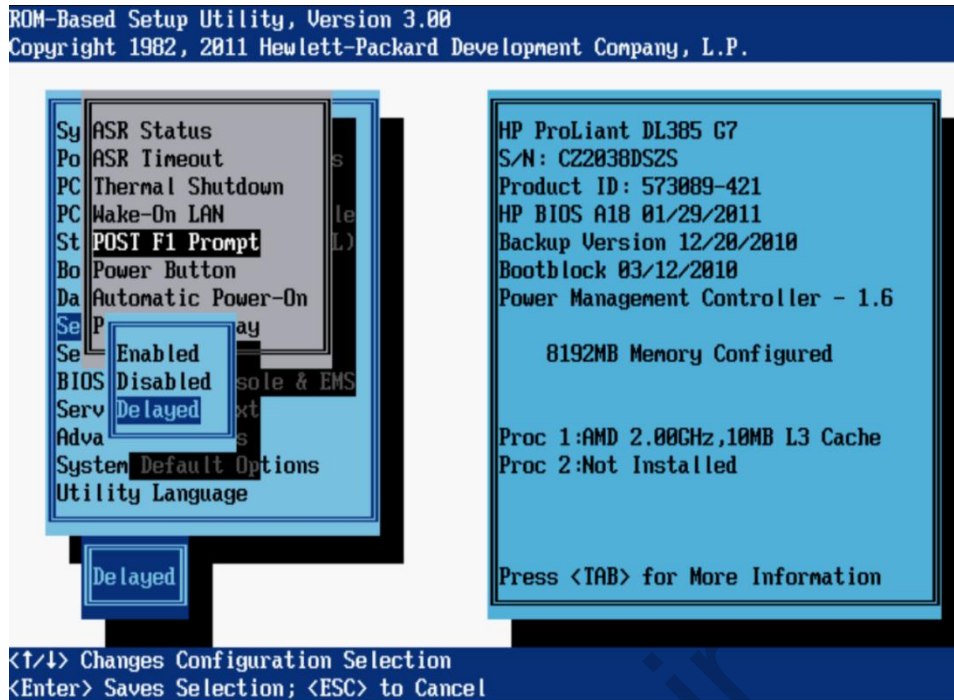
## ASR Status and ASR Timeout



ASR configuration screen

The ASR Status option is a toggle setting that either enables or disables ASR. When set to Disabled, no ASR features function. The ASR Timeout option sets a timeout limit for resetting a server that is not responding. When the server has not responded in the selected amount of time, the server automatically resets. The time increments available are 5, 10, 15, 20, and 30 minutes.

## POST F1 Prompt



Post F1 Prompt configuration screen

The POST F1 Prompt option is a toggle setting that configures the server so the F1 key must be pressed to proceed when an error occurs during the power-up sequence. A series of system tests executes during POST before continuing with the following:

- If failures occur that allow the system to continue operating, the system continues to boot but posts a message.
- If critical components fail or are missing, the server attempts to boot. If it can boot, it posts a message and an F1 prompt.
  - If Enabled is selected and an error occurs, the system stops at the F1 prompt until the F1 key is pressed, before continuing to boot.
  - If Delayed is selected and an error occurs, the system pauses for 20 seconds at the F1 prompt, and then continues to boot the operating system.
- If the system cannot run with the missing or failed components, it halts until those components are replaced.

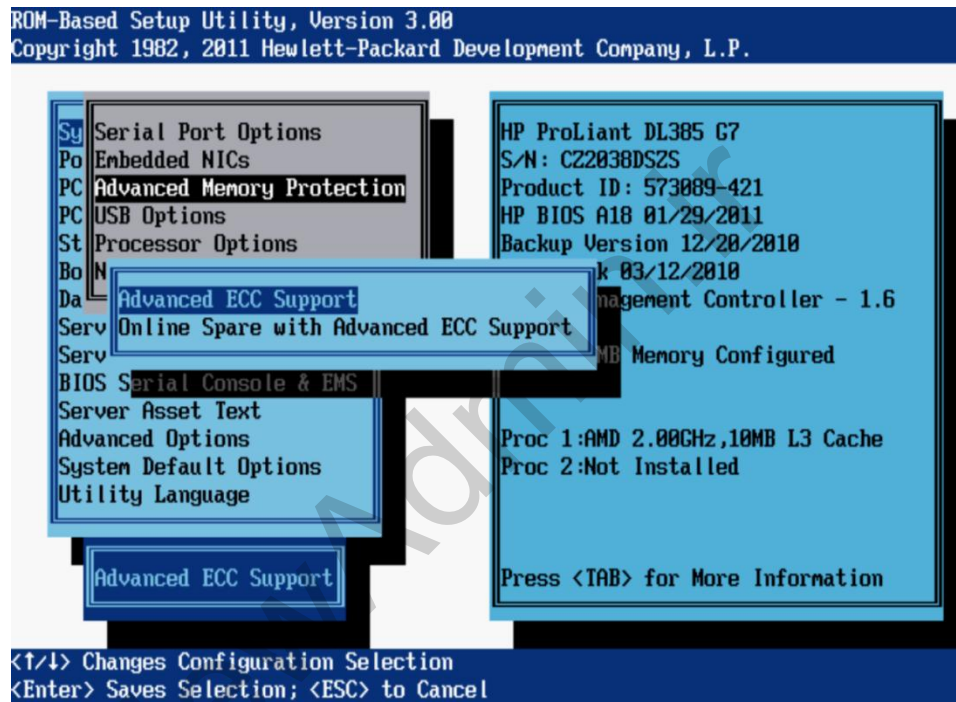
The POST F1 Prompt setting is delayed by default in ProLiant BL, ML, and DL servers.

## System Options submenu

The System Options menu enables basic I/O server configuration with the following options:

- Serial Port Options
- Embedded NICs
- Advanced Memory Protection
- USB Options
- Processor Options
- NUMLOCK Power-On State

### Advanced Memory Protection



Advanced memory configuration screen

The Advanced Memory Protection option provides the following memory protection modes:

- Advanced ECC Support provides the largest memory capacity to the operating system.
- Online Spare with Advanced ECC Support provides additional protection against degrading Fully Buffered DIMMs.

Not all options are available on all servers. It depends on the server generation and the processor used.

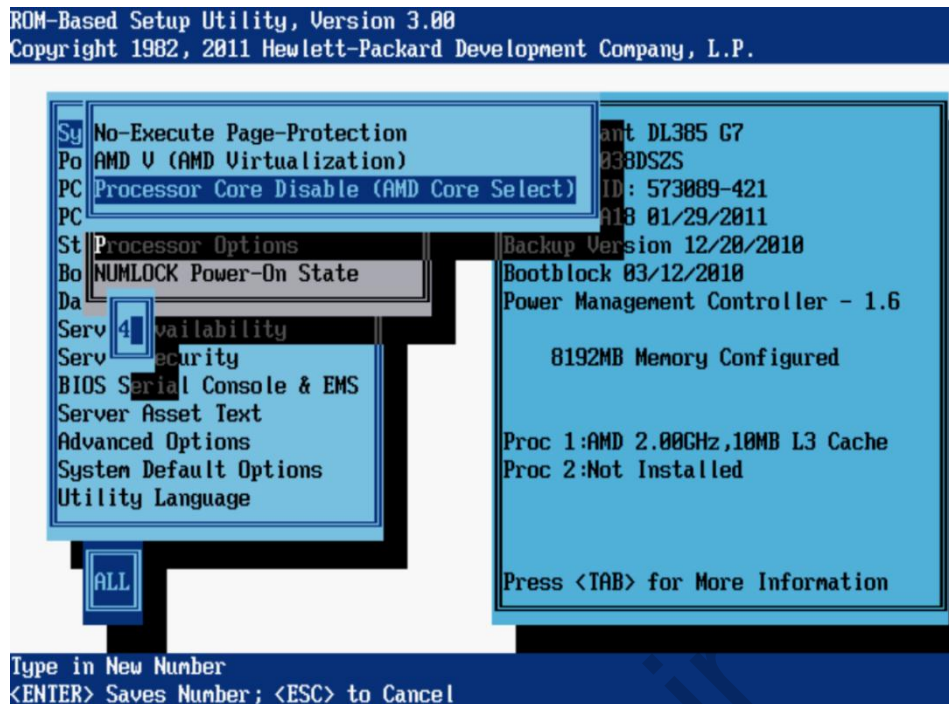
Manufacturers of DDR-3 SDRAM DIMMs produce two types of DIMMs:

- Unbuffered DIMMs (UDIMMs)—These DIMMs represent the most basic type of memory module. They offer lower latency and (relatively) low power consumption, but they are limited in capacity. UDIMMs with ECC are identified with an E suffix in the module name (for example, PC3-8500E). UDIMMs are applicable for systems with low DIMM counts and where low power is required and large memory capacities are not required.
- Registered DIMMs (RDIMMs)—RDIMMs offer larger capacities than UDIMMs and include address parity protection. Registered DIMMs are identified with an R suffix in the module name (for example, PC3-8500R).

The following table shows the differences between RDIMMs and UDIMMs.

	<b>RDIMMs</b>	<b>UDIMMs</b>
DIMM sizes available	2GB, 4GB, 8GB, 16GB	1GB, 2GB
Low power version of DIMMs available	√	
ECC support	√	√
Advanced ECC support	√	√
Address parity	√	
Memory Mirroring and Lockstep Mode support	√	
Relative cost	Higher	Lower
Maximum capacity on a server with 9 DIMM slots	96GB	12GB
Maximum capacity on a server with 12, 16, or 18 DIMM slots	192GB	24GB

## Processor options



Disabling cores option screen from Processor Options menu

The Processor Options menu gives you access to the following settings:

- **No-Execute Memory Protection**—This setting enables the hardware portion of a feature that protects systems against malicious code and viruses. When used in combination with an operating system that supports this feature, certain memory is marked as not for executable code. Viruses that attempt to insert and execute code from nonexecutable memory locations are intercepted and an exception is raised. The default setting is **Enabled**.
- **Intel Virtualization Technology or AMD V (AMD Virtualization)**—When enabled, a Virtual Machine Manager supporting this feature can use hardware capabilities provided by Intel. The default setting is **Enabled**.
- **Intel Hyperthreading Options**—This toggle setting allows Intel Hyperthreading Technology to be enabled or disabled, although it is enabled by default. Intel Hyperthreading delivers two logical processors that can execute multiple tasks simultaneously using shared hardware resources of a single processor core. The option is supported through the system BIOS.

---

### Note

This option is not available on AMD based servers.

---

### INTERNET

For more information on Intel Hyperthreading, see the HP website:  
<http://h18004.www1.hp.com/products/servers/technology/hyperthreading.html>

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- **Turbo Mode**—This setting enables a processor that has available power headroom and is under its temperature specification to transition to a higher frequency than the rated speed. Disabling this feature reduces power usage but also reduces the maximum achievable performance of a system under some workloads. The default setting is **Enabled**.

---

**Note**

This option is not available on AMD based servers.

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- **Intel VT-d2**—When enabled, a Virtual Machine Manager supporting this feature can use hardware capabilities provided by the Intel Virtualization Technology for Directed I/O. The default setting is **Enabled**.

---

**Note**

This option is not available on AMD based servers.

---

- **Core Disabling Options or Processor Core Disable (AMD Core Select)**

Depending on the applications used, this feature has the following benefits:

- Reduces processor power usage and improves overall performance.
- Improves overall performance for applications that benefit from higher performance cores rather than from additional processing cores.
- Addresses issues with software licensed on a per-core basis.

---

**Note**

Available options depend on the type of processor used.

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## Trusted Platform Module

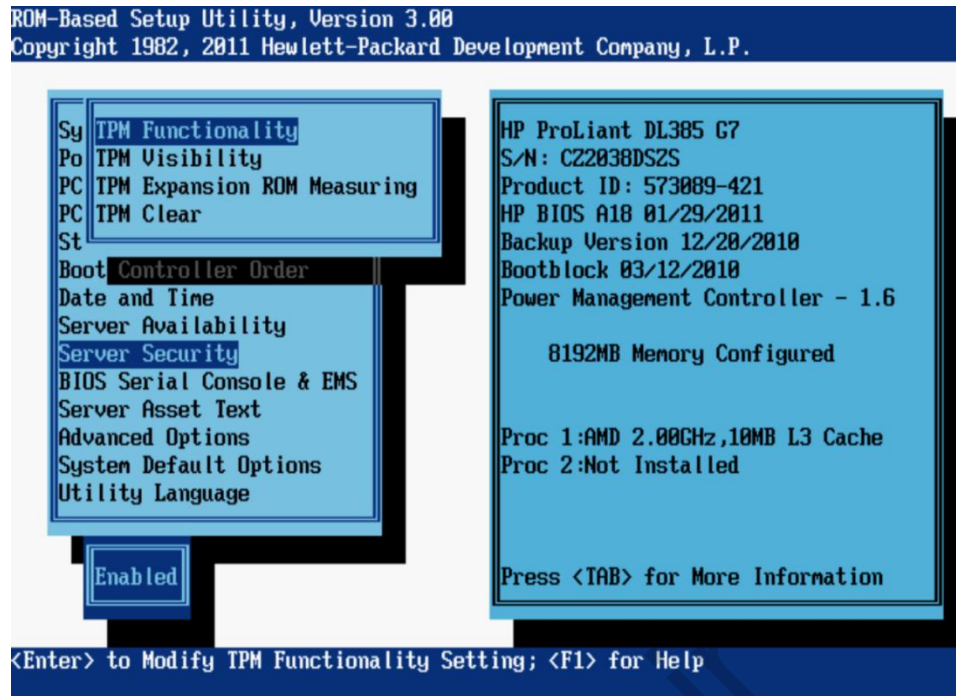
The Trusted Platform Module (TPM) is a hardware-based system security feature that can securely store information, such as passwords and encryption keys, which can be used to authenticate the platform. It can also be used to store platform measurements that help to ensure that the platform remains trustworthy.

The TPM v1.2 is supported on ProLiant G6/G7 servers and on select G5 ProLiant servers. The optional TPM v1.2 module can be attached and secured to the system board with a rivet supplied with the module. To prevent possible damage to the TPM module or to the system board, the TPM cannot be removed from the board after it has been installed.

BitLocker is a feature in Windows Server 2008 that works with features in the TPM to provide authenticated system boot and logical disk drive encryption. The TPM logically and physically protects the key used for encryption to safeguard operating system integrity and data. BitLocker-based physical protection is active even when the server is not powered or operating; therefore, BitLocker protects data if a disk is stolen and mounted on another machine for data mining. BitLocker also protects data if an attacker uses a different operating system or runs a software hacking tool to access a disk.

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## Enabling and configuring the TPM



TPM menu in RBSU

IT administrators can use the RBSU to enable and configure the TPM installed on a ProLiant server. Because the RBSU is embedded in the system ROM of a server, users must complete the following steps to access the TPM menu:

1. To start the RBSU, press the **F9** key when prompted during the startup sequence.
2. Select **Server Security**.
3. Select **Trusted Platform Module**.

Selecting **TPM Functionality** allows you to enable or disable the TPM and BIOS secure startup. The TPM is fully functional when enabled. Disabling TPM functionality disables the BIOS secure startup but still allows the TPM to be visible to the operating system. The TPM can respond to most commands in this mode, depending on how it was disabled. Selecting **Disable** might prevent the server from booting to a TPM-aware operating system.

The TPM Visibility option can make the TPM invisible to the operating system. When the TPM is hidden, BIOS secure startup is disabled, and the TPM does not respond to commands from any software. Hiding the TPM might prevent the server from booting to a TPM-aware operating system. TPM Visibility can be set to **Hide** if the TPM is installed but no longer needed. Hiding the TPM is a way to prevent the operating system and runtime users from seeing the TPM and attempting to re-enable it.

The TPM expansion ROM measuring option allows the BIOS to measure PCI or PCI-e expansion ROM code and store that measurement in the TPM. On subsequent reboots, validation software or operating systems that use the measurements stored in the TPM can use this data to detect modifications to PCI or PCI-e expansion ROM versions. If the TPM expansion ROM measuring option is enabled and a PCI or PCI-e card with an option ROM is inserted, the change will be detected and a password will be required.

The TPM Clear option allows the user to reset the TPM to factory settings, which clears any passwords, keys, or ownership. Clearing the TPM might prevent the server from booting to a TPM-aware operating system.

---

**Note**

The TPM is a customer-configured option. HP will not configure the TPM as part of the CTO or other pre-installation process and is not liable for maintaining recovery keys or for an inability to access data. Customers are strongly advised to perform the recommended procedures to back up customer keys and data. Disaster recovery requires the use of data created by those procedures. HP is unable to override or bypass the protections provided by BitLocker and the TPM, and it is unable to decrypt data protected by BitLocker and the TPM.

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## BitLocker on ProLiant servers

For Windows Server 2008, BitLocker uses the TPM to ensure the integrity of the startup sequence and lets IT administrators encrypt both the operating system volume and additional data volumes on the same server. BitLocker makes the encrypted volume accessible only if it has not been tampered with and if the encrypted drive is located in the original computer. BitLocker is not installed by default with Windows Server 2008; users can add it from the Server Manager page. Before installing the operating system, IT administrators should enable the TPM and create two disk partitions.

BitLocker requires at least two New Technology File System (NTFS) volumes: an operating system volume and a system volume. The system volume must be the active partition and must have a capacity of at least 1.5GB.

### **Precautions affecting server maintenance and management**

Microsoft recommends temporarily disabling BitLocker before updating any system firmware. After the firmware flash is complete, the server should be rebooted and BitLocker can be re-enabled.

If BitLocker is enabled with TPM functionality or if TPM Expansion ROM Measuring functionality is turned on, the system will be locked out and the recovery key will be required to recover the system. If the key is not available, all BitLocker-protected volumes will be inaccessible.

Some examples of activities that can cause the system to be locked out are:

- Flashing System ROMs
- Flashing Option ROMs (NIC, storage, and so forth)
- Flashing iLO 2 or iLO 3
- Installing new PCI devices
- Changing position of hard drives

During the execution of online flash tools, the presence and state of the TPM module will be detected. If the TPM is detected and enabled when a firmware flash is attempted, a pop-up warning message displays. The administrator must acknowledge this warning before the installation can continue. If the administrator is using a command line interface, no pop-up warning message is given. The installation will be terminated and a log file will be generated. A warning message is displayed when the system ROM is being updated with a System ROMPaq, Windows Online Flash, Linux Online Flash, or HP SIM. The message is also displayed if TPM functionality or TPM Expansion ROM Measuring are enabled and the IT administrator is flashing iLO 2 firmware, NIC option ROMs, storage option ROMs, or other option ROMs. Updating the option ROM on third-party cards or older HP options might not result in a warning message, but could initiate the recovery process.

## Configuring the storage subsystem

After configuring the system BIOS, you can configure a storage subsystem differently than the default by using the Option ROM Configuration for Arrays (ORCA) or the Array Configuration Utility (ACU).

- ORCA supplies basic configuration settings during initial setup and assists users who have minimal requirements.
- ACU provides a more comprehensive set of configuration options than ORCA. It can be used for initial setup and for modifying the configuration.

Although most recent HP Smart Array controllers include ORCA functionality and can be configured using ORCA or ACU, older Smart Array controllers support only ACU.

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## Option ROM Configuration for Arrays

```

Option Rom Configuration for Arrays, version 8.30.00.00
Copyright 2010 Hewlett-Packard Development Company, L.P.
Controller: HP Smart Array P410i, slot 0
Direct-Attached Storage

Main Menu
Create Logical Drive
View Logical Drive
Delete Logical Drive
Manage License Keys
Cache Settings

<Enter> to create a new logical drive
<UP/DOWN ARROW> to select main menu option; <ESC> to exit
Note: For more configuration options use the HP Array Configuration Utility

```

ORCA main menu options

ORCA is a basic ROM-based configuration utility that runs automatically during initial startup. It executes from the option ROM that is located on the array controllers. ORCA can also be run manually.

The ROM-based ORCA does not require diskettes or CDs to run, and it can:

- Start when the server is powering up
- Create, configure, and delete logical drives
- Configure the controller as the boot controller if it is not set already
- Assign an online spare for the created logical drives
- Specify a RAID level
- Register the Smart Array Advanced Pack license
- Modify controller cache settings

---

**Note**

ORCA enables you to set the boot controller order during the initial configuration only. When more than one controller exists, the other controllers do not have to be array or Smart Array controllers.

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Because ORCA is designed for users who have minimal configuration requirements, ORCA does not support:

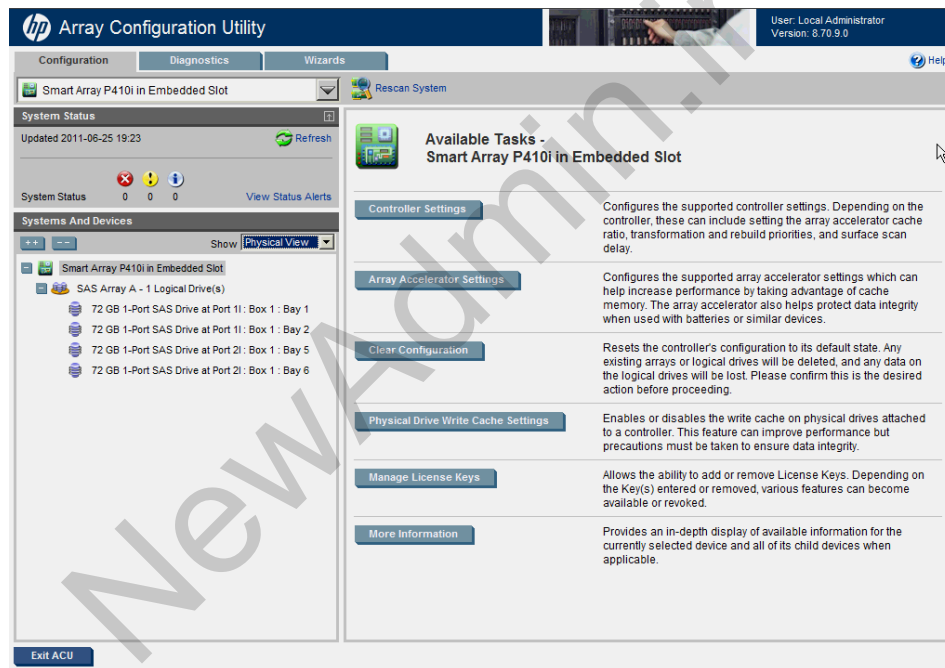
- Drive expansion
- RAID level migration
- Setting the stripe size or controller settings
- Languages other than English

When an HP array controller with ORCA support is installed on the system, the controller-based option ROM prompts during POST.

- If no logical drives are configured on the array controller, the prompt remains for 10 seconds before the system bypasses ORCA and continues with the POST sequence.
- If any logical drives are configured, the prompt remains for 5 seconds.

To run ORCA, press **F8** when prompted during the POST process.

## Array Configuration Utility



Array Configuration Utility main screen

The ACU simplifies array configuration by providing an interface to the intelligent features of Smart Array controllers. You can start the ACU from the operating system, the SmartStart CD, or a bootable diskette.



ACU features include:

- Configuration wizards for optimized array configurations
- Express and standard initial configuration options
- Easy reconfiguration through capacity expansion, logical drive extension, RAID level migration, and stripe size migration tools
- User-selectable stripe sizes
- Support for fault-tolerant RAID levels 0, 1, 1+0, 5, 6 (formerly known as Advanced Data Guarding or ADG), 50, and 60
- Variable cache read/write ratio and stripe size for tuning controller performance
- Drive rebuild and capacity expansion priority settings
- Online spare (hot spare) configuration
- Separate fault tolerance configuration on a logical drive basis
- Set drive UID for quick storage identification

The ACU can be accessed from the SmartStart CD or from the operating system level with a ProLiant Support Pack installed. The ACU also has a command line interface available for scripted configuration.

Smart Array Pack functionality can be accessed using the ACU. This functionality includes:

- RAID 6 and 60s
- Advanced Capacity Expansion
- Mirror Splitting and Recombining in Offline Model
- Drive Erase
- Performance optimization

## Learning check

1. List two types of SL chassis used for hosting ProLiant SL servers:

.....  
.....  
.....  
.....  
.....

2. List six tasks that are performed when deploying a ProLiant server.

.....  
.....  
.....  
.....  
.....  
.....

3. List three types of option ROMs.

.....  
.....  
.....

4. During the system startup process, which key do you press to access RBSU?

- a. F8
- b. F9
- c. F10
- d. F12

5. Which HP tool is used to configure hardware settings and to prepare a server for an operating system installation?

.....

6. Which utility can be used to disable cores on the processor?

- a. Embedded Inspect Utility
- b. RBSU
- c. ORCA
- d. SmartStart 8.x

7. What does ORCA enable you to do?

.....

.....

.....

.....

.....

NewAdmin.ir

NewAdmin.ir

### Objectives

After completing this module, you should be able to:

- Explain the benefits of HP integrated Lights-Out (iLO) products
- Identify the functions of HP iLO products

NewAdmin.ir

## HP Lights-Out technology and benefits



HP integrated Lights-Out

IT administrators face many challenges in managing distributed remote sites and space-constrained data centers. HP remote management products improve operational efficiency, enabling customers to:

- Minimize costly downtime with remote maintenance and control facilities for quick recovery
- Manage their servers from any console on the network
- Access their servers through a web browser interface
- Monitor configuration and usage of remote devices
- Restart remote servers
- Leverage operating system security for user authentication and encrypt communications with Secure Sockets Layer (SSL) and Secure Shell (SSH) encryption
- Support distributed remote sites as if they were local
- Maintain secure data centers, with centralized user accounts providing all security credentials

Server remote management is a necessity for IT organizations of all sizes today as they strive to meet business demands for efficiency and responsiveness.

HP remote management gives the administrator virtual presence; that is, the administrator has complete control as if he or she was in front of servers in data centers or at remote sites. HP integrated Lights-Out delivers unique remote management simplicity and agility that lowers operational costs, improves IT productivity, and increases system availability.

Lights-Out technology is an autonomous management subsystem that resides in a host server to manage it through any server state—initial power-on testing, before the operating system is loaded, while the operating system is functional, and even during an operating system failure.

Integrated Lights-Out is an HP innovation that integrates industry-leading Lights-Out functionality and basic system board management capabilities on selected HP ProLiant servers. HP iLO consists of an intelligent processor and firmware that provides standard and advanced levels of Lights-Out remote management functionality. Basic system board management functions, diagnostics, and essential Lights-Out functionality are provided as standard features of the server and are referred to as integrated Lights-Out Standard.

Advanced functionality, referred to as integrated Lights-Out Advanced, can be licensed with the optional Integrated Lights-Out (iLO) Advanced. iLO Advanced offers sophisticated virtual administration features for full control of servers in dynamic data centers and remote locations.

## Advantages of Lights-Out technology products

HP Lights-Out technology provides these advantages:

- **Easy to set up and use**—A ROM-based configuration utility enables setup without additional software. Setup can also be done using the browser interface over the network. For large deployments, an HP utility can be used to configure multiple servers simultaneously.
- **Group administration and action**—Enables an administrator to easily configure both network and global settings for a group rather than one at a time. Deployment can be through a batch process or HP Systems Insight Manager (HP SIM). Group actions can include controlling the power switch, rebooting, ROM upgrades, retrieving important blade topology information, and switching the Unit ID LED on and off. The remote deployment of servers is also supported.
- **Integrated Management Log (IML)**—Maintains a copy of the host server IML, which can be accessed using a standard browser, even when the server is not operational.
- **iLO Event Log or Remote Insight Event Log**—Provides a detailed event log that records user actions such as turning server power on and off, resetting the server, changes in user configuration, clearing event log, and successful and unsuccessful login attempts. A supervisor can use this log to audit user actions.
- **Headless server deployment**—Simplifies cable management by reducing the required cables from five to three per server. A monitor, keyboard, mouse, and switch box are not needed in every rack.
- **Auxiliary power**—The iLO management processor obtains its power through a separate connection to the auxiliary power plane of the server. Even if the host server is powered down, Lights-Out management functions are still available. As long as the server is connected to a power source, the iLO management processor can power itself up and remain fully functional. If the server provides redundant power supplies, iLO uses redundant power and continues operation in the event of a power supply failure.

Remote capability for administrative functions—virtual media lets the administrator:

- Run local applications on remote host servers
- Apply firmware upgrades to remote servers
- Deploy an operating system on remote servers from a Virtual CD network drive
- Perform disaster recovery of failed operating systems
- Install applications on the remote server from a Virtual CD



Starting with the HP ProLiant DL385 G7 server, all new G7 servers will ship with the integrated Lights-Out 3 (iLO 3) management processor. HP iLO 3 provides all of the benefits of iLO 2, including powerful remote administration, optimized server power and thermal control, and embedded server health status, but it takes performance to the next level with an 800% improvement in remote console performance and 360% improvement in virtual media performance.

Like its predecessor, iLO 3 has a standard and an advanced version. HP iLO Standard ships at no additional charge with ProLiant ML and DL servers, and iLO Standard for HP BladeSystem ships standard with all ProLiant BL servers. HP iLO Advanced or iLO Advanced for BladeSystem unlocks the full capabilities of iLO 3 on ProLiant ML, DL, and BL servers.

## HP iLO Advanced Pack

The advanced remote management capabilities for ProLiant servers are based on the iLO 2 and iLO 3 processors embedded on most current ProLiant servers.

HP iLO provides essential remote management capabilities, enabling administrators to diagnose and configure remote servers. Features of iLO Standard include:

- Simple, text-based command line interface to execute tasks securely
- Virtual power button to turn the power on or off remotely
- Server diagnostics with detailed power-on self-test (POST) tracking, integrated management log access, and server status
- Virtual indicators that enable an administrator to view or change the status of the unit identification light on the server
- Shared network port
- Simple Network Management Protocol (SNMP) alerting and alert forwarding through HP SIM

The iLO Advanced Pack expands on the features of integrated Lights-Out with the purchase of a software key, enabling a virtual presence with remote graphical console capabilities and virtual media support. Other features enabled by the iLO Advanced Pack include:

- Directory services support
- Power monitoring
- Terminal services pass through
- Power monitoring
- Shared Remote Console
- Record boot and fault buffers
- Dynamic power capping

---

**INTERNET**

For more information about the iLO Advanced Pack go to the HP website at:  
<http://www.hp.com/go/ilo>

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## Functions of the iLO 3 management processor

Two versions of iLO management processor are currently used. G5 and G6 servers use iLO 2, and G7 servers are equipped with the iLO 3 management processor.

### New in HP integrated Lights-Out 3

HP iLO 3 adds support for:

- Web 2.0 Interface using JSON technology
- Improved Microsoft Windows Integrated Remote Console (IRC)
- Multiple monitor display support
- Click-once installs
- Improved .NET framework
- Java Integrated Remote Console
- Linux Integrated Remote Console
- Higher performance virtual media
- Sea of Sensors support
- Hardware Advanced Encryption Standard (AES) encryption engine

HP iLO 3 is based on the iLO 2 processor and shares many common features. However, to use iLO 3 to access a preoperating system, text-based remote console, a remote serial console must be used.

### iLO 2 features removed in iLO 3

Some features known from iLO 2 have been removed in iLO 3:

- Telnet interface (replaced with five SSH sessions)
- Terminal services pass-through (iLO 3 IRC is amply comparable)
- Virtual Serial Port Applet (VSP functionality is still available through SSH)
- Stand-alone Virtual Media Applet (functionality is included in the Java IRC)
- Local accounts two-factor authentication (Kerberos provides two-factor support for Lightweight Directory Access Protocol [LDAP] accounts)
- Remote console hot keys (obsolete, real-keyboard-like response)

- BladeSystem p-Class support (obsolete, iLO 3 is not available for p-Class systems)
- HPLOMIGC (of the two utilities, a “C” command line version has been retired; most HP customers use the HPLOMIG)
- c-Class BladeSystem Wizard (the HP Onboard Administrator [OA] provides this functionality)

## iLO3 firmware updates

Changes in the iLO 3 firmware since its initial release include:

- Support for Internet Explorer 7, 8, and 9
- New user interface
- Enterprise One Voice user interface—one look and feel for HP web page user interfaces
- 2-Factor authentication support through Kerberos
- Language Pack support, with Japanese as the first Language Pack
- Various problem fixes and other improvements and enhancements

## ILO 3 user interface

```

192.168.19.48 - PuTTY
login as: admin
admin@192.168.19.48's password:
User:admin logged-in to ILOCZ2038DSZS.(192.168.19.48)
iLO 3 Advanced HP limited-distribution date-restricted test 1.25 at May 26 2011
Server Name: DL385G7
Server Power: On

</>hpiLO-> power

status=0
status_tag=COMMAND COMPLETED
Sat Jun 25 19:30:10 2011

power: server power is currently: On

</>hpiLO-> textcons

```

iLO3 SSH interface

ILO 3 is accessible through the following user interfaces.

- SSH
- Web-based interface
- Scripted interface (XML)

## Text-based iLO 3 interface

The SSH interface of iLO 3 enables administrators to use the most important iLO 3 features from a text-based console. The following commands are supported:

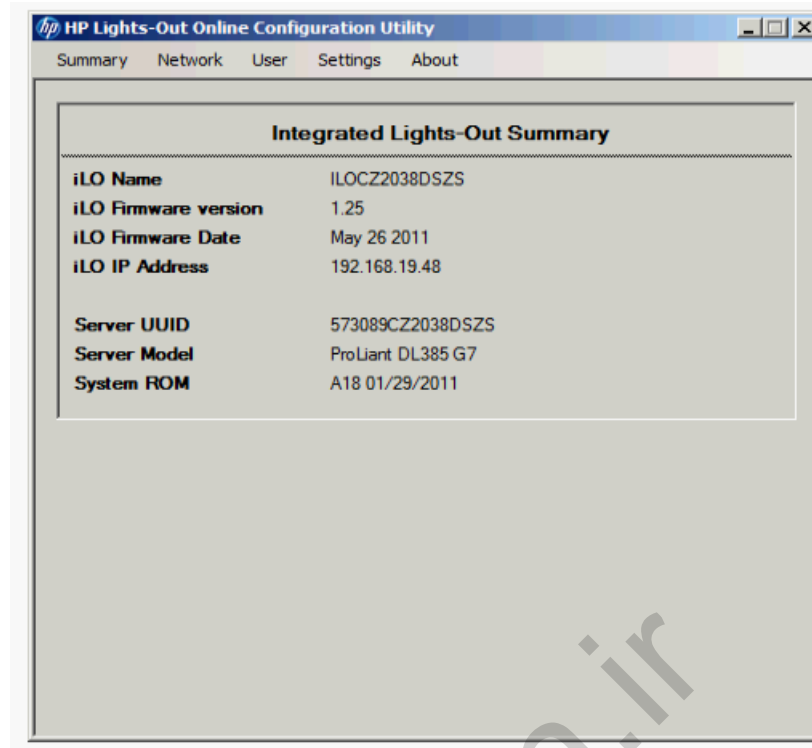
- Manipulating the server power button
- Redirection to a virtual serial port
- Redirection of the text based console
- Manipulating the user ID (UID)
- Connecting Virtual Media to a target server

A scripted interface can be used with the CPQLOCFG or HPONLCFG utilities for remote configuration. Each parameter from a web-based interface can be set from an XML file.

### INTERNET

For more details about scripting, go to <http://h18006.www1.hp.com/products/servers/management/ilobest-practice.html> or to the **Support & Drivers** web page on <http://www.hp.com>

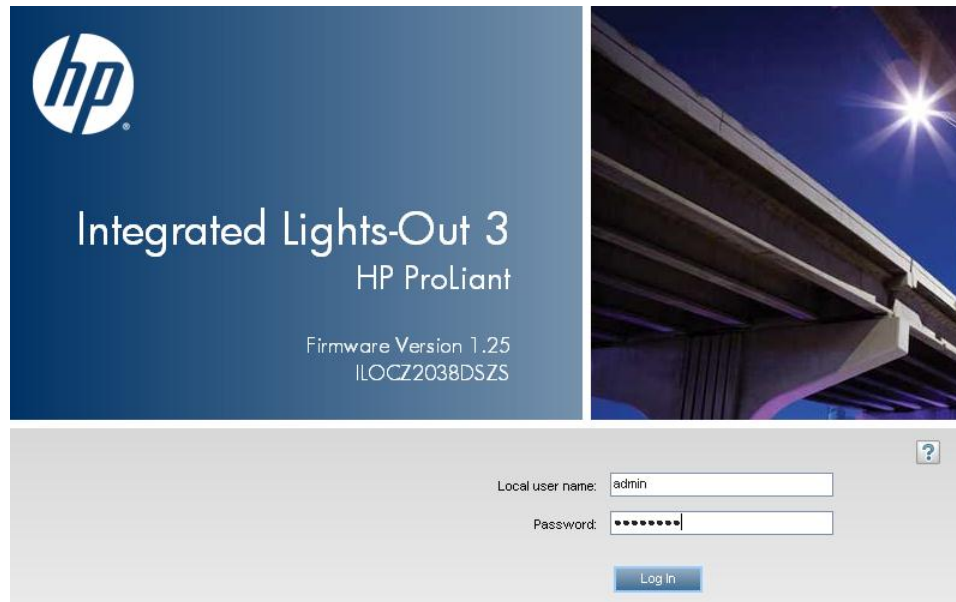
## HP Lights-Out Online Configuration Utility



HP Lights-Out Online Configuration Utility

The HP Lights-Out Online Configuration Utility (HPONCFG) enables users to configure iLO from within the operating system or from the HP SmartStart CD without requiring a server reboot. A graphical user interface provides a basic subset of the features offered by the HPONCFG Command Line Utility without requiring scripting skills.

## Using the iLO 3 web interface



Web interface login screen

The two types of login credentials can be used to access the iLO 3 web interface are local user accounts and domain user accounts. Local user accounts are stored inside iLO 3 memory when the default user **Administrator** is enabled.

## Information capabilities of iLO 3

The screenshot shows the HP iLO 3 web interface. The top navigation bar includes the HP logo, 'Integrated Lights-Out 3 ProLiant DL385 G7', 'Local User: admin', 'iLO Hostname: ILOCZ2038DSZS', 'Home', and 'Sign Out' buttons. A left sidebar menu is expanded to show 'Information' with sub-items: Overview, System Information, iLO Event Log, Integrated Management Log, Diagnostics, Insight Agent, Remote Console, Virtual Media, Power Management, and Administration. The main content area is titled 'iLO Overview' and is divided into three sections: 'Information', 'Status', and 'Active Sessions'.

**Information**

Server Name	DL385G7
Product Name	ProLiant DL385 G7
UUID	30333735-3938-5A43-3230-333844535A53
Server Serial Number	CZ2038DSZS
Product ID	573089-421
System ROM	A18 01/29/2011
Backup System ROM	12/20/2010
Integrated Remote Console	<a href="#">iNET</a> Java
License Type	iLO 3 Advanced HP limited-distribution date-restricted test
iLO Firmware Version	1.25 May 26 2011
IP Address	192.168.19.48
iLO Hostname	ILOCZ2038DSZS.

**Status**

System Health	OK
Server Power	ON
UID Indicator	UID OFF
TPM Status	Present/Not Enabled
iLO Date/Time	Sat Jun 25 21:07:52 2011

**Active Sessions**

User:	IP	Source
Local User: admin	192.168.16.51	Web UI

At the bottom of the interface, there are status indicators for 'POWER: ON' and 'UID: OFF'.

System overview

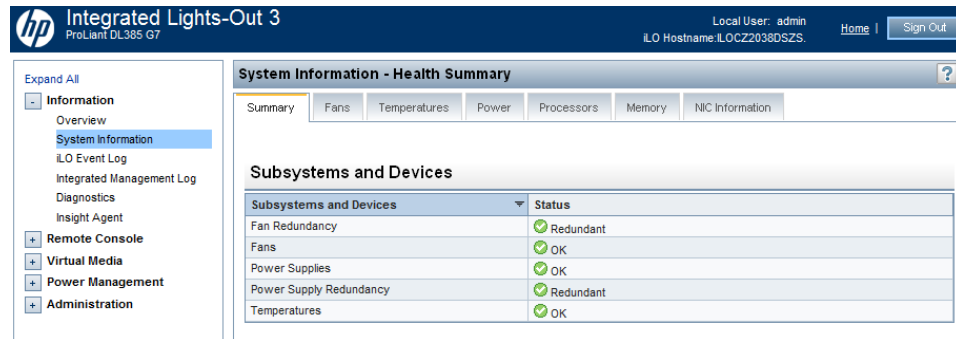
The iLO 3 web interface displays the information page with system status and status summary information, and provides access to health information, system logs, and Insight Agent information. The options available in the Information section are:

- Overview
- System Information
- iLO 3 Event Log
- Integrated Management Log
- Diagnostics
- Insight Agents
- Direct access to remote consoles

The Overview page displays first, providing information about the server.



## System Information and Summary



The screenshot shows the HP Integrated Lights-Out 3 web interface. The top navigation bar includes the HP logo, 'Integrated Lights-Out 3', 'ProLiant DL385 G7', 'Local User: admin', 'ILO Hostname: ILOEZ2038DSZS', 'Home', and 'Sign Out'. The left sidebar contains a navigation menu with categories: Information (Overview, System Information, ILO Event Log, Integrated Management Log, Diagnostics, Insight Agent), Remote Console, Virtual Media, Power Management, and Administration. The main content area is titled 'System Information - Health Summary' and has tabs for Summary, Fans, Temperatures, Power, Processors, Memory, and NIC Information. The 'Summary' tab is selected, displaying a table of subsystems and devices.

Subsystems and Devices	Status
Fan Redundancy	Redundant
Fans	OK
Power Supplies	OK
Power Supply Redundancy	Redundant
Temperatures	OK

ILO 3 web interface—System information page

System Information displays the health of the monitored system. Many of the features necessary to operate and manage the components of the ProLiant server have migrated from the health driver to the iLO 3 microprocessor. These features are available without installing and loading the health driver for the installed operating system. The iLO 3 microprocessor monitors these devices when the server is powered on during server boot, operating system initialization, and operation. Monitoring continues through an unexpected operating system failure.

The System Information Summary tab displays by default. System Information also offers the following embedded health tabs: Fans, Temperatures, Power, Processors, Memory, and NIC Information.

## iLO 3 Event Log

The screenshot shows the HP iLO 3 Integrated Lights-Out 3 interface. The top header displays the HP logo, 'Integrated Lights-Out 3', and 'ProLiant DL385 G7'. On the right, it shows 'Local User: admin', 'Home', and 'Sign Out' buttons. Below the header, there is a navigation menu on the left with categories like Information, Remote Console, Virtual Media, Power Management, and Administration. The main area is titled 'iLO Event Log' and contains a table of events. At the bottom, there is a status bar with indicators for 'POWER: OFF', 'UID: BLINK', and a green checkmark.

Severity	Class	Last Update	Initial Update	Count	Description
Information	iLO 3	06/12/2011 17:39	06/12/2011 17:39	1	SSH login: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 17:39	06/12/2011 17:39	1	SSH logout: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 17:40	06/12/2011 17:40	1	XML login: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 17:40	06/12/2011 17:40	1	XML logout: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 17:43	06/12/2011 17:43	1	Browser login: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 21:28	06/12/2011 21:28	1	Browser logout: admin - 192.168.19.37 (d1380g6.raz-lab).
Warning	iLO 3	06/12/2011 23:22	06/12/2011 23:22	1	SSH login failure from: 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 23:22	06/12/2011 23:22	1	SSH login: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 23:22	06/12/2011 23:22	1	SSH logout: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 23:23	06/12/2011 23:23	1	XML login: admin - 192.168.19.37 (d1380g6.raz-lab).
Information	iLO 3	06/12/2011 23:23	06/12/2011 23:23	1	XML logout: admin - 192.168.19.37 (d1380g6.raz-lab).

iLO3 Event Log

The iLO 3 Event Log page is a record of significant events detected by iLO 3. Logged events include major server events such as a server power outage or a server reset and iLO 3 events such as unauthorized login attempts. Other logged events include successful or unsuccessful browser and remote console logins, virtual power and power cycle events, clear event log actions, and some configuration changes such as creating or deleting a user.

HP iLO 3 provides secure password encryption, tracking all login attempts and maintaining a record of all login failures. Authentication failure logging enables administrators to configure logging criteria for failed authentications. Administrators can configure failed login attempt tracking for every attempt or for every second, third, or fifth attempt. In addition, they can capture the client name for each logged entry to improve auditing capabilities in Dynamic Host Configuration Protocol (DHCP) environments, and they can record the account name, computer name, and IP address of each entry. When login attempts fail, iLO 3 also generates alerts and sends them to a remote management console.

## Integrated Management Log

Severity	Class	Last Update	Initial Update	Count	Description
✖	Network	06/25/2011 13:11	06/25/2011 13:02	2	Network Adapter Link Down (Slot 0, Port 4)
✖	Network	06/25/2011 13:11	06/25/2011 13:02	2	Network Adapter Link Down (Slot 0, Port 3)
✖	Network	06/25/2011 12:16	06/25/2011 12:16	1	Network Adapter Link Down (Slot 0, Port 4)
✖	Network	06/25/2011 12:16	06/25/2011 12:16	1	Network Adapter Link Down (Slot 0, Port 3)
⚠	POST Message	06/25/2011 11:38	06/25/2011 11:06	6	POST Error: 1729-Background Parity Initialization Not Yet Complete
⚠	POST	06/25/2011	06/25/2011	2	POST Error: 1794-Slot X Drive Array - Array Accelerator Battery is charging. The Array Accelerator Cache will be enabled

Integrated Management Log page

The Integrated Management Log (IML) page is a record of historical events that have occurred on the server as reported by various software components. Events are generated by the system ROM and by services like the System Management (health) driver.

Administrators can view the logged remote server events. Logged events include all server-specific events recorded by the system health driver, including operating system information and ROM-based POST codes.

---

**Note**

For more information about the types of events logged, see the server user guide.

---

Entries in the IML can be used during problem diagnosis or for predicting possible problems before they occur. Preventative action might be recommended to avoid possible disruption of service. ILO 3 manages the IML, which can be accessed using a supported browser, even when the server is off. The ability to view the event log even when the server is off can be helpful when troubleshooting remote host server problems.

## Diagnostics

The screenshot displays the HP iLO 3 Integrated Lights-Out 3 Diagnostics page. The page title is "Integrated Lights-Out 3" and the sub-title is "ProLiant DL385 G7". The local user is "admin" and the ILO hostname is "ILOCC2038DSZS". The page is divided into a left navigation pane and a main content area.

The left navigation pane includes the following items:

- Expand All
- Information
  - Overview
  - System Information
  - iLO Event Log
  - Integrated Management Log
  - Diagnostics**
  - Insight Agent
- Remote Console
- Virtual Media
- Power Management
- Administration

The main content area is titled "Diagnostics" and contains the following sections:

**iLO Self-Test Results**

Self-Test	Status	Notes
Power Management Controller	①	1.6
CPLD - PAL0	①	ProLiant DL385 G7 System Board PAL version 0x0B
CPLD - PAL1	①	ProLiant DL385 G7 SAS PAL version 0x07
NVRAM data	✓	
EEPROM	✓	
Host ROM	✓	
Supported host	✓	

**Reset Integrated Lights-Out**

All active connections to iLO are lost when you reset iLO. No configuration changes are made.

**Non-Maskable Interrupt (NMI) Button**

The use of NMI may result in data loss. Use with caution.

**Redundant ROM support**

The server enables you to upgrade or configure the ROM safely with redundant ROM support. One side of the ROM contains the current ROM program version, while the other side of the ROM contains a backup version.

**Active ROM**

System ROM	A18
System ROM Date	01/29/2011

**Backup ROM**

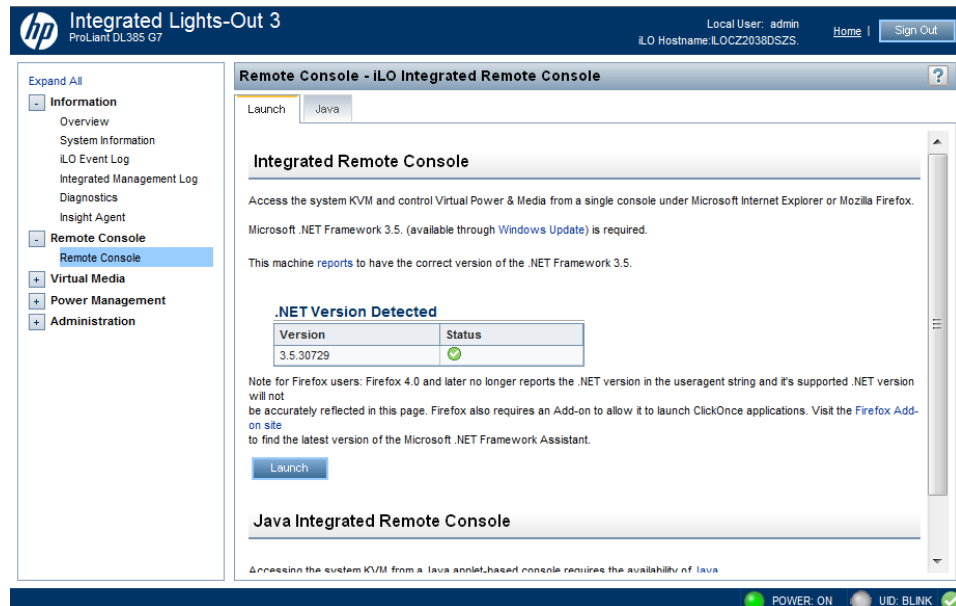
Backup ROM Date	12/20/2010
Bootblock Date	03/12/2010

At the bottom of the page, there are status indicators: POWER: OFF and UID: BLANK.

Diagnostics page on iLO3

The Diagnostics option from the Information menu displays server and iLO 3 data, including iLO 3 self-test results. It also provides options to reset iLO 3 and to generate a non-maskable interrupt (NMI) to the system.

## HP iLO 3 Remote Console



Remote Console options

The iLO 3 Remote Console redirects the host server console to the network client browser, providing full text, graphical mode video, keyboard, and mouse access to the remote host server if that server is licensed.

HP iLO 3 uses virtual KVM technology to improve remote console performance comparable with other KVM solutions.

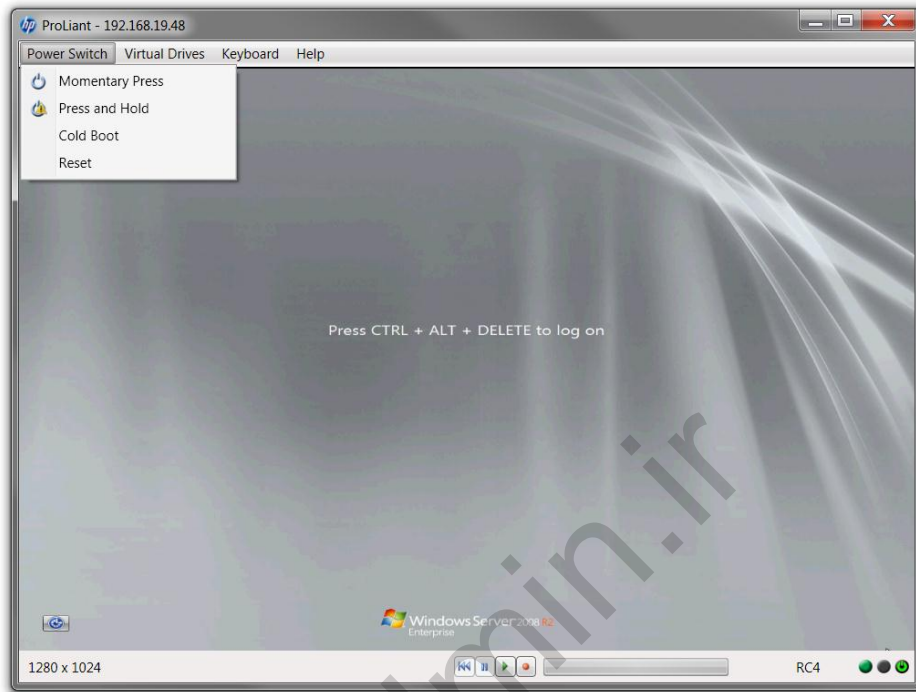
With remote console access, the administrator can observe POST boot messages as the remote host server restarts and initiate ROM-based setup routines to configure the hardware of the remote host server. When installing operating systems remotely, the graphical remote consoles (if licensed) enable you to view and control the host server screen throughout the installation process.

Remote console access provides complete control over a remote host server as if sitting in front of the system, including access to the remote file system and network drives. The remote console enables you to change the hardware and software settings of the remote host server, install applications and drivers, change remote server screen resolution, and gracefully shut down the remote system.

Up to 10 users are allowed to log in simultaneously to iLO 3; however, only four users can access a shared Integrated Remote Console. If an administrator attempts to open the Remote Console while it is already in use, a warning message displays, indicating that it is in use by another user.

The Remote Console Information page provides access links to the different remote console access options. After deciding which console option to use, click the appropriate link. HP iLO 3 provides the following remote console access options:

- **Integrated Remote Console**—Provides access to the system KVM, allowing control of virtual power and virtual media from a single console using an Internet Explorer or Firefox browser on Microsoft Windows.



Integrated Remote Console

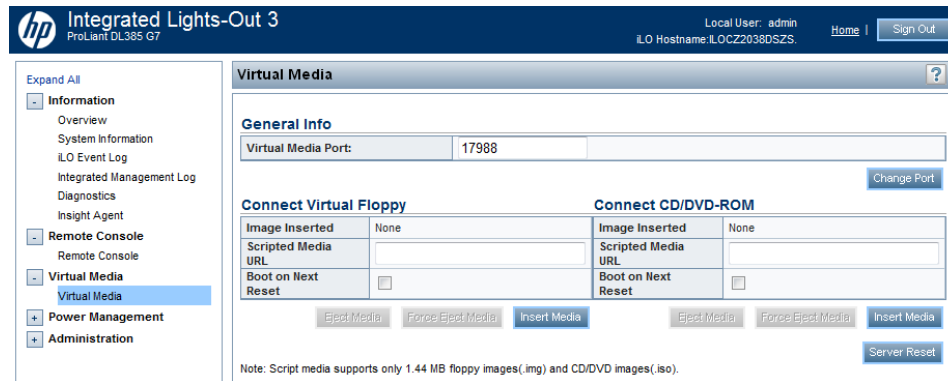
- **Java Integrated Remote Console**—Provides access to the system KVM through a Java applet-based console. This Remote Console is the familiar Remote Console support carried forward from the original iLO product, but it requires that Java be installed on the client system. The Remote Console operates with all operating systems and browsers supported by iLO 3.

The graphical console of iLO 3 has changed from the iLO 2 version together with other functionality.

The improved Windows Integrated Remote Console provides:

- Higher performance
- Scalable display (scroll bars omitted)
- Multiple monitor display support
- Click-once installation
- .NET framework (for a better look and feel)—for example, the Windows remote console was previously ActiveX but can now run on Internet Explorer, Firefox, and smartphones

## Virtual Media



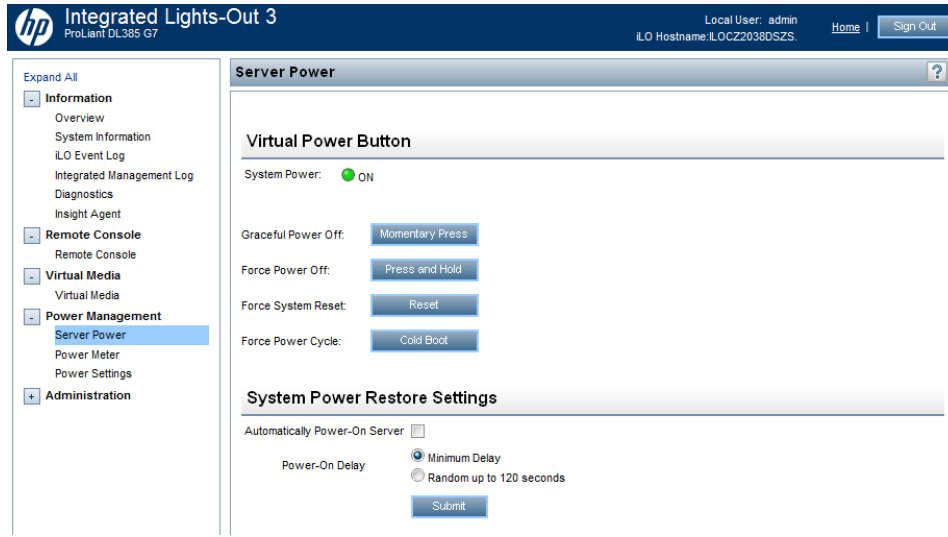
ILO 3 interface—Virtual Media

Virtual Media is a licensed feature. If Virtual Media is not licensed, the message `iLO 3 feature not licensed` displays. The ability to use iLO 3 Virtual Media is granted or restricted through iLO 3 user privileges. Users must have the Virtual Media privilege to select a virtual media device and connect it to the host server.

The iLO 3 Virtual Media option provides a virtual floppy disk drive and CD/DVD-ROM drive that can direct a remote host server to boot and use standard media from anywhere on the network.

Using iLO 3, Virtual Media devices are available when the host system is booting. The iLO 3 Virtual Media devices connect to the host server using USB technology, which enables new capabilities for the iLO 3 Virtual Media devices when connected to USB-supported operating systems. Different operating systems provide various levels of USB support.

## Power Management



Server Power screen

iLO 3 power management enables administrators to view and control the power state of the server, monitor power usage, monitor the processor, and modify power settings. The Power Management page has three menu options:

- Server Power
- Power Meter
- Power Settings

### Server Power

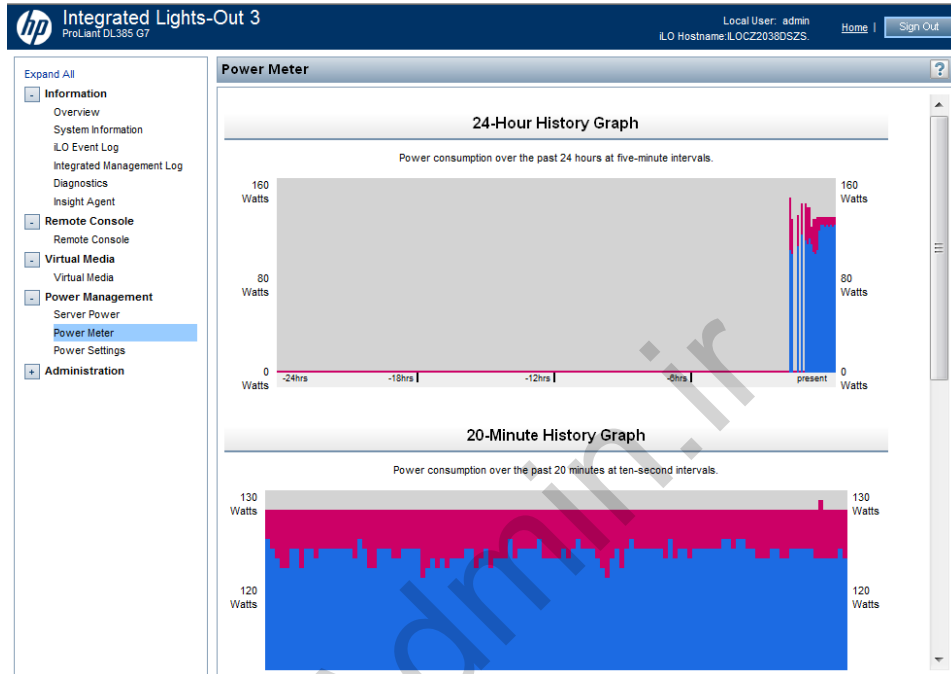
To change the current server power state using the Virtual Power button options, the user must have the Virtual Power and Reset privilege. Some of the power control options do not gracefully shut down the operating system. An operating system shutdown should be initiated using the Remote Console before using the Virtual Power button options. The following options are available:

- **Momentary Press**—This button provides behavior identical to pressing the physical power button.
- **Press and Hold**—This button is identical to pressing the physical power button for 5 seconds and then releasing it. This option provides the Advanced Configuration and Power Interface (ACPI)-compatible functionality that is implemented by some operating systems. These operating systems behave differently depending on a short press or long press. The behavior of this option might circumvent any graceful shutdown features of the operating system.



- **Reset**—This button initiates a system reset. This option is not available when the server is powered down. The behavior of this option might circumvent any graceful shutdown features of the operating system.
- **Cold Boot**—This function immediately removes power from the system, circumventing graceful operating system shutdown features. The system will restart after approximately 6 seconds. This option is not available when the server is powered down.

## Power Meter



Power Meter Readings

The Power Meter page displays server power utilization as a graph. This page has two sections: Power Meter Readings and Power History.

## Power Settings

**Power Settings** ?

---

**Power Regulator Settings**

Power Regulator for ProLiant:

HP Dynamic Power Savings Mode  
 HP Static Low Power Mode  
 HP Static High Performance Mode  
 OS Control mode

[Apply](#)

---

**Power Capping Settings**

Measured Power Values	Watts	Percent (%)	Power Cap Thresholds
Maximum Available Power	920 Watts	632%	Maximum Power Cap
Peak Observed Power	228 Watts	100%	Minimum High-Performance Cap
Minimum Observed Power	98 Watts	0%	Minimum Power Cap
Power Cap Value	165 Watts	52 %	

Enable power capping [Show values in BTU/hr](#) [Apply](#)

---

**SNMP Alert on Breach of Power Threshold**

Warning Trigger	Warnings Disabled	
Warning Threshold	0	Watts
Duration	0	Minutes

[Apply](#)

---

**Other Settings**

Enable persistent mouse and keyboard [Apply](#)

Server Power Settings

The Power Regulator for ProLiant feature enables iLO 3 to dynamically modify processor frequency and voltage levels based on operating conditions to provide power savings with minimal effect on performance. The Power Management Settings page enables you to view and control the power regulator mode of the server. The current user must have the Configure iLO 3 Settings privilege to change this setting.

The Power Regulator for ProLiant section has the following options:

- Enabling HP Dynamic Power Savings Mode sets the processor to dynamically set the power level based on usage.
- Enabling HP Static Low Power Mode sets the processor to minimum power.
- Enabling HP Static High Performance Mode sets the processor to the highest supported processor state and forces it to stay in that state.
- Enabling OS Control Mode sets the processor to maximum power.

The Power Capping Settings section displays measured power values and enables you to set a power cap and disable power capping. Measured power values include the server power supply maximum value, the server maximum power, and the server idle power. The power supply maximum power value refers to the maximum amount of power that the server power supply can provide. The server maximum and idle power values are determined by two power tests run by the ROM during POST.

## Power efficiency

HP iLO 3 enables you to implement improved power usage using a High Efficiency Mode (HEM). HEM improves the power efficiency of the system by placing the secondary power supplies into step-down mode. When the secondary supplies are in step-down mode, the primary supplies provide all the DC power to the system. The power supplies are more efficient (more DC output Watts for each Watt of AC input) at higher power output levels, and the overall power efficiency improves.

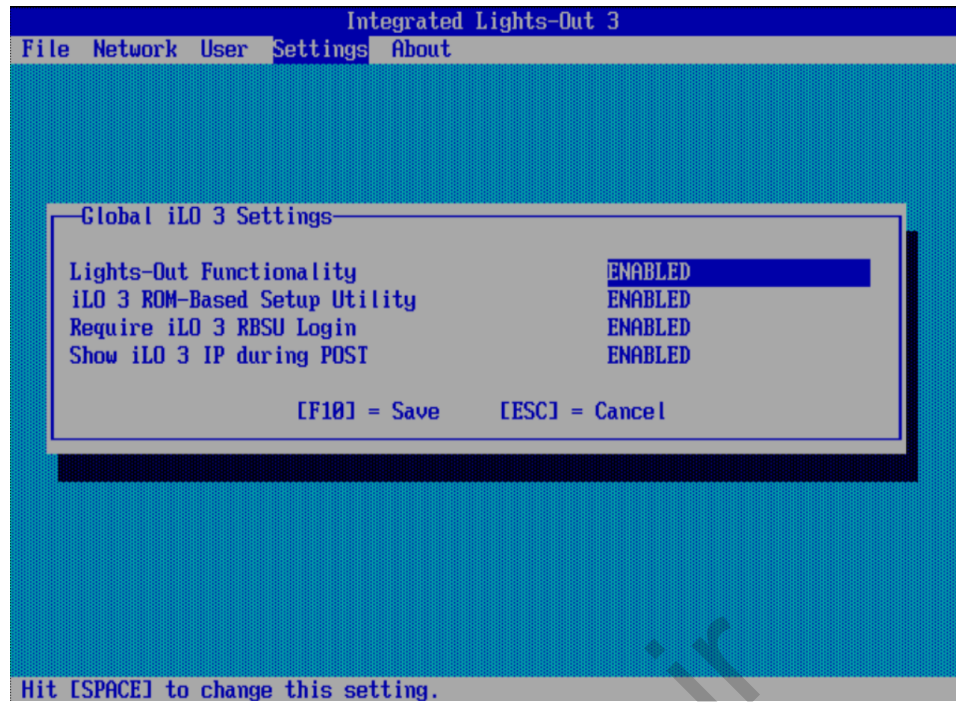
When the system begins to draw more than 70% capacity of the maximum power output of the primary supplies, the secondary supplies return to normal operation (out of step-down mode). When the power use drops below 60% capacity of the primary supplies, the secondary supplies return to step-down mode.

HEM enables systems to achieve power consumption equal to the maximum power output of the primary and the secondary supplies, while maintaining improved efficiency at lower power usage levels. HEM does not affect power redundancy. If the primary supplies fail, then the secondary supplies immediately begin supplying DC power to the system, preventing any downtime.

HEM can only be configured through the ROM-Based Setup Utility (RBSU). These settings cannot be modified through iLO. The settings for HEM are Enabled or Disabled (also called Balanced Mode), and Odd or Even supplies as primary. These settings are visible in the High Efficiency Mode & Standby Power Save Mode section of the System Information, Power tab. This section displays the following information:

- If HEM is enabled or disabled
- Which power supplies are primary (if HEM is enabled)
- Which power supplies do not support HEM

## ILO 3 ROM-Based Setup Utility



ILO 3 RBSU

HP recommends the iLO 3 RBSU to initially set up iLO 3 and configure iLO 3 network parameters for environments that do not use DHCP and the Domain Name System (DNS) or Windows Internet Naming Service (WINS). RBSU provides the basic tools to configure iLO 2 network settings and user accounts to get iLO 2 on the network.

Administrators can use RBSU to configure network parameters, directory settings, global settings, and user accounts. The iLO 3 RBSU is not intended for continued administration. RBSU is available every time the server is booted and can be run remotely using the iLO 3 remote console. The iLO 3 RBSU can be disabled in the Global Settings preferences. Disabling the iLO 3 RBSU prevents reconfiguration from the host unless the iLO Security Override switch is set.

# Learning check

1. Which utility can be used to configure integrated Lights-Out when the Windows operating system is installed on the ProLiant server with the latest ProLiant Support Pack?
  - a. HP Lights-Out Online Configuration Utility
  - b. Onboard Administrator Config Utility
  - c. Management Configurator
  - d. HP iLO 3 Management Homepage
2. Telnet interface was removed from iLO 3 because more SSH connections are now available.
  - True
  - False
3. Which options are available when manipulating the power button from the iLO interface?
  - a. Momentary Press
  - b. Shutdown Button
  - c. Press and Hold
  - d. Cold Boot
  - e. Reset System
  - f. Warm Reboot
  - g. Hold 10 seconds
4. Explain the most important benefits the customer gets with the iLO Advanced Pack.

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### Objectives

After completing this module, you should be able to:

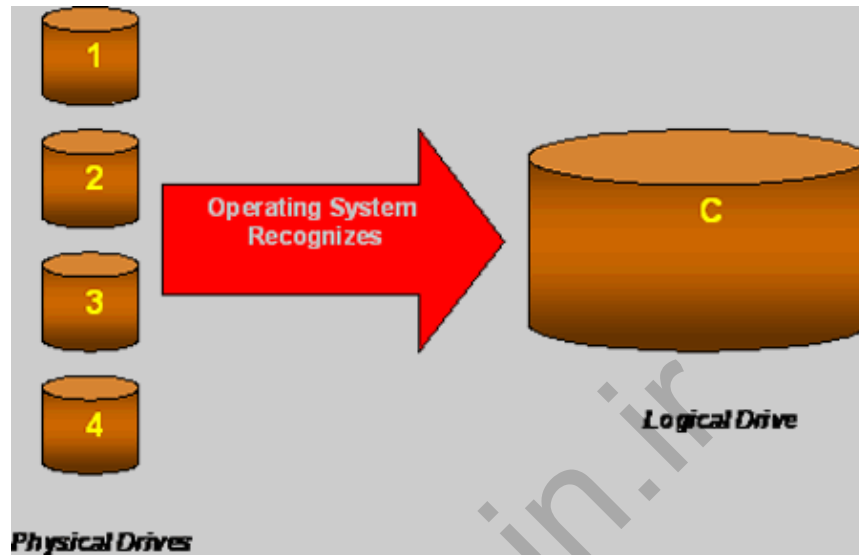
- Identify underlying storage technologies
- Differentiate disk drive technologies
- Describe features of HP Smart Array Controllers
- Identify array configuration utilities
- Describe HP Storage Modular Smart Arrays

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## Storage technologies

To prevent data loss, it is important to have a good understanding of drive array technology and a good working knowledge of SCSI basics before servicing any drive array. This section covers the technology needed to support HP Smart Array Controllers.

### Drive array basics



Drive array basics

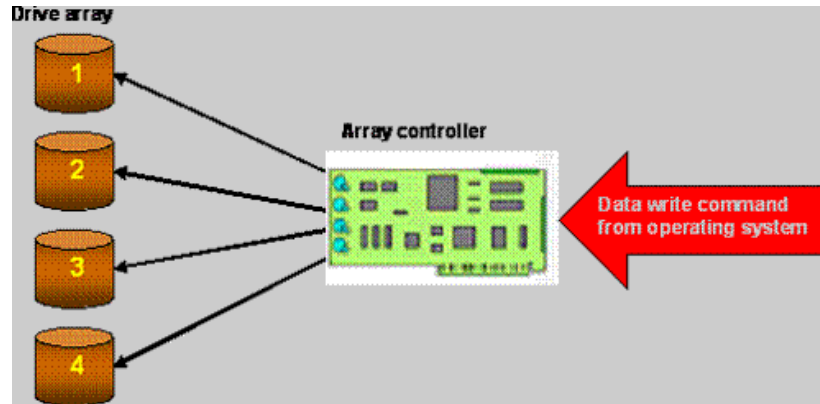
An array is a set of physical disk drives that can be combined into a single logical drive or subdivided into multiple logical drives that are distributed across all disks in the set. Depending on the limits of the particular HP array controller, it can have from 1 to 32 logical drives.

The preceding graphic shows four physical drives combined into one logical drive.

All drives in an array must be of equal size. If they are different sizes, all drives are recognized as the same size equal to the smallest drive, and the extra space is ignored.



## Array advantages



Array advantages

Having several physical hard drives enables you to divide the data across multiple drives. A file is divided into a selected number of sectors and then written concurrently across a series of drives.

Because multiple drives are accessed simultaneously, the process of writing (or reading) a file across multiple drives is much faster than writing to or reading from a single drive. This is called **data striping**.

Another advantage is that multiple SCSI channels can be used at the same time, increasing performance. Because multiple commands can be issued across multiple channels, the commands can be processed concurrently. The requests are processed in the most logical order (this is called **tagged command queuing**).

HP Smart Array Controllers implement hardware-level control of the array.

Drive array configuration information is stored on the RAID information sector of the hard drives and in the array controller NVRAM. This design enables you to change the controller without reconfiguring it; the new controller can read the array configuration information from the RAID information sector of the drives. It further allows you to move a set of configured hard drives from one machine to another without data loss. Again, the new array controller can read the configuration information from the RAID information sector of the hard drives.

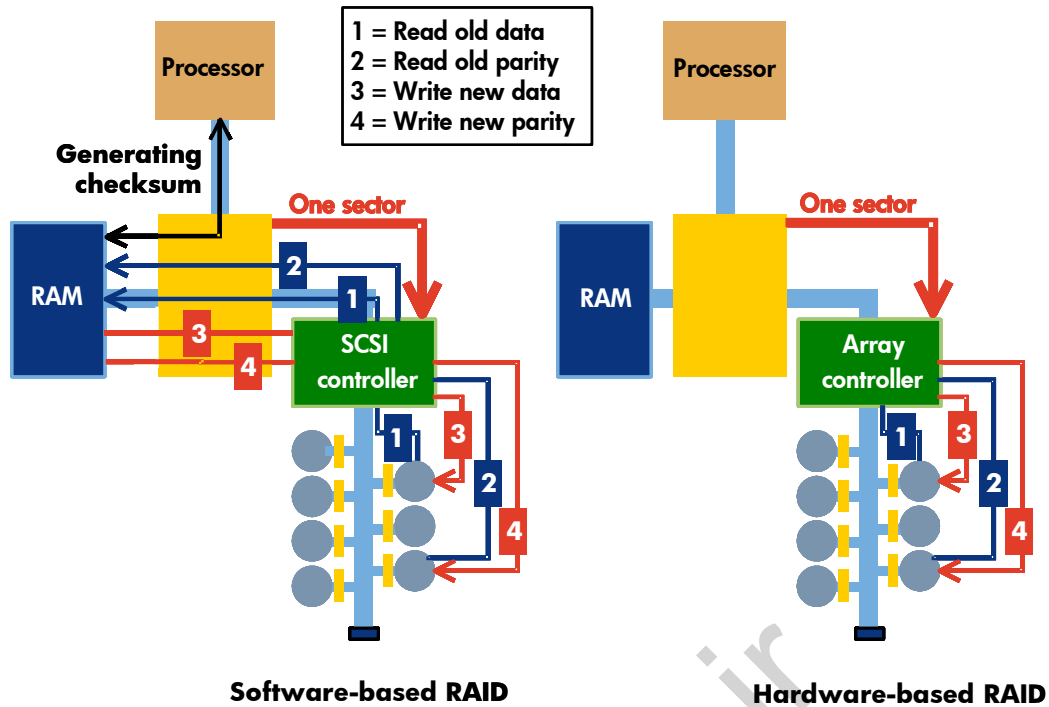
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### Note

Some legacy equipment also stores drive configuration in NVRAM on the system board. If you need to service legacy equipment that uses SCU for configuration, consult the associated equipment documentation for information.

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## Software and hardware RAID



Software and hardware implementation of RAID 5

It is possible to have a RAID configuration without an array controller. This is known as **software RAID**. HP supports both software-based and hardware-based RAID.

### Software-based RAID

With software-based RAID, the array management functions are implemented by software executing in a host environment such as the operating system.

Software RAID requires additional transfers across the I/O bus. Although software RAID is not as versatile as hardware RAID, it offers a cost-effective, entry-level, fault-tolerant solution. Software-based RAID is incorporated in embedded Serial Advanced Technology Attachment (SATA) controllers in some HP ProLiant servers and is enabled through the ROM-Based Setup Utility (RBSU).

The advantages of software-based RAID are:

- The ability to span multiple host controllers (duplexing)
- Lower cost

## Hardware-based RAID

With hardware-based RAID, the array management functions are implemented by the hardware and firmware within a RAID controller. The RAID controller orchestrates read and write activities in the same way that a controller for a single disk drive does, treating the array as if it were a single physical or logical drive.

Hardware-based RAID is transparent to the host software and is self-contained within the storage solution. It does not interfere with the primary function of the host, which translates into higher overall performance and a potential for advanced RAID capabilities.

With a hardware RAID solution, no extra activity occurs on the I/O bus, memory bus, or frontside bus after the data reaches the array controller. All RAID-related activities are local to the storage bus of the array controller.

The advantages of hardware-based RAID are:

- Faster, more reliable performance than software RAID
- Support for online spare drives
- Decreased processor load
- User-friendly configuration utilities
- No operating system interface required when starting a rebuild

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**Note**

Online spares are extra drives that are automatically brought online when a drive fails in a RAID set. Online spare drives are only available with hardware-based RAID.

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## Advantages of HP hardware-based RAID

HP implements RAID at the hardware level with value-added features in its Smart Array Controllers. The advantages of HP hardware-based RAID are:

- Safe write caching through a battery-backed array accelerator on some models
- Superior manageability such as multiple volumes with different RAID levels
- High flexibility such as separating I/O into different disk volumes
- Automatic recovery and online spares
- Automatic data distribution and I/O balancing across multiple disk drives
- Superior performance and I/O optimization

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## HP disk drives

HP uses industry-standard drives in ProLiant servers, but has modified the firmware of the SCSI drives to support these additional features:

- Reorganization of the drive geometry
- Self-monitoring of performance characteristics
- Support for the HP Pre-Failure Warranty
- Enhanced diagnostics
- Enhanced error detection and correction

## HP disk drives comparison

HP currently uses different families of disk drives:

- Entry-level drives
- Midline drives
- Enterprise drives
- Solid State Drives
- BladeSystem IO Accelerator
- IO Accelerator for ML/DL

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**INTERNET**

For the latest ProLiant disk drive portfolio, go to:

**<http://h18004.www1.hp.com/products/servers/proliantstorage/drives-enclosures/index.html>**

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Characteristics of each drive group are shown in the following table.

	» 6G SAS Solid State Drives (SSD)	» Solid State Drives (SSD) Gen2	» BladeSystem IO Accelerator	» Serial ATA (SATA) Entry	» Serial ATA (SATA) Midline	» Serial Attached SCSI (SAS) Midline	» Serial Attached SCSI (SAS) Enterprise	» IO Accelerator for ML/DL
Product category	SSD	SSD	PCI-attached Solid State Storage	Entry Drives	Midline Drives	Midline Drives	Enterprise Drives	PCIe attached solid state storage
Usage	Enterprise Mainstream (MLC) for equal read/write workload with heavy applications and Enterprise Performance (SLC) for unrestricted read/write workload applications	Mainstream drive environments where data is highly random with heavy reads where low latency and high IO performance is more important than capacity	Local storage for Extreme IOPS and Bandwidth Index optimization acceleration	Low I/O non-mission critical: boot	High capacity storage: backup, archive	Midline: High-capacity, high availability storage: backup, archiving and reference	Enterprise: Mission critical, high IO: Email, ERP, CRM	Local storage for Extreme IOPS and low latency solutions Index optimization acceleration
Capacity (GB)	200, 400, 800GB MLC 200/400GB SLC	60, 120	320, 640	2.5" 5, 4K -120, 250 2.5" 7.2K 500GB (9.5mm) 3.5" 7.2K -160, 250	2.5" 7.2K 160, 500, 1000 3.5" 500, 1000, 2000, 3000	2.5" - 500, 1000 3.5" - 1000, 2000, 3000	2.5" 15K - 72, 146 2.5" 10K - 146, 300, 450, 600, 900 3.5" 15K - 146, 300, 450, 600	ioDrive:160GB (SLC) 320GB (MLC) ioDrive Duo:320GB (SLC) 640GB & 1.28TB (MLC)
RPM	N/A	N/A	N/A	7.2K	5.4K/7.2K	7.2K	10K, 15K	N/A
Form factor	2.5"	2.5"	Type-1 Mezzanine Card	2.5", 3.5"	2.5", 3.5"	2.5", 3.5"	2.5", 3.5"	ioDrive: Low profile PCIe x 4 (spec 1.1) ioDrive Duo:PCIe 2.0
Transfer rate (MB/s)	6.0Gb/s	3.0Gb/s	800 MB/s	1.5Gb/s, 3Gb/s	3Gb/s	6Gb/s	3Gb/s 6Gb/s	Varies by device see quickspec
Connectivity	Dual-Port	Single-Port	PCI-Express x4	Single-Port	Single-Port	Dual-Port	Dual-Port	PCIe x 4/PCIe 2.0
Hot pluggable	Yes	No	No	Yes	Yes	Yes	Yes	No
Interface	SAS	SATA	PCI	SATA	SATA	SAS	SAS	PCI
Warranty	3 year Maximum use limitations apply	3 year	3 year	1 year	1 year	1 year	3 year	3 year

HP disk drives comparison

## Solid State Drives



Solid State Drives

HP is introducing the next generation of Solid State Drives for ProLiant servers. These Solid State Drives are 3Gb/second SATA interface or 6Gb/second serial-attached SCSI (SAS) interface models. Available capacities are 60GB, 120GB, 200GB, 400GB, and 800GB.

The product, based either on NAND Single-Level Cell flash or Multi-Level Cell flash technology, is used as small form factor (SFF) and large form factor (LFF) hot-plug devices on the HP universal drive carrier for general use across the ProLiant portfolio. These drives deliver higher performance, lower latency, and low-power solutions when compared with traditional rotating media, and they fit seamlessly into the existing HP server infrastructure.

Features of Solid State Drives include:

- Extreme ruggedness
  - Extended operating temperature (0° to 60°C or 32°F to 140°F)
  - Shock and vibration almost a non-issue
- High read performance
  - Greater than 50x SATA random read performance
  - Greater than 15x SAS random read performance
  - No seek time for high IOPS
  - Limited write performance (relative to 15K rpm SAS)
- Increased reliability (No moving parts)
- Up to 10x reduced power (less than 2W, compared to 9W for 15K rpm 2.5-inch SAS)
- Thermal, size, and acoustic advantages
  - No noise, low heat
  - Small and light weight
- Available also in 2.5-inch and 3.5-inch carriers
  - 60GB, 120GB, 200GB, 400GB, 800GB
  - SATA 3Gb/s and SAS 6Gb/s
  - MLC or SLC technology



## HP SAS Expander Card



HP SAS Expander Card

The HP Smart SAS Expander Card enhances the Smart Array Controller family by allowing support for more than eight internal hard disk drives on select ProLiant servers when connected to a Smart Array P410 Controller (SA-P410) or Smart Array P410i Controller (SA-P410i). The full-height, SAS expander card supports up to 24 internal drive bays plus an external connection for tape.

The HP SAS Expander Card is ideal for ProLiant server customers who want to use RAID for more than eight internal hard disk drives or for ProLiant server customers who purchase an additional internal drive cage and want to be able to use RAID across all internal drives.

## HP disk drive reliability and availability features

HP offers several technologies to help decrease the probability of drive failures and the potential of data loss.

### Mean time between failures

Mean time between failures (MTBF) is the expected time that it takes a hardware component to fail because of normal wear and tear. For disk drives, MTBF is calculated from the theoretical steady-state failure rate from a large population of drives tested in volume manufacturing.

The actual MTBF of an individual drive depends on the drive usage and environmental conditions. Stressing a drive beyond normal usage can significantly reduce the predicted MTBF of the drive.

The MTBF of an array is equal to the MTBF of an individual drive divided by the number of drives in the array. The number lowers because more physical spindles are subject to failure. This is a good reason to use RAID configurations that support fault tolerance.

#### **Example**

If the MTBF of a single drive is 200,000 hours, the MTBF of an array with five similar drives is calculated as 200,000 divided by 5, for a total array MTBF of 40,000.



#### **Important**

When the number of drives increases in a RAID configuration, the efficiency of the array increases; however, the MTBF of each drive predicted by the drive manufacturer does not change.

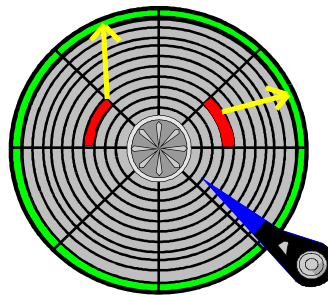
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## Extending MTBF

To offset the increased probability of drive failure in drive arrays, HP offers a unique set of high-availability technologies such as:

- Dynamic sector repair
- Hard drive failure prediction technology
- Online spare drives
- Automatic data recovery

### Dynamic sector repair



Dynamic sector repair automatically remaps bad sectors

Under normal operation, even initially defect-free drive media can develop defects. This is a common phenomenon. The bit density and rotational speed of disks are increasing, and so is the likelihood of problems. A drive can usually remap bad sectors internally without external help. This is accomplished by using cyclic redundancy check (CRC) checksums, which are stored at the end of each sector.

All Smart Array Controllers perform a surface analysis as a background job when there is no other disk activity. Even a completely unreadable sector can be rebuilt and remapped by using the fault-tolerant RAID capabilities of the controller.

The process of continually performing background surface scans on the hard drives during inactive periods and automatically remapping bad sectors is known as **dynamic sector repair** (DSR).

DSR provides the following features:

- Functions automatically with hardware-based fault tolerance, but it is not available when hardware fault tolerance is not used.
- Uses the fault tolerance of the drive subsystem to replace a bad sector with a spare sector. The correct data is written to the spare sector on the same drive.
- Triggers automatically after a specified time.
  - HP Smart Array Controllers start DSR after 30 seconds of idle time.
  - You can use the HP Array Configuration Utility (ACU) to adjust this setting from 1 to 30 seconds.
- Relocates data to a sector on an adjacent track if two sectors within the same track are bad.
- Runs as a background task and does not affect disk subsystem performance. When the operating system makes a request, DSR discontinues.

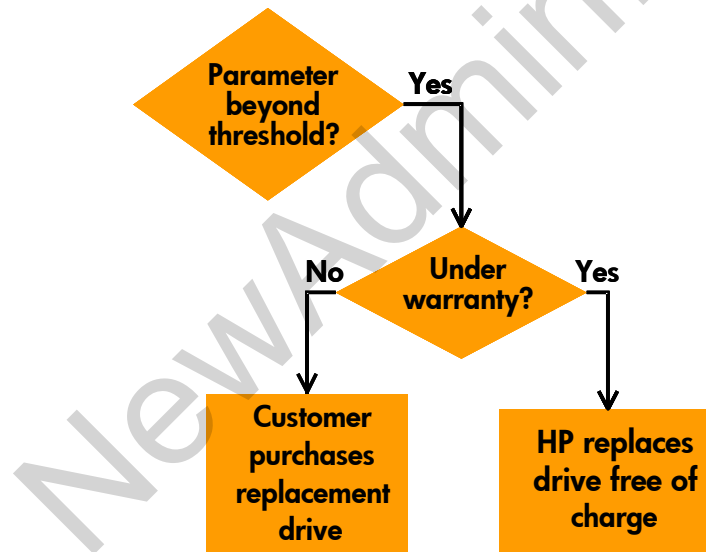
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**Note**

The disk drive activity LEDs flash when the DSR is running.

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## Hard drive failure prediction technology



Hard drive failure prediction technology diagram

HP pioneered failure prediction technology for hard drives by monitoring tests run by Smart Array Controllers. These tests, called **Monitoring and Performance (M&P)** or **Drive Parameter Tracking**, externally monitor hard drive attributes such as seek times, spin-up times, and media defects (more than 20 parameters) to detect changes that could indicate a potential failure.

## S.M.A.R.T.

HP worked with the hard drive industry to help develop a diagnostic and failure prediction capability known as **Self-Monitoring Analysis and Reporting Technology** (S.M.A.R.T.). Over the years, HP used both M&P and S.M.A.R.T. to support hard drive failure prediction technology for the Pre-Failure Warranty replacement of hard drives. This technology has matured to the point that HP now relies exclusively on S.M.A.R.T. for hard drive failure prediction technology to support the Pre-Failure Warranty.

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### Note

In 2001, HP began shipping SCSI hard drives configured to disable M&P tests on the Smart Array Controllers. This action eliminated false failure predictions and improved performance by eliminating the hourly M&P controller-initiated tests.

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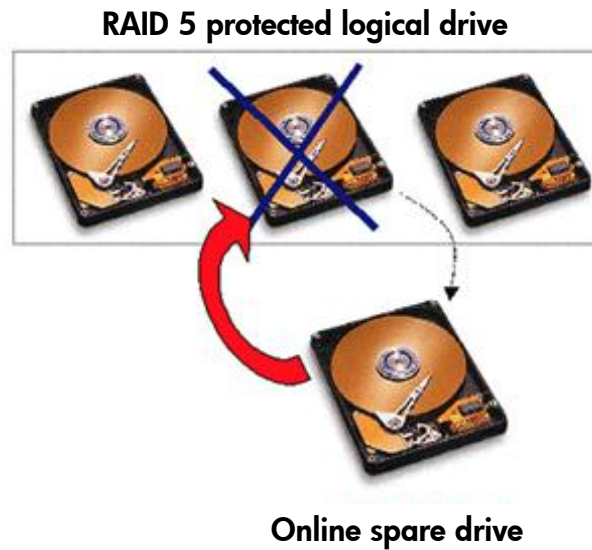
S.M.A.R.T. improves failure prediction technology by placing monitoring capabilities within the hard drive. These monitoring routines are more accurate than the original M&P tests because they:

- Are designed for a specific drive type
- Have direct access to internal performance, calibration, and error measurements

The S.M.A.R.T. technology uses internal performance indicators and real-time monitoring and analysis to improve data protection and fault prediction capability beyond that of the original M&P tests. In addition, HP Smart Array Controllers proactively scan the hard drive media during the idle time and respond to any media defects that are detected.

S.M.A.R.T. can often predict a problem before a failure occurs. An HP Smart Array Controller recognizes S.M.A.R.T. error codes and notifies the system of an impending hard drive failure. HP Systems Insight Manager (HP SIM) is notified whenever a potential problem arises. When HP drives fail to meet expected criteria, they are eligible for replacement under the HP Pre-Failure Warranty.

## Online spare drives



Online spare drives

For mission-critical applications that cannot tolerate any outages, online spare drives supported by HP Smart Array Controllers should be considered. An online spare drive acts as a temporary replacement for a failed drive. If a drive fails, the controller automatically rebuilds the data that was on the failed drive on the online spare. The controller also sends the data that would normally be stored on the failed drive directly to the online spare.

One online spare drive can be added to any fault-tolerant logical drive; however, RAID 0 is not supported. The capacity of the online spare must be at least as large as that of the largest drive size used in the array.

If efficient use of drive capacity is important, an online spare can be assigned to more than one array. Most Smart Array Controllers support up to four online spare drives.

The online spare drive does not need to be partitioned or formatted. It is always active and running, even when it is not in use. The online spare drive is available for RAID 1, RAID 1+0, RAID 5, RAID 50, RAID 60, and RAID 6 (ADG).

When a data drive fails, the online spare drive automatically starts to rebuild the data of the failed drive. The rate at which the data is rebuilt on the online spare depends on the priority assigned to the rebuilding process and the total number of drives in the array.

Only RAID 6 and RAID 60 can handle two simultaneous drive failures in all cases. Other RAID solutions require that the online spare drive be completely rebuilt before the failure of a second drive can be handled without data loss. However, it is unlikely that a second drive will fail during the rebuild time.

As soon as the failed drive is replaced, the data is automatically rebuilt on the new drive. After the data has been completely rebuilt on the new drive, the online spare switches back to its role as an online spare drive. This avoids roaming online spare drives.

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**Note**

HP SIM monitors the online spare drive just like all the other active drives.

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## Automatic data recovery

A Smart Array Controller automatically detects when a failed drive has been replaced. When the RAID level is set for 1, 1+0, 5, or 6, the data is automatically rebuilt on the new drive. Then, you only need to replace the failed drive. If the system supports hot-pluggable drives, you can replace the drive while the system is running.

When a drive fails, the data recovery time is influenced by the following factors:

- Type and size of the drive
- RAID level
- Workload on the system
- Controller type
- HP Smart Array Accelerator setting
- HP Smart Array drive recovery priority level

If the system is in use during the drive rebuild process, the recovery time depends on the level of system activity. If a system has moderate activity, it should recover in about the same time as when there is no load. This is true for most systems, especially when RAID 1 is used. RAID 5 is more sensitive to system load during the recovery period because of the considerably heavier I/O requirements of the failed system. You can use the ACU to set or change the rebuild priority at any time.

**Important**

Selecting a high rebuild priority could result in reduced server performance when the rebuild is in progress. Setting a low rebuild priority allows normal server performance because rebuilding occurs only when the server disks are idle; the rebuild time could take significantly longer, depending on the level of system activity.

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## Smart Array Controllers

HP Smart Array Controllers provide hardware-level RAID support. The Smart Array Controller accepts write commands, calculates any parity data, decides where the data and the parity data are to be written, and then orchestrates the writing of that data. Taking that overhead away from the operating system and giving it to the array controller considerably speeds reads and writes. This configuration also provides several fault-tolerant features that protect data integrity.

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**INTERNET**

To access the latest information about ProLiant RAID controllers, including the compatibility matrix between ProLiant servers and ProLiant RAID controllers, go to:

<http://h18004.www1.hp.com/products/servers/proliantstorage/arraycontrollers/index.html>

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### Smart Array Controller classification

To simplify the Smart Array Controller product line, HP divides it into three general categories:

- **Integrated controllers**—Integrated Smart Array Controllers are intelligent array controllers for entry-level, hardware-based fault tolerance. These low-cost controllers provide an economical alternative to software-based RAID.
- **Entry-level controllers**—These controllers are usually less expensive than high-performance controllers and have smaller memory sizes. If write cache is available, it is provided as an upgrade as opposed to shipping standard with the controller.
- **High-performance controllers** —Smart Array Controllers generally have write cache as a standard feature, and it is often upgradeable in this category of controllers. This group also supports RAID 60 and RAID 6, formerly known as Advanced Data Guarding (ADG), with the optional Smart Array Advanced Pack.
- **Flash-backed write cache**—This is a new cache technology using flash memory. If the cache DRAM contains write data when power is lost, the write data is copied into flash memory chips on the cache module, drawing power from attached capacitors. When power is restored, if the flash memory chips contain write data, the data is copied back into the DRAM so it can be flushed to the drives.



Advantages over battery-backed cache architectures include:

- No 72-hour deadline for retrieving the data before the batteries fully discharge
- Capacitors charge faster than batteries; the controller disables the write cache for only a few minutes, waiting for capacitors to charge, rather than a few hours waiting for batteries to charge
- No need for periodic battery replacement
- No special disposal process

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## HP array controller portfolio

The HP array controller portfolio consists of many models with differing SAS channels, size of memory, and performance.

**INTERNET**

For more information about the current line of HP array controllers for ProLiant servers, go to:

<http://h18004.www1.hp.com/products/servers/proliantstorage/arraycontrollers/index.html>

### Serial controllers 3Gb/s

	Ports	Connectors(ext/int)	Cache (read/write)	RAID level	Max drives supported	Battery/Flash Backed Cache	Recovery ROM	Protocol Support	I/O Slot Type
<a href="#">Smart Array E200</a>	8	0/2	64 MB	0, 1, 1+0 standard, RAID 5 optional	8	Optional	No	3Gb SAS/ 1.5Gb SATA	PCI-Express x4 2.5G
<a href="#">Smart Array P400</a>	8	0/2	256 MB	0, 1, 1+0, 5 standard, RAID 6 optional	18	Optional	Yes	3Gb SAS/ 1.5Gb SATA	PCI-Express x8 2.5G
<a href="#">Smart Array P700m/256</a>	8	4/0	256 MB	0,1,0+1	108	No	No	3Gb SAS/1.5Gb SATA	PCI-Express x8 2.5G
<a href="#">Smart Array P700m/512</a>	8	4/0	512 MB	0, 1, 1+0, 5, 6 optional	108	Yes	Yes	3Gb SAS/1.5Gb SATA	PCI-Express x8 2.5G
<a href="#">Smart Array P800</a>	16	2/2	512 MB	0, 1, 1+0, 5, 6 standard	108	Yes	Yes	3Gb SAS/ 1.5Gb SATA	PCI-Express x8 2.5G

Serial 3Gb/s controller portfolio

### Serial controllers 6Gb/s

	Connectors	Cache (read/write)	RAID level (w/o Cache)	RAID level (w/Cache + battery)	Max Drives Supported	Battery/Flash Backed Write Cache	# of Arrays/LUNs
<a href="#">HP Smart Array P212 Controller</a> 1 internal, 1 external ports	1 int/ 1 ext	Zero Memory (ZM)	Raid 0, 1, 0+1	SAAP RAID 5, 5+0, R6 & R6+0	54	Optional	64
<a href="#">HP Smart Array P410i Controller</a> 2 internal ports on embedded controller	2 int	Zero Memory (ZM)	Raid 0, 1, 0+1	SAAP RAID 5, 5+0, R6 & R6+0	24	Optional	2 or 64 with cache
<a href="#">HP Smart Array P410 Controller</a> 2 internal ports on standup PCIe controller	2 int	256 MB	Raid 0, 1, 0+1	SAAP RAID 5, 5+0, R6 & R6+0	25	Optional	64
<a href="#">HP Smart Array P411 RAID Controller</a> 2 external ports	2 ext	256 MB	Raid 0, 1, 0+1	SAAP RAID 5, 5+0, R6 & R6+0	100	Optional	64
<a href="#">HP Smart Array P812 RAID Controller</a> 2 internal 4 external ports	2 int/4 ext	1 GB	Not Applicable	All R0, R1, R1+0, R50, R5, R6, R60	108	Yes	64
<a href="#">HP Smart Array P712m RAID Controller</a> 2 internal, 2 external ports (with 256 cache)	2 int/2 ext	Zero Memory (ZM)/256 MB	Raid 0, 1 (int)	Dependant on attached arrays	2 (int) Dependant on Enclosure (ext)	n/a	2 (int)/512 (ext)
<a href="#">HP Smart Array P711m RAID Controller</a> 0 internal, 4 external ports	4 ext	1 GB	Not Applicable	Dependant on attached arrays	Dependant on attached arrays	yes	512 (ext)

Serial 6Gb/s controller portfolio

## Standard features

Several features that are common to all Smart Array Controllers give them their reputation for reliability:

- **Data compatibility**—Complete data compatibility with previous-generation Smart Array Controllers allows for easy data migration from server to server and the controller upgrades any time higher performance, greater capacity, or increased availability is needed. Every successive generation of Smart Array Controllers understands the data format of other Smart Array Controllers.
- **Consistent configuration and management tools**—Smart Array products use a standard set of configuration and management tools and utility software that minimize training requirements and simplify maintenance tasks.
- **Universal hard drive standards**—Form-factor compatibility across many enterprise platforms enables easy upgrades, data migration between systems, and management of spare drives.
- **Online spares**—You can configure spare drives before a drive failure occurs. If a drive fails, recovery begins with an online spare and data is reconstructed automatically.
- **Recovery ROM**—Recovery ROM provides a unique redundancy feature that protects from a ROM image corruption. A new version of firmware can be flashed to the ROM while the controller maintains the last known working version of the firmware. If the firmware becomes corrupt, the controller reverts back to the previous version of firmware and continues operating. This reduces the risk of flashing firmware to the controller.

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**Note**

Although common in most new controllers, Recovery ROM is not a standard feature of all Smart Array Controllers.

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When the ROM is upgraded, the inactive image (the one not being used by the system) is upgraded, usually without any noticeable difference in operation. When Recovery ROM is used for the first time, however, the backup ROM images are upgraded, causing a boot delay of about 20 seconds.

- **Pre-failure alerts and a Pre-Failure Warranty**—Failing components can be detected and replaced before a fault occurs.

## RAID levels supported by HP array controllers

HP array controllers support the following RAID levels.

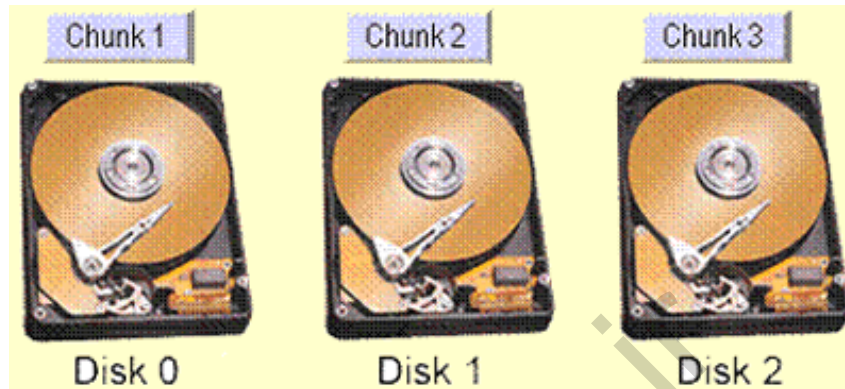
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**Note**

RAID generally refers to the level of fault tolerance that the array has been assigned. Array generally refers to the physical aspects (hard drives, logical drives, and array controller).

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### RAID 0—Disk striping



RAID 0—disk striping

A file is divided into stripes (shown as chunks in the graphic) and then written across multiple disks. Data is striped across all drives.

This greatly decreases disk latency (the amount of time a disk head has to wait for the target sector to move under the head).

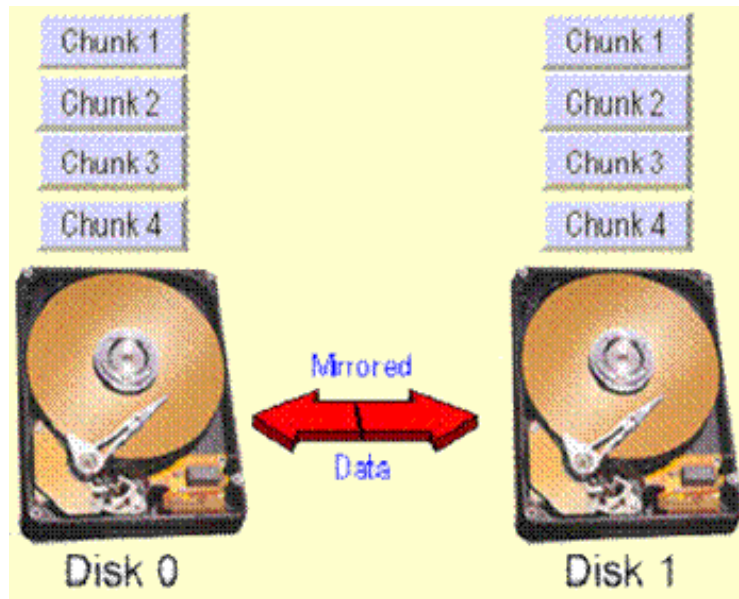
- All of the disk space is available for data.
- RAID 0 is the least costly.
- Overall disk performance is improved, especially the speeding up of operations that retrieve data from disk storage.
- Read and write performance is excellent.
- RAID 0 is not fault-tolerant and provides no redundancy (and therefore no hot-plug capability).
- All data is lost if one of the drives fails.
- By definition, RAID 0 requires two or more drives for a true stripe set. However, with Smart Array Controllers, you can create a RAID 0 logical volume with a single drive.

**Caution**

Data striping is faster than conventional file writing to a single disk; however, there is no fault tolerance if any single drive fails. As you can see in the graphic, if disk 1 should fail, all data on the array would be lost.

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## RAID 1—Disk mirroring



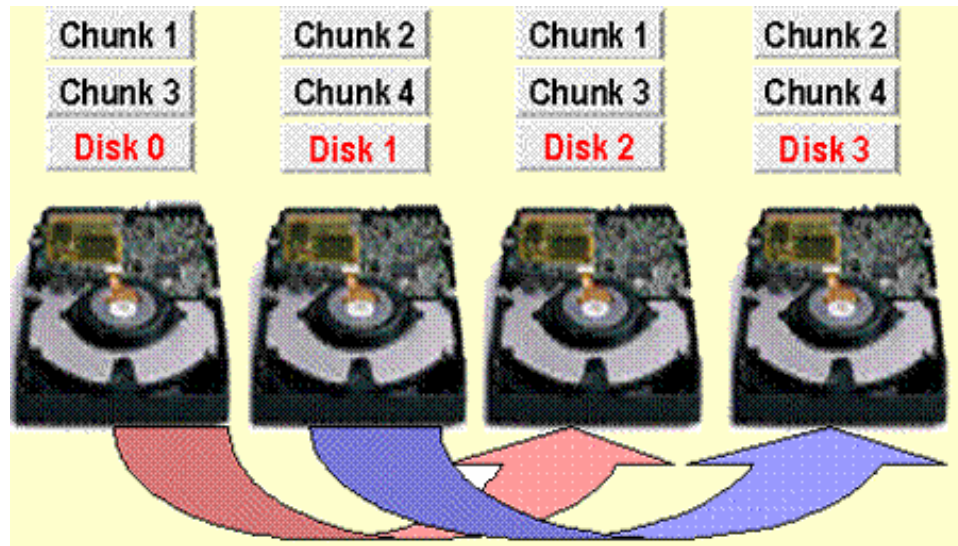
RAID 1—disk mirroring

Data is written twice, to two separate mirrored drives. If one drive fails, the mirrored drive is the backup. A RAID 1 implementation requires an even number of disks, mirrors the entire data structure on different drives, and allows split seeks—the drives with the requested data nearest to the read/write heads are used for the read, which slightly improves read performance.

RAID 1 requires an even number of drives, with a maximum of 30 when connected to dual-channel controllers supporting the Wide-Ultra SCSI-3 or Wide-Ultra2 protocols. Additionally, drives must be added in pairs to achieve a RAID 1 expansion.

This viable, fault-tolerant solution is considered expensive because it requires twice as much drive storage. Only 50% of the total disk space is available for data storage.

## RAID 1+0—Mirroring of stripe sets



RAID 1+0—mirroring of stripe sets

RAID 1+0 is actually mirroring with more than two drives. A stripe set (RAID 0) is created across each half of the mirrored drives (RAID 1), thereby both mirroring and striping the data.

Multiple disks can fail without data loss if the disks are not in the same mirror pair. In the preceding graphic example, disks 0 and 1 could fail and all data would be intact on disks 2 and 3. However, if two disks in the same mirrored pair fail, the data is lost. RAID 1+0 cannot guarantee protection against a two-disk failure.

In a RAID 1+0 configuration, all HP Smart Array Controllers can:

- Sustain an entire bus failure if the drives are equally distributed across the buses
- Service I/O requests to all operational drives in a degraded condition
- Survive  $n/2$  drive failures, where  $n$  is the number of drives in the array, as long as one member of each mirrored pair survives

RAID 1+0 requires an even number of drives.

This solution is fault-tolerant but is considered expensive. It requires double the disk space because only 50% of the total disk space is available for data storage.

RAID 1+0 has good performance and redundancy, but also has write penalties (two physical write requests for one logical write request).

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**Note**

RAID 1+0 is sometimes referred to as RAID 10 by other manufacturers.

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## RAID 5—Distributed Data Guarding (data striping and error correction)



RAID 5—Distributed data guarding

Concurrent access and distributed parity are properties of RAID 5. Data is striped across multiple drives and then its parity sum is calculated, which is also striped across multiple drives. Performance increases because parity is spread across all drives, and there is no need to access a single parity drive after every write command.

RAID 5 is best suited for I/O-intensive applications and transaction processing, thereby making it an ideal solution for high-performance, fault-tolerant servers.

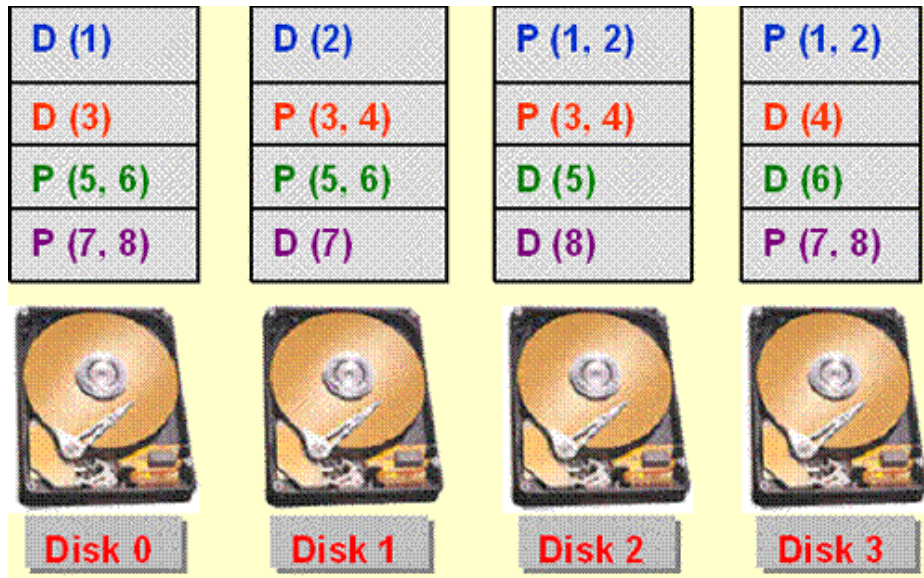
Any single drive can fail and the information from the lost drive can be recovered from the parity data stored on other drives.

A minimum of three drives is required, and  $n+1$  drives are needed, where  $n$  is the number of drives used for data.

For RAID 5, HP recommends that no more than 14 (8 is optimal) physical drives be used per logical drive with Smart Array Controllers.

The biggest limitation of RAID 5 is the increased read time in a failure. In RAID 5, regardless of which disk fails, data must be recalculated on each read from the remaining disks.

## RAID 6—Advanced Data Guarding



RAID 6—Advanced data guarding

RAID 6, formerly known as Advanced Data Guarding (ADG), provides high fault tolerance. It distributes two sets of parity data protecting against two drive failures. As illustrated in the graphic, parity (P) is written twice for each piece of data (D). These two sets are different, and each set occupies a capacity equivalent to that of one of the constituent drives.

RAID 6 provides high read performance and high data availability. Any two drives can fail without loss of critical data.

Only select Smart Array Controllers offer RAID 6, which provides:

- Higher fault tolerance than RAID 5
- Lower implementation costs than RAID 1+0
- Greater usable capacity per U than RAID 1

Using patented HP technology, you can safely deploy large-capacity disk drives and create large storage volumes. Protection extends to an array with up to 56 drives and requires only two drives to store the parity information.

RAID 6 requires a minimum of four hard drives, and  $n+2$  drives, where  $n$  is the number of drives used for data.

Because of the two sets of parity data, RAID 6 provides a relatively low write performance as compared to RAID 5 with its one set of parity data.



## RAID 50 and 60

RAID 50 and RAID 60 are new RAID levels introduced with the new generation of array controllers.

RAID 50 and 60 methods stripe the data across multiple RAID or JBOD (Just a Bunch of Disks) sets with different levels of parity. These nested RAID types allow users to configure arrays across HP Storage Modular Smart Arrays (MSAs).

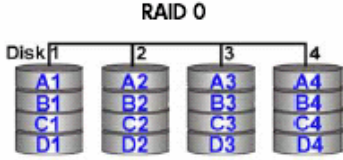


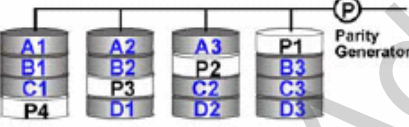
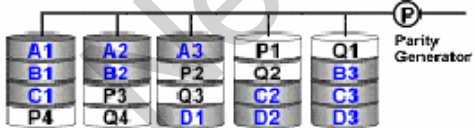
RAID 50 (RAID 5+0) is a nested RAID method that uses RAID 0 block-level striping across RAID 5 arrays with distributed parity. RAID 50 tolerates one drive failure in each spanned array without loss of data. RAID 50 configurations require a minimum of six drives and require less rebuild time than single RAID 5 arrays.

RAID 60 (RAID 6+0) is a nested RAID method that uses RAID 0 block-level striping across multiple RAID 6 arrays with dual distributed parity. With the inclusion of dual parity, RAID 60 tolerates the failure of two disks in each spanned array without loss of data. RAID 60 configurations require a minimum of eight drives.

RAID 6 and 60 are available as an option with the Smart Array Advanced and are not supported on all Smart Array Controllers.

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## RAID summary

RAID LEVELS	Function/Applications	Limitations
<p><b>RAID 0</b></p>  <p>Requires a minimum of one drive.</p>	<p>Data is distributed across separate disk drives.</p> <p>Image Editing • Video Production • Pre-Press Applications</p>	<p>Highly vulnerable to failure. The entire array will fail if one drive fails.</p>
<p><b>RAID 1</b></p>  <p>Requires a minimum of two drives.</p>	<p>Mirroring - Identical data stored on two drives, high fault tolerance, very good performance (higher read performance than RAID 0).</p> <p>Accounting • Payroll • Financial</p>	<p>50% of capacity dedicated to fault protection. Doubles the number of drives required.</p>
<p><b>RAID 1+0</b></p>  <p>Requires a minimum of four drives.</p>	<p>Implemented as striped, mirrored disks.</p> <p>Database applications requiring high performance and fault tolerance; sacrifices storage efficiency.</p>	
<p><b>RAID 5</b></p>  <p>Requires a minimum of three drives. Pn represents one set of parity.</p>	<p>One set of parity data is distributed across all drives. Protects against the failure of any one drive in an array.</p> <p>Transaction processing • File and application servers • ERP • Internet and Intranet servers</p>	<p>Potentially risky for large arrays. Can only withstand the loss of one drive without total array failure. Low write performance (improved with battery-backed cache).</p>
<p><b>RAID 6 (ADG)</b></p>  <p>Requires a minimum of four drives. Pn and Qn represent two sets of parity.</p>	<p>Two sets of parity data are distributed across all drives. Protects against the failure of two drives in an array. Provides higher fault tolerance than RAID 5.</p> <p>For 24x7 applications that require a higher level of fault tolerance than RAID 5.</p>	<p>Lower write performance than other RAID levels. Sequential and burst-write performance can be much improved with battery-backed cache.</p>

### RAID summary

**Note**

Raid 0 is defined for two drives, but can be configured with one by a Smart Array Controller.

## Selecting the appropriate RAID level

The following table provides suggested RAID levels based on the customer requirements.

<b>Most important</b>	<b>Also important</b>	<b>Suggested RAID level</b>
Fault tolerance	Cost effectiveness I/O performance	RAID 6 (ADG) RAID 1+0
Cost effectiveness	Fault tolerance I/O performance	RAID 6 (ADG) RAID 5 (RAID 0 if fault tolerance is not required)
I/O performance	Cost effectiveness Fault tolerance	RAID 5 (RAID 0 if fault tolerance is not required) RAID 1+0

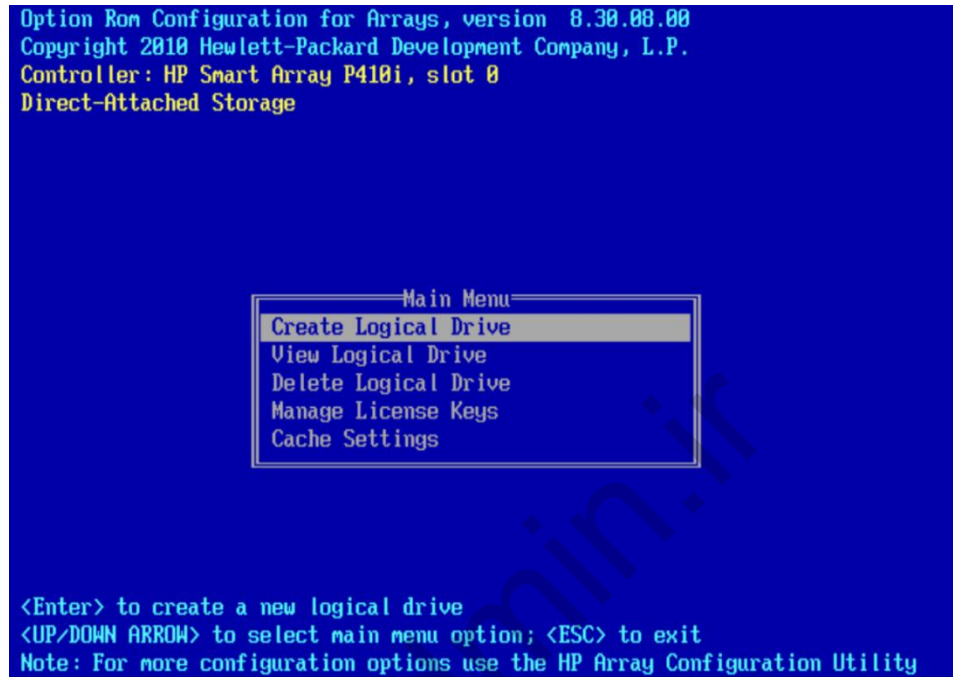
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# Array configuration utilities

HP array controllers for ProLiant servers can be configured with two utilities:

- Option ROM Configuration for Arrays (ORCA)
- Array Configuration Utility (ACU) and its variants

## ORCA



Option ROM Configuration for Arrays screen

After system configuration is complete and the server restarts, if an array controller is present, ORCA automatically configures the array to a default setting based on the number of drives connected to the controller.

ORCA is a simple ROM-based configuration utility that runs independently of the operating system. It executes from the option ROM located on the array controller. ORCA is designed to perform functions that require minimal configuration:

- Create, configure, and delete logical drives
- Specify RAID levels
- Configure online spares (hot spares)
- Configure separate fault tolerance on a logical drive basis
- Enter a license key
- Manipulate cache settings

ORCA disk configuration defaults are based on the number of drives in the array:

- One drive—RAID 0
- Two drives—RAID 1
- Three to six drives—RAID 5
- More than six drives—No auto-configuration

ORCA is available in English only and has no provision for drive expansion, RAID level migration, or stripe size changes. To perform those tasks, use the ACU.

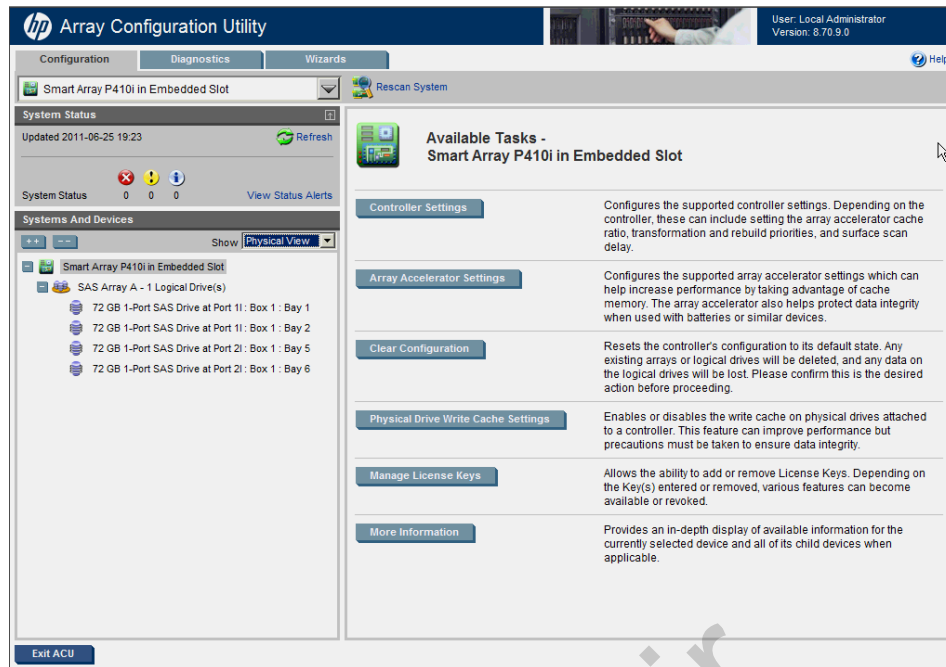
For the most efficient use of drive space, do not mix drives of different capacities within the same array. ORCA treats all physical drives in an array as if they have the same capacity as the smallest drive in the array. The excess capacity of any larger drives is wasted because it is unavailable for data storage.

The probability that an array will experience a drive failure increases with the number of physical drives in the array. If you configure a logical drive with RAID 5, keep the probability of failure low by using no more than 14 physical drives in the array.

If any data has been written to the drive, ORCA will not configure the drive automatically.

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## Array Configuration Utility



Web-based interface of the Array Configuration Utility

The ACU enables both online local and remote management and configuration of an array through a browser. This utility simplifies array configuration by providing an interface to the intelligent features of Smart Array Controllers.

You can start the ACU from within the supported operating system or from the HP SmartStart CD.

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### Note

For more information on operating system support for current and previous versions of the ACU, visit the ACU home page at:

**<http://h18004.www1.hp.com/products/servers/proliantstorage/software-management/acumatrix/index.html>**

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The ACU can manage all Smart Array Controllers from one central location and enables you to perform these tasks:

- Online array expansions
- Online logical drive capacity extensions
- Online RAID level migrations
- Online stripe size migrations
- Configurations using the configuration wizards
- Drive and expansion priority changes
- Stripe size selection
- Controller performance tuning through variable cache read/write ratios and stripe sizes
- Storage identification through blinking drive tray LEDs

The ACU also enables you to configure:

- Online spares (hot spares)
- The Array Accelerator
- RAID 0, 1, 1+0, 5, RAID 50, RAID 60, and RAID 6 (ADG)
- Separate fault tolerance on a logical drive basis

### **Configuring physical and logical drives**

When the array configuration is saved from the ACU, the information is stored on the RAID information sector on each hard drive. This allows administrators to replace computer components and move a set of drives from one machine to another without losing data.

In most cases, all disk drives attached to a controller should be grouped into a single array, which provides the most efficient use of resources.

Using the ACU, administrators can assign physical drives to an array and designate up to four drives per array controller as online spares. All physical drives within an array should be the same size. If disks of higher capacity are installed within a single array, the extra capacity will not be available.

## HP Smart Array Advanced Pack



HP Smart Array Advanced Pack (SAAP)

HP Smart Array Advanced Pack (SAAP) firmware provides advanced functionality within Smart Array Controllers. This firmware further enhances performance, reliability, and availability of data. SAAP is hosted on the Smart Array Controller hardware firmware stack. It can be enabled beginning with the present generation of Smart Array Controllers.

SAAP requires a license key for activation. After activation, administrators can use several standard capabilities:

- RAID 6 (ADG) protects against failure of any two drives. It requires a minimum of four drives, but only two will be available for data. ADG can tolerate multiple simultaneous drive failures without downtime or data loss and is ideal for applications requiring large logical volumes because it can safely protect a single volume of up to 56 disk drives. RAID ADG also offers lower implementation costs and greater usable capacity per U than RAID.
- RAID 60 allows administrators to split the RAID storage across multiple external boxes. It requires a minimum of eight drives, but only four will be available for data.
- Advanced Capacity Expansion (ACE) automates higher capacity migration using capacity transformation to remove logical drives by shrinking and then expanding them online. Standard drive migration and expansion remain unchanged.
- Mirror Splitting and Recombining in Offline mode divide a RAID 1 configuration into two RAID 0 configurations. This is similar to a scaled-down rollback functionality that requires two disk drives.
- Drive Erase completely erases physical disks or logical volumes. This capability is useful when decommissioning, redeploying, or returning hard drives.



- Video On Demand Performance Optimization optimizes performance of video on demand and improves latency during video streaming.

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**Note**

At a minimum, a 256MB cache and battery kit is required to enable the SAAP license key. SAAP is not available on Zero Memory Configurations.

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**INTERNET**

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More information about SAAP is available at [www.hp.com/go/SAAP](http://www.hp.com/go/SAAP)

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## Array expansion and RAID migration

The Smart Array Controller family provides four functions:

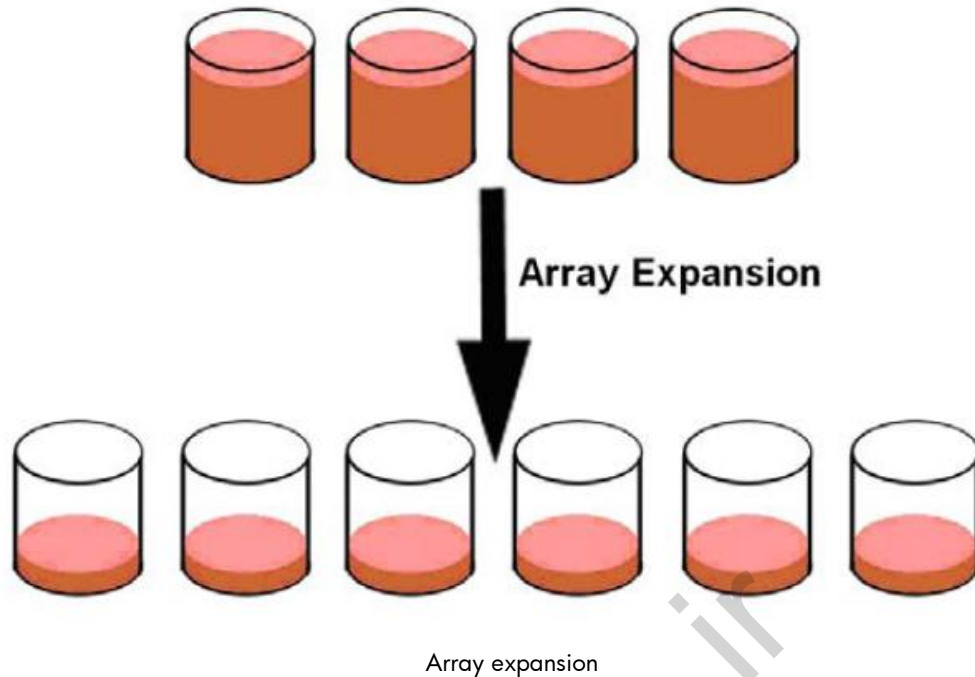
- **Capacity expansion**—Adds physical drives to an array, usually performed in anticipation of additional changes to the storage configuration, such as volume extension or new logical drive creation.
- **Volume/logical drive extension**—Increases the size of an existing volume or logical drive to enable the operating system to use the newly available space in the array.
- **RAID level migration**—Enables administrators to migrate from one RAID level to another (for example, from a two-drive RAID 1 mirror configuration to a three-drive RAID 5 configuration).
- **Stripe size migration**—Changes the array stripe size to boost performance.

**Important**

Before performing any of the preceding functions, back up your data.

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## Array expansion



Performing an array capacity expansion is the process of adding physical drives to an existing array. Each drive added must have a capacity no less than that of the smallest drive in the existing array.

Drive array expansion is performed at the array controller level, not at the logical drive level. The logical drives that exist on the array before the expansion takes place are unchanged; only the amount of free space on the array changes.

All current HP Smart Array Controllers support online array expansion without data loss. To perform an online array expansion, install a new drive in a hot-pluggable drive bay and use the ACU to add the new drive to an existing array.

After the expansion process is started, the data is redistributed across all drives, which creates free space on each drive. The free space that was created on all drives is then available to:

- Create a new logical drive
- Extend the capacity of an existing logical drive
- Support RAID level migration of the existing logical drives

The expansion process is independent of the operating system because the logical drive on the Smart Array level appears as a physical drive to the operating system. In other words, the operating system is unaware of the drives connected to the Smart Array Controller.

Data reallocation runs as a background process. It can be assigned a high, medium, or low priority (default), depending on the performance required while the data is being reallocated. RAID protection is maintained throughout the reallocation process.

**Important**

While the online capacity expansion is taking place, no other expansion, extension, or migration can occur simultaneously on the same array controller.

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The amount of time required to perform the online capacity expansion depends on several parameters:

- Logical drive size
- Drive speed (protocol and rpm of the attached drives) and the number of drives
- Controller (supported SCSI protocol and battery-backed write cache settings)
- Server processor speed
- Amount of other I/O work that the server is processing
- Priority level of the capacity expansion

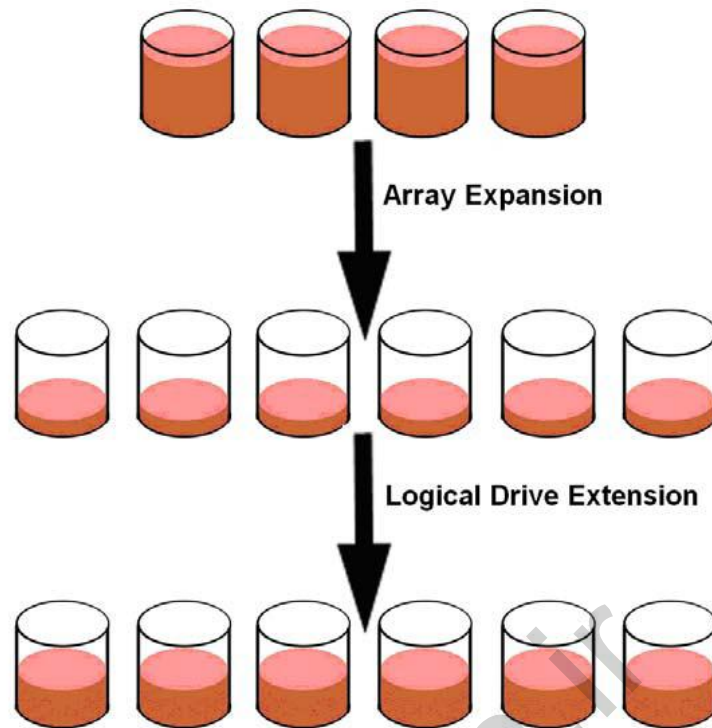
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**Note**

Capacity expansion is a special case. You can alternatively do a one-for-one drive swap with higher-capacity drives and let the array rebuild after each swap. After all drives have been swapped, you can then perform an array extension. This is useful in the event you cannot physically add any more drives to the array.

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## Volume and logical drive extension



Volume and logical drive extension

Performing a drive extension is the process for growing the size of a logical drive. In this case, the increased size of the logical drive is reported to the operating system.

Some operating systems do not support online logical drive extension through the ACU. To use the added capacity without losing data, the operating system must support volume extension.

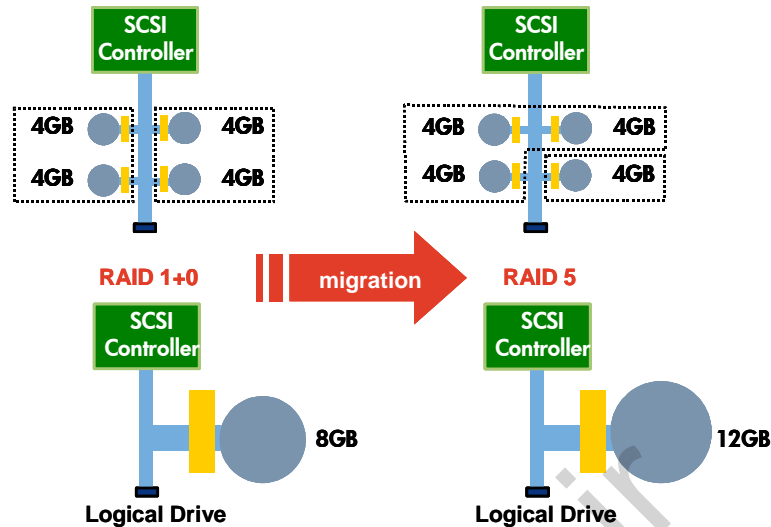
Advanced operating systems support volume and logical drive extension. This enables you to add drives to an existing RAID set and to extend the logical drive so that it displays as free space at the end of the same drive presented to the operating system. If the operating system does not support online logical drive extensions, these options are also available:

- **Diskpart.exe command line utility**—Enables you to extend an existing partition into free space. This utility is included with Windows Server 2003 or the Windows 2000 Resource Kit.
- **HP OpenView Storage Volume Growth**—Enables the dynamic expansion of volumes on Microsoft Windows 2000 or Windows Server 2003 basic disks.
- **Utilities from third-party software vendors**—Enable you to repartition disks without data loss. Most of these utilities work offline.

**Note**

Some operating systems require updates or service packs to support volume or logical drive extension. For example, Windows 2000 requires at least Service Pack 3 (SP3).

## RAID-level migration



RAID-level migration

All current HP array controllers support RAID-level migration. You can easily migrate a logical drive to a new RAID level. For the migration to occur, ensure that sufficient unused drive space is available in the array, based on the initial and final settings for the stripe size and RAID level.

In Windows, NetWare, and Linux architectures, you can perform the RAID-level migration online without disrupting the system operation or incurring data loss. Offline migrations can be performed with any operating system.

## Stripe size migration

Each RAID level has a default stripe size value designed to provide good performance across many types of applications. Certain applications, especially those that perform a majority of one type of transaction, might require you to tune the stripe size to increase performance.

The stripe size can have the following impact:

- **Stripe size is too large**—Results in poor load balancing across the drives.
- **Stripe size is too large**—Results in excessive cross-stripe transfers (split I/Os).

The optimum stripe size for a given application is shown in the following table.

Type of server application	Suggested stripe size change
Mixed read/write	Accept the default value
Mainly sequential read (such as audio/video applications)	Use larger stripe sizes for best performance
Mainly write (such as image manipulation applications)	Use smaller stripes for RAID 5 and RAID 6 Use larger stripes for RAID 0 and RAID 1+0

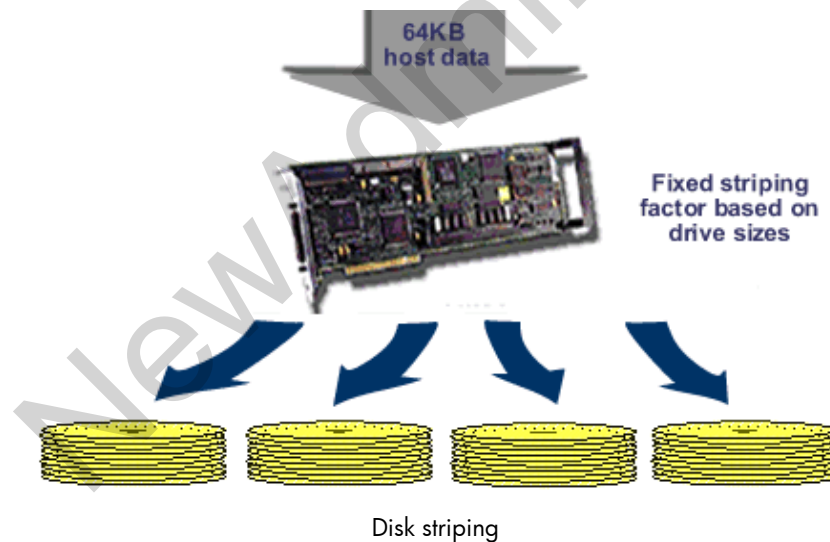
You can try progressively larger or smaller stripe sizes online without disruption or data loss to determine the best overall performance for a particular application.

## Array performance tuning

You can optimize the performance of an array in several ways, including:

- Choosing a stripe size suitable for the type of data transfer common to the system
- Changing the fault-tolerance mode to one that requires less overhead
- Enlarging the logical drive to span all available controller channels (depending on the controller)
- Changing the read/write cache ratio in the Smart Array Controller

## Disk striping



To increase the speed of operations that retrieve data from disk storage, you can use disk striping to distribute volume segments across multiple disks. The most effective method of disk striping is to distribute the volume segments equally across the disks.

Striping improves disk response time by uniting multiple physical drives into a single logical drive. The logical drive is then arranged so that blocks of data are written alternately across all physical drives in the logical array. The number of sectors per block is referred to as the **striping factor**.

**Example**

If the striping factor is 32, the array controller writes 32 sectors to one physical drive, then 32 sectors to the next physical drive in the array. Cycling continues through the drives until the write is complete. Because a sector is 512 bytes, a striping factor of 32 is equivalent to a stripe block of 16KB.

Depending on the type of array controller used, the striping factor can be modified, usually with the system configuration utility provided by the manufacturer. Many of the HP Smart Array Controllers can be modified online with online utilities. These utilities indicate the status of the logical drives and arrays and display the completion percentage of the rebuild process. The `cpqonlin.nlm` utility is used for Novell NetWare and the ACU is used for Windows. The ACU for Linux is installed with the ProLiant Support Pack (PSP).

**Caution**

With HP controllers released before the Smart Array 3100ES, changing the stripe size can destroy data. In addition, any change to the logical volume geometry (such as striping factor, volume size, or RAID level) can also destroy data. Therefore, HP recommends that you always perform a complete backup before making a modification to an array.

RAID 0 striping improves volume I/O because you can read and write data concurrently to each disk. If one of the disks fails, the entire volume becomes unavailable. To provide fault tolerance, implement a fault-tolerant RAID level that is supported by the Smart Array Controller.

## Optimizing the stripe size

Selecting the appropriate stripe size (chunk) is important for achieving optimum performance within an array. The stripe size represents the amount of data that is read or written to each disk in the array when data requests are processed by the array controller.

**Note**

The terms chunk, block, and segment are used interchangeably. Chunk is used most often when discussing storage.

The default stripe size delivers good performance in most circumstances. When high performance is important, you might need to modify the stripe size.

The following table shows the range of stripe sizes available per RAID level. If the RAID level is changed and the new RAID level does not support the existing stripe size, the ACU changes the stripe size automatically.

<b>Fault tolerance Level</b>	<b>Default stripe size (KB)</b>	<b>Available stripe sizes (KB)</b>
RAID 0	128	8, 16, 32, 64, 128, 256
RAID 1 or 1+0	128	8, 16, 32, 64, 128, 256
RAID 5	16	8, 16, 32, 64
RAID 6	64	8, 16, 32, 64

To choose the optimal stripe size, you must understand how the applications request data.

Split I/Os are stripes that are split across two disks, causing both disks to seek, rotate, and transfer data. The response time will be based on the slowest disk. Split I/Os also reduce the request rate because fewer drives are available to service incoming requests.

If you stripe disks on two or more SCSI controllers, which is called **controller multiplexing**, the operating system must calculate where to place data in relation to the striping, in addition to other calculations that contribute to processor overhead. For best performance, stripe disks only on the same controller or use an HP Smart Array Controller that has multiple channels and specific circuitry for handling these calculations.

A multichannel card uses only one interrupt. Certain Smart Array Controllers, such as the 6400 series, feature two or more channels for enhanced performance and capacity.



## Caching and cache data protection

Disk caching improves performance by making frequently read data available in the cache and delaying write requests to the disk drives. The data in the cache must be protected against potential loss and data corruption.

### **Array Accelerator (read/write cache)**

The Array Accelerator on the Smart Array Controllers dramatically improves I/O performance. Depending on the controller, the Array Accelerator size can be 4, 16, 32, 64, 128, 256, or 512MB.

The Array Accelerator uses an intelligent read-ahead algorithm that anticipates data requests and reduces wait time. This algorithm detects sequential read activity on single or multiple I/O threads and predicts which requests will follow. The data is then gathered and stored in the high-speed cache of the Array Accelerator. As soon as the data is requested by the operating system, it is delivered approximately 100 times faster than a disk can deliver the data.

By default, the Array Accelerator cache capacity is divided equally between reads and writes. If your server application has significantly more reads than writes or more writes than reads, you might need to change this setting to improve performance. You can accomplish this change online without restarting the system. The optimal ratio setting is application-dependant.

Whenever random access patterns are detected, the read-ahead algorithm is disabled. Using the read-ahead algorithm with random I/O slows the system down instead of making it faster.

When the disks are busy, new writes are stored in the cache and then written to the disk later when there is less activity. This feature is called **write-back**. Some of the smaller blocks can usually be combined into larger blocks, resulting in fewer but larger blocks being written to the disk, thereby improving performance.

### **Write cache backup**

All Smart Array Controllers with battery-backed write cache (BBWC) feature a removable memory module and a BBWC enabler that are usually connected by a short cable. In the event of a server shutdown, you can remove the memory module, BBWC enabler, and hard drives and install them without using tools in another ProLiant server that supports BBWC. When the new server is powered on, the initialization process writes the preserved data to the hard drives.

In the event of a general power outage, the BBWC enabler protects data in the memory module, which holds both the read cache and the write cache. The size of each cache can be allocated through the ACU.

Whenever the system power is on, the batteries in the BBWC enabler are recharged continuously through a trickle charging process. The batteries protect the data in a failed server for up to three or four days, depending on the size of the memory module. Under normal operating conditions, the batteries last for three years before replacement is necessary.

The BBWC enabler consists of the following components:

- A battery module, which includes a charger and status indicators
- A field-installable battery cable

The BBWC enabler is a standard feature on some Smart Array Controllers, or it is available as an option.

New Smart Array controllers can also use Flash Backed Write Cache (FBWC).

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**INTERNET**

For more information about the HP Smart Array Controllers, go to:  
<http://h18004.www1.hp.com/products/servers/proliantstorage/arraycontrollers/index.html>

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### **Recovery ROM**

HP Smart Array Controllers feature recovery ROM, which reduces the risk of firmware corruption when flashing new firmware to the controller.

The controller maintains two copies of its firmware in ROM. The previous firmware is maintained after the new firmware is flashed to the controller. If corruption does occur, the controller will roll over to the standby firmware.

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## Modular Smart Array family

The HP Storage Modular Smart Array (MSA)/P2000/D2000 family consists of the following members:

- MSA20, MSA30, MSA50, MSA60, MSA70
- HP 2000fc Modular Smart Array (G1 and G2)
- HP 2000i Modular Smart Array (G1 and G2)
- HP 2000sa Modular Smart Array (G1 and G2)
- P2000 G3
- D2000 Disk Enclosures

### MSA20

The HP Modular Smart Array 20 Enclosure is a SATA 1.5Gb/s disk drive storage enclosure with Ultra320 SCSI host connectivity. These enclosures deliver industry-leading availability, storage density, and upgradeability to meet the demanding and growing storage needs of customers. The MSA20 delivers the ideal mix of low cost and high capacity, for minimum I/O workloads such as reference data, archival, and disk-to-disk backup.

Key features:

- Serial-ATA 3G delivers data transfer rates greater than 100MB/s.
- Ultra320 (LVD) host support provides compatibility with sixth-generation Smart Array controllers.
- 2U rack height is standard.
- A common storage platform allows for future storage consolidation to the storage area network (SAN).
- Hot-pluggable disk drives, power supplies, and fans are included.
- Redundant fans and redundant power supplies are included.
- Each MSA20 enclosure comes with dual power supplies that are sufficient to provide power to the enclosure and maintain normal operating levels.
- Integrated Environmental Monitoring monitors environmental conditions within the enclosure and components such as the power supply and fans.
- Easy removal of parts provides better serviceability—no tools are required.
- Storage capacity of up to 12TB per enclosure (using 1TB SATA disk drives) is standard.
- The modular design enables up to 21 enclosures to be mounted in one 42U rack for a single rack storage capacity of up to 189TB of disk storage or up to eight enclosures in an MSA1500 or an MSA1510i configuration for storage capacity of 64TB in an entry-level SAN.

## MSA30

The HP Modular Smart Array 30 is an Ultra320 SCSI disk drive storage enclosure. These enclosures deliver industry-leading data performance, availability, storage density, and upgradeability to meet the demanding and growing storage needs of customers. The drive carrier is designed to support the fastest current Ultra320 hard drives on the same SCSI bus.

Key features:

- Is 3U rack height.
- Supports up to 14 (1-inch) Ultra320 (as well as legacy Ultra3 and Ultra2 drives) Universal hard disk drives.
- Provides storage capacity of up to 4.2TB per enclosure (using 300GB 1-inch disk drives).
- Modular design allows the MSA30 to be used in any storage configuration from JBOD (Just a Bunch of Disks) to Smart Array storage enclosures to external RAID arrays. Up to 14 enclosures can be mounted in one 42U rack for a single-rack storage capacity of up to 28.4TB of disk storage (JBOD configuration) or up to 12 enclosures in an EMA16000 (HSG80 configuration) for a single-rack storage capacity of 24.4TB.
- A common storage platform allows for future storage consolidation to the SAN.
- Award-winning innovative Single Connect Attach (SCA) direct connect drive carrier provides better cooling and reliability for 10,000-rpm and 15,000-rpm drives.
- Contains hot-pluggable disk drives, power supplies, and fans.
- Contains redundant fans, dual power supplies, and single- or dual-bus I/O module options.
- Environmental Monitoring Unit (EMU) monitors environmental conditions within the enclosure and components such as the power supplies and fans.

## MSA50

The HP 50 Modular Smart Array (MSA50) Enclosure is a 1U serial-attached SCSI (SAS) disk drive storage enclosure supporting small form factor (SFF) SAS or Serial ATA (SATA) drives. This enclosure delivers industry-leading data performance, availability, storage density, and upgradeability to meet the demanding and growing storage needs of customers.

The all new SFF drive carrier is designed to support the Universal form factor hard drive in either SAS or SATA. This new form factor provides optimized performance per U of space while delivering unparalleled power consumption.

The MSA50 enclosure supports direct attach storage to HP ProLiant and HP Integrity servers. The MSA50 supports the cascading of shelves in a 1+1 configuration to allow a maximum of 20 SFF drives in a 2U configuration attached to a single controller port. This single controller port incorporates four lanes for a total maximum throughput of 12Gb/s for SAS.

Key features:

- Is 1U rack height.
- Supports up to 10 SFF SAS and SATA Universal hard disk drives.
- Provides storage capacity of up to 3TB SAS per enclosure (using 300GB 3G 10,000-rpm 2.5-inch SAS dual-port disk drives) or 5TB SAS Midline (using 500GB SAS MDL) or 2.5TB SATA (using 250GB SATA disk drives)
- Is cascadable 1+1 for up to 20 spindles in a 2U configuration or 6TB SAS, 10TB SAS MDL, or 5TB SATA.
- Modular design allows the MSA50 to be used in any storage configuration from JBOD to Smart Array storage enclosures.
- A common storage platform allows the potential for future storage consolidation to the SAN.
- Universal SFF SAS drive carrier provides better cooling and reliability by providing increased air flow through the storage unit.
- Contains hot-pluggable disk drives, fans, and power supplies.
- Contains field-replaceable fans, I/O Module, and midplane.

## MSA60

The HP 60 Modular Smart Array enclosure is a 2U SAS disk drive storage enclosure supporting 3.5-inch SAS, SATA and SAS Midline (MDL) drives. This enclosure delivers industry-leading data performance, availability, storage density, and upgradeability to meet the demanding and growing storage needs of customers.

This enclosure is designed to support 3.5-inch Universal SAS, SATA, or SAS MDL hard drive form factors. The MSA60 enclosure supports direct attach storage (DAS) to ProLiant and Integrity servers.

The MSA60 supports the cascading of shelves in a 1+3 configuration to allow a maximum of 48 drives in an 8U configuration behind each of the two external ports on the HP Smart Array P800, the HP Smart Array E500, HP Smart Array P411, or the HP Smart Array P812 Controllers for a total of 96 drives in 8 enclosures. This single controller port incorporates four lanes for a total maximum throughput of 12Gb/s for SAS.

Key features:

- Is 2U rack mount form factor.
- Utilizes SAS host interface.
- Supports dual domain with HP Smart Array P800 Controller (requires dual-port SAS drives).
- Has multi-initiator support with the SCG44e host bus adapter (HBA) (AH303A) with dual-port SAS drives only.
  - HP-UX and Open VMS on selected Integrity servers
- Supports twelve 3.5-inch hot-pluggable drives.
- Supports 72GB, 146GB, 300GB, and 450GB 15,000-rpm and 400GB 10,000-rpm 3.5-inch 3G SAS single-port and dual-port drives, and 300GB, 450GB, and 600GB 6G SAS dual-port drives.
- Supports HP 6G SAS dual-port MDL disk drives (1TB and 2TB capacities).
- Is compatible with HP SATA 3G disk drives (250GB, 500GB, 750GB, 1TB, and 2TB capacities).
- Uses modular design.
- Supports 1+3 cascading (behind a single SAS port).
- Delivers SATA 3G data transfer rates greater than 100MB/s.
- Provides storage capacity of up to 7.2TB per enclosure using 6G, 600GB DP SAS disk drives.

- Provides storage capacity of up to 24TB per enclosure using 2TB SATA disk drives or 2TB SAS MDL HDD.
- Contains hot-pluggable disk drives, power supplies, and fans.
- Redundant fans and power supplies ship as standard equipment with base enclosure.
- Each MSA60 enclosure comes with dual power supplies that are sufficient to provide power to the enclosure and maintain normal operating levels.
- Integrated Environmental Monitoring monitors environmental conditions within the enclosure and components such as the power supply, fans, and temperature.
- Easy removal of parts provides better serviceability—no tools are required.
- Supports Microsoft Windows 2003, Microsoft Windows 2008, Red Hat Linux, SUSE Linux, Novell NetWare, HP-UX 11iv2 and 11iv3, and Open VMS 8.3 1H.
- Supported with Smart Array P800, the Smart Array E500, the Smart Array P600, the Smart Array P411, the Smart Array P212 or the HP Smart Array P812 Controller for ProLiant and Integrity servers in a single initiator environment.

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**Note**

Smart Array P411, P212 & P812 Controllers are supported on ProLiant servers only.

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- Attached to HP SC44Ge HBA for HP-UX and Open VMS support on selected Integrity servers (servers that support PCI-e cards).
- Supported with ACU, ORCA, and HP SIM through configuration utilities provided by means of the Smart Array controller.
- Is RoHS compliant.
- Has 3-year limited warranty (MSA60 enclosure only).
- Pre-Failure Warranty covers SAS and SATA disk drives.

## MSA70

The HP StorageWorks 70 Modular Smart Array enclosure is a 2U SAS disk drive storage enclosure supporting 2.5-inch SAS or SATA drives. This enclosure delivers industry-leading data performance, availability, storage density, and upgradeability to meet the demanding and growing storage needs of customers.

The MSA70 enclosure is designed to support 2.5-inch Universal SAS and SATA hard drive form factors. This enclosure supports direct attach storage to ProLiant and Integrity servers.

The MSA70 supports the cascading of shelves in a 1+1 configuration to allow a maximum of 50 drives in a 4U configuration behind each of the two external ports on the HP Smart Array P800, the HP Smart Array E500, the HP Smart Array P411, the HP Smart Array P212 or the P812 Controller for a total of 100 drives in four enclosures. (A single controller port incorporates four lanes for a total maximum throughput of 12Gb/s for SAS.)

Key features:

- Is 3G SAS host connectivity.
- Supports dual domain with HP Smart Array P800 Controller for ProLiant and Integrity servers (requires dual-port SAS drives).
  - Single environment only
- Multi-initiator supports with the SC44Ge HBA (AH303A) with dual-port SAS drives only.
  - HP-UX and Open VMS on selected Integrity servers
- Supports twenty-five 2.5-inch hot-pluggable drives.
- Supports HP 6G SAS dual-port disk drives, (300GB, 450GB, and 600GB capacities).
- Supports HP 6G SAS Dual-port Midline (MDL) disk drives (500GB capacity).
- Supports HP SATA 3G disk drives, (250GB and 500GB capacities).
- Has maximum storage capacity of 7.5TB (with twenty-five 300GB 3G DP SAS), 12.5TB (with twenty-five 500GB 6G SAS DP MDL) or 12.5TB (with twenty-five HP SATA 3G 500GB hard drives).
- Can be attached to Smart Array P800, the Smart Array E500, the HP Smart Array P600, the HP Smart Array P411, the HP Smart Array P212, or the HP Smart Array P812 Controllers for ProLiant and Integrity servers.

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**Note**

Smart Array P411, P212 and P812 controllers are supported on ProLiant servers only.

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- Can be attached to HP SC44Ge HBA for HP-UX and OpenVMS support on selected Integrity servers (servers that support PCI-e cards).
- Supports attachment of up to three dual I/O MSA70 behind MSA2324fc (99 SFF drives for a total of 29.7TB SAS or 24.7TB SATA). Supports Microsoft Windows 2003, Microsoft Windows 2008, Red Hat Linux, SUSE Linux, VMware, Novell NetWare, HP-UX 11iv2 and 11iv3, Open VMS 8.3 1H.
- Supports 1+1 cascading (behind a single SAS port).
- Supports boot from storage.
- Redundant hot-plug power supplies and fans are standard.
- Addition of second I/O module adds dual domain capability, providing higher level of redundancy and reliability.

## HP 2000fc Modular Smart Array G2

The HP 2000fc G2 Modular Smart Array (MSA2000fc) represents the newest Fibre Channel model of the MSA2000 family, which includes the MSA2000i G2 iSCSI and the MSA2000sa G2 SAS-connected models. This generation of HP storage arrays is specifically designed for entry-level customers and features the latest in functionality and technology at highly affordable price points.

The MSA2000fc G2 is a 4Gb Fibre Channel-connected 2U SAN or direct-connect solution (operating system dependent) designed for small- to medium-size departments or remote locations. The controller-less chassis is offered in two models—one comes standard with 12 large form factor (LFF) 3.5-inch drive bays and the other can accommodate 24 SFF 2.5-inch drives (common with ProLiant servers). Both can simultaneously support enterprise-class SAS drives and archival-class SATA drives. The chassis can have one or two MSA2300fc G2 controllers.

Key features:

- Contains high performance Modular Smart Array controllers, each with two 4Gb Fibre Channel ports.
- Supports Single- or dual-controller.
- Contains 1GB transportable cache per controller—battery-free cache backup with super capacitors and compact flash.
- Supports 512 LUNs with LUN size up to 16TB.
- Has 2U rack-mount chassis combining both the controller and disk shelf.
- Supports twelve 3.5-inch or twenty-four 2.5-inch dual-ported SAS, SAS MDL, or SATA MDL drive bays (supports mixing of drive types in a single shelf).

- Supports expansion to four additional LFF enclosures for a total of 60 LFF disks.
- Supports expansion to three additional SFF enclosures (MSA70) for a maximum total of 99 SFF disks.
- Has redundant power supplies and fans as a standard.
- Supports RAID levels 0, 1, 3, 5, 6, 10, 50.
- Supports nondisruptive online controller code upgrade (requires dual controllers with multipathing software).
- Has heterogeneous support for 32-bit and 64-bit Windows, Red Hat and SUSE Linux, and HP-UX.
- Supports Windows Server 2008 x64 Hyper-V and VMware.
- Is qualified and certified for Windows, Linux, and HP-UX, and OpenVMS clustering.
- Supports optional controller-based snapshot and clone functionality.

## HP 2000i Modular Smart Array G2

The HP 2000i G2 Modular Smart Array selection of SAN devices features the latest in efficient consolidation, functionality, and technology at affordable prices. The ideal customers needing to consolidate their storage include smaller companies with tight budgets and limited IT expertise or larger companies that have perhaps hundreds of smaller departments and remote locations.

The MSA2000i G2 features a 1Gb Ethernet (1GbE) iSCSI connected array. It allows customers to grow their storage as demands increase up to 36TB SAS or 120TB SAS MDL or SATA, supporting up to 32 hosts for iSCSI attach. All models support the optional HP Storage 2000 Modular Smart Array Snapshot Software, which offers controller-based snapshot and cloning functionality. Planning for future growth is easy by starting with the basic modular pieces and adding capacity as needs arise.

Key features:

- Contains high performance Modular Smart Array controller with two 1-GbE ports per controller.
- Has single- and dual-controller capability.
- Contains 1GB transportable cache per controller—battery-free cache backup with super capacitors and compact flash.
- Supports 512 LUNs with LUN size up to 16TB.

- Has 2U rack-mount chassis combining both the controller and disk shelf.
- Supports Twelve 3.5-inch dual-ported SAS, SAS MDL, or SATA MSA2000-specific drives (supports mixing of drive types in a single shelf).
- Supports expansion to four additional enclosures and a total of 60 LFF disks.
- Supports expansion to three additional SFF enclosures (MSA70) for a maximum total of 99 SFF disks.
- Has redundant power supplies and fans as a standard.
- Supports RAID levels 0, 1, 3, 5, 6, 10, and 50.
- Supports Nondisruptive online controller code upgrade (requires dual controllers with multipathing software).
- Has heterogeneous support for 32-bit and 64-bit Windows and Red Hat Linux.
- Supports Windows Server 2008 x64 Hyper-V, VMware, Red Hat Enterprise Linux Virtualization, and Citrix XenServer.
- Is qualified and certified for Windows and Linux clustering.
- Supports optional controller-based snapshot and clone functionality.

## HP 2000sa Modular Smart Array G2

The HP 2000sa G2 Modular Smart Array is a 3Gb SAS direct-attach, external shared storage solution that helps customers easily transition from direct attached to centralized storage. It allows departmental and small- to medium-size businesses to grow capacity as demands increase up to 36TB SAS or 120TB SAS Midline (MDL) or SATA, and supporting up to 64 hosts.

With up to 511 LUNs and LUN sizes up to 16TB, the MSA2000sa G2 gives maximum configuration flexibility. The MSA2000sa G2 allows mixing of enterprise-class, dual-ported SAS drives, and archival-class SATA drives, and supports both LFF and SFF drives.

The optional HP StorageWorks 2000 Modular Smart Array Snapshot Software offers increased data protection. The MSA2000sa G2 can be configured with a single controller for a low initial price with future expansion capability, or with a dual controller for situations that require higher availability and performance for the most demanding entry-level situations.

Key features:

- Supports high performance Modular Smart Array controller with four 3Gb SAS ports per controller.
- Has single- and dual-controller capability.
- Supports 1GB transportable cache per controller—battery-free cache backup with super capacitors and compact flash.
- Supports 511 LUNs with 16TB LUNs supported.
- Has 2U rack-mount chassis combining both the controller and disk shelf.
- Supports twelve 3.5-inch dual-ported SAS or SATA MSA2000-specific drives (supports mixing of drive types in a single shelf).
- Supports twenty-four 2.5-inch dual-ported SAS or SATA ProLiant drives (also supports mixing of drive types in a single shelf).
- Supports expansion to four additional enclosures and a total of 48 disk drives.
- Supports expansion to three additional SFF enclosures (MSA70) for a maximum total of 99 SFF disks.
- Has redundant power supplies and fans as a standard.
- Supports RAID levels 0, 1, 3, 5, 6, 10, and 50.
- Supports non-disruptive on-line controller code upgrade.
- Has heterogeneous support for 32-bit and 64-bit Windows, Red Hat Linux, and SUSE Linux.
- Supports Windows Server 2008 x64 Hyper-V, VMware, Red Hat Enterprise Linux Virtualization, and Citrix XenServer.
- Is qualified and certified for Windows, Linux, and Solaris clustering.
- Supports optional controller-based snapshot and clone functionality.

## P2000 G3



P2000 G3 SFF Modular Smart Array

The HP Storage 2000 family of storage arrays features P2000 G3 MSA arrays with the latest 8Gb Fibre Channel, 6Gb SAS, 10GbE iSCSI connected models, and a new iSCSI model with four 1Gb iSCSI ports per controller.

The arrays are designed for entry-level customers and feature the latest in functionality and host-connect technology while offering excellent price:performance. They are ideal for companies with small budgets or limited IT expertise, and also larger companies with departmental or remote requirements. Each solution is designed to be easy to deploy, to be secure, along with low management costs, while driving rapid return on investment through efficient storage consolidation.

The P2000 G3 arrays are 2U SAN or direct-connect solutions (operating system and protocol dependent) offering a choice of five controllers:

- Two Fibre Channel controller types
  - A high-performance, 8Gb dual port model
  - A unique dual-purpose Combo controller with two 8Gb Fibre Channel ports and two 1GbE iSCSI ports
- A 6Gb SAS SAS controller with four ports per controller
- A two port 10GbE iSCSI controller
- A four-port 1Gb iSCSI controller

Whatever the situation calls for, the P2000 G3 lineup has the right solution.

The dual-protocol P2000 G3 MSA FC/iSCSI Combo Controller gives exceptional flexibility. The 8Gb Fibre Channel ports support a full Fibre Channel SAN while the two 1GbE iSCSI ports can serve two purposes. With this combination you can economically share the array storage resource with a smaller department accessing it over iSCSI or enable the new optional Remote Snap functionality over the iSCSI protocol (also available over Fibre Channel).

The P2000 G3 SAS is the follow-on product to the MSA2000sa G2, adding the latest 6Gb SAS technology to the four host ports per controller. The P2000 G3 SAS array is designed for directly attaching up to four dual-path or eight single-path rack servers. SAS array support for HP BladeSystem solutions uses the recently introduced HP 6Gb SAS BL Switch.

The P2000 G3 10GbE iSCSI model brings the latest in high-performance host connection with technology generally found only in higher priced arrays. The bandwidth it provides in conjunction with server consolidation is highly advantageous in shared storage configurations. Array connection to 10GbE switches that are in turn connected to 1GbE NICs is commonplace. Directly attached server support requires the server units to have 10GbE NICs.

The most recent addition is the P2000 G3 iSCSI controller featuring four 1Gb iSCSI Ethernet ports, double the number of the G2 model. This allows an array that keeps the price of the components, particularly the interconnects, low while markedly increasing the performance capabilities.

All P2000 G3 models can be equipped with single or dual controllers, feature the same scalability, and offer 6Gb SAS back-end transmission speed to drives and JBOD configurations. Significant data protection advances are delivered by the all P2000 G3 arrays. All G3 units come standard with 64-snapshot capability at no extra cost, and there is an option for the G3 series of 512 snapshots. Volume Copy (clone) also comes standard. Optional Remote Snap (replication) capability is offered on the Fibre Channel or FC/iSCSI versions (only) to protect user data.

The controllerless P2000 chassis is offered in two models—one comes standard with 12 LFF 3.5-inch drive bays and the other can accommodate 24 SFF 2.5-inch drives. Both can simultaneously support enterprise-class SAS drives, SAS Midline, and archival-class SATA Midline drives. Either chassis can have one or two matching P2000 G3 controllers (same protocol) and are available with AC or DC power supplies.

The HP modular approach to entry-level SAN solutions enables incremental customer purchases, allowing the array to grow as needs grow, thus allowing a maximum return on investment. You can choose a single controller unit for low initial cost with the ability to upgrade later or decide on a model with dual controllers for the most demanding entry-level situations. There are no unexpected additional charges, licenses, or fees as you add enclosures or hosts and users.

Capacity can easily be added as the need develops by attaching additional drive enclosures. Maximum capacity ranges with LFF drives up to 57.6TB SAS, 288TB SAS Midline, or 192TB SATA Midline with the addition of the maximum number of drive enclosures. Configurations using the SFF drive chassis and the maximum number of drive enclosures can grow to 134TB of SAS, 149TB of SAS Midline, or 74.5TB SATA Midline with a total of 96 LFF or 149 SFF drives.

## Key features:

- Ease of management featuring browser-based out-of-band access enables a department or small company to effectively handle growing storage requirements, with the aid of an intuitive GUI to administer the unit with a minimum of complexity. This makes the unit ideal for local or remote installations.
- All G3 models come standard with 64 controller-based snapshots and clone capability. The G3 arrays also support an optional 512 snaps.
- You can choose either a low-cost single controller array or start with a configured dual controller array model to fit your budget, high availability, and performance needs.
- All models feature a wide variety of drives, including enterprise-class SAS, SAS Midline, and archival-class SATA Midline in either P2000 LFF 3.5-inch or ProLiant SFF 2.5-inch drives.
- The P2000 G3 models can have a maximum number of P2000 LFF drive enclosures (seven), a maximum number of D2700 SFF enclosures (five), or a mix both sizes. The array can grow incrementally from a few drives to 134TB SAS, 288TB of SAS MDL, or 192TB SATA MDL.
- The units come with 2GB transportable read/write cache per controller and battery-free cache backup with super capacitors and compact flash.
- Vdisks can be spanned across multiple enclosures.
- RAID levels 0, 1, 3, 5, 6, 10, and 50 can be accommodated.
- Maximum drive counts are two drives for RAID 1; 16 drives for RAID levels 0, 3, 5, 6, and 10; and 32 drives for RAID level 50.
- It supports 512 LUNs with a LUN size up to 16TB.
- Supports the nondisruptive online controller code upgrade requires dual controllers with multipathing software.
- The units are upgradable by design. Owners of an original MSA2000 G1 or G2 array can do data-in-place controller upgrades to the P2000 G3 Fibre Channel; Combo FC/iSCSI; 1Gb or 10GbE iSCSI; or P2000 G3 SAS. Cross protocol upgrades are also supported between the protocols. This unique ability protects the earlier investments in chassis, drives, and JBODs configurations.

## D2000



D2000 with LFF drives

The D2000 enclosures support direct attach storage to ProLiant servers with the HP Smart Array P411, P212, or P812 Controllers. On ProLiant and Integrity servers, dual domain support is available for the HP Smart Array P411 and P812 Controllers attached to a D2600 or D2700 unit (single initiator environment only). The HP-UX 11i v3 and Windows 2008 R2 operating systems are supported for HP Integrity servers (single initiator environment only).

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# Learning check

1. List three advantages of hardware-based RAID:

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.....  
.....  
.....  
.....

2. What is a common rotational speed of HP SAS hard drives?

.....  
.....  
.....  
.....

3. List at least three types of RAID levels HP Smart Array Controllers do support:

.....  
.....  
.....  
.....  
.....

4. ORCA can be used to change the RAID level.

- True
- False

5. The HP Storage MSA20 uses 8Gb Fibre Channel controllers.

- True
- False

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### Objectives

After completing this module, you should be able to:

- Describe the HP Insight Foundation Suite for ProLiant
- Describe the HP ProLiant Support Pack
- Describe the Management DVD and HP Smart Update Firmware DVD
- Identify features and benefits of the HP Service Pack for ProLiant
- Identify differences in HP ProLiant 100 series setup

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# HP Insight Foundation Suite for ProLiant

The primary component of ProLiant software is the Insight Foundation Suite for ProLiant. It ships with ProLiant servers and includes the essential software that every customer needs to install, configure, and manage ProLiant servers. It is a single, comprehensive source for all ProLiant server support software.

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**Note**

The Insight Foundation Suite for ProLiant is optional when a server is ordered through CTO.

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The Insight Foundation Suite for ProLiant includes:

- Two SmartStart CDs (one for x86 32-bit and one for x86 64-bit operating systems)
- ProLiant Support Pack for Windows (included on the SmartStart CD)
- ProLiant Support Pack for Linux (included on the SmartStart CD)
- One Smart Update Firmware DVD
- One Management DVD

The Management DVD provides the tools needed to monitor, patch, and control ProLiant ML, DL, SL, and BL servers, including systems running VMware and Microsoft virtual machines. Use the Management DVD autorun to install HP Systems Insight Manager (HP SIM) and the other basic management tools that you require.

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**INTERNET**

For more information on the HP Insight Foundation Suite for ProLiant, go to:  
<http://hp.com/go/foundation>

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## HP USB Key Utility

HP USB Key Utility is a Microsoft Windows application that enables you to copy the SmartStart CD or Firmware Maintenance CD or DVD to a USB memory key. SmartStart and Firmware Maintenance applications can then be started from a USB key instead of from the CD/DVD.

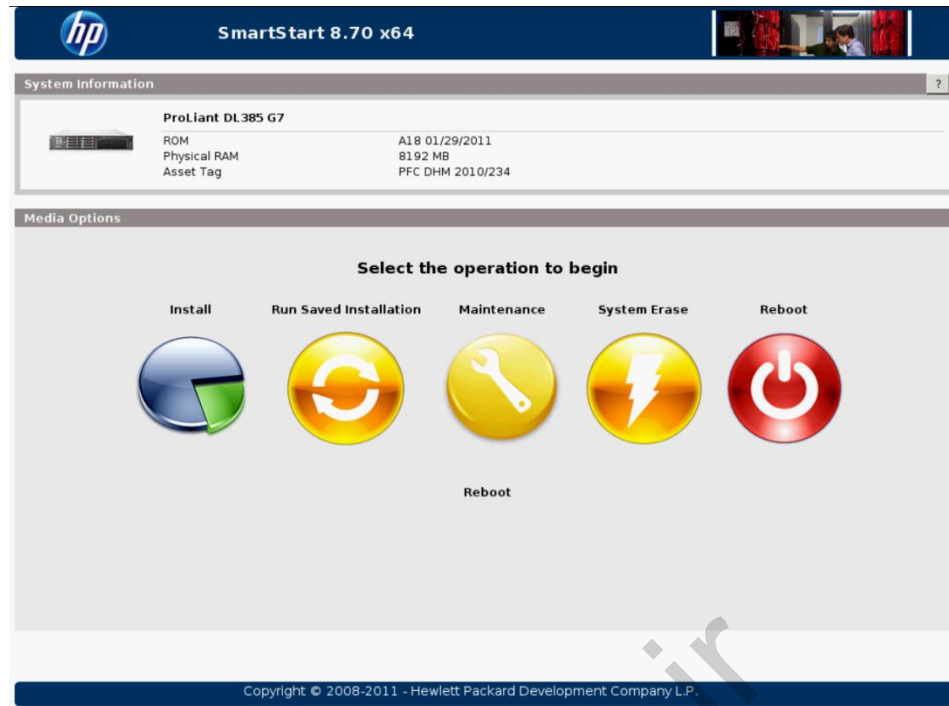
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**Note**

USB keys can be created from SmartStart 8.30 and later.

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## SmartStart



SmartStart CD 8.70 x64 main screen

The HP SmartStart CD contains the SmartStart Setup Program, which is the integration tool that optimizes platform configurations and simplifies the setup and installation of HP servers.

SmartStart performs the following functions:

- Configures HP hardware
- Loads optimized drivers
- Assists with software installation
- Replicates installation
- Integrates operating systems on HP servers to optimize reliability and performance

Integration management features facilitate the consistency and reliability of server deployment and maintenance.

The SmartStart software is easy to use for single-server deployment. SmartStart requires user attention throughout the process and can be performed on only one server at a time. Not all operating systems supported by the server can use the SmartStart installation.

## SmartStart CD

The SmartStart CD is delivered in the HP Insight Foundation Suite for ProLiant and is helpful for both novice and advanced users. It supports the ProLiant ML, DL, SL, and ProLiant BL (BladeSystem) servers.

The SmartStart CD contains optimized drivers and utilities that provide maximum performance on all leading operating systems. The SmartStart 6.x and later CD contains ProLiant Support Packs (PSPs) and utilities.

### ProLiant Support Packs

PSPs are operating-system-specific bundles of HP server support software. Each PSP includes multiple self-installable components known as Smart Components, which include optimized drivers, management agents, and utilities. PSPs are supported for the following operating systems:

- Microsoft Windows
- Linux

The SmartStart CD contains these utilities:

- **Array Configuration Utility (ACU)**—Enables you to configure newly added array controllers and associated storage devices. Array Diagnostic Utility (ADU) functionality is combined with the ACU so you can run diagnostic tests.
- **Insight Diagnostics**—Performs tests on system components and displays information about the hardware and software configuration of a server.
- **System Erase Utility**—Provides options to clean different areas of the system such as attached drives, unattached drives, BIOS, and NVRAM.
- **HP Lights-Out Configuration**—Configures HP integrated Lights-Out (iLO) parameters such as the network configuration or user names.
- **Create a bootable USB key**—Creates a bootable USB key with SmartStart CD content.
- **USB Punchout Creation Utility**—Adds the SmartStart CD to a USB bootable key. This option allows multiple CD images on USB keys.

## SmartStart installations

SmartStart offers an assisted installation path. There is no replicated installation path as with SmartStart 5.5 and earlier. The assisted installation prepares the server hard drives by:

- Erasing the drives
- Creating a boot partition
- Preparing for the file system
- Installing server support software, including the PSP

For manual installations of server-supported operating systems, use vendor-supplied operating system media and the ROM-based utilities such as the ROM-Based Setup Utility (RBSU) and the Option ROM Configuration for Arrays (ORCA). The ACU can be used for full array configuration from the SmartStart CD.

Perform a manual installation if the operating system is not supported through the assisted SmartStart installation or if you want maximum customization with an operating system that supports a SmartStart-assisted installation path.

ProLiant servers can also be configured and deployed with a supported operating system using HP deployment tools such as HP Insight Rapid Deployment software.

Server systems that support RBSU and ORCA include maintenance utilities and automatic configuration operations that enable you to boot from the operating system CD to install the operating system. You then can install server support software manually from the SmartStart CD or obtain the latest PSP from the HP website.

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**INTERNET**

Use SmartStart 5.5 for an assisted installation on older servers that do not support RBSU or ORCA. SmartStart 5.5 is available through the HP subscription service. It can also be downloaded from <http://www.hp.com/go/support>.

For details on all server options supported for SmartStart, see the SmartStart Product Support Matrix at <http://www.hp.com/servers/smartstart>.

Before deploying a server, always verify the operating system support matrix; it is accessible at <http://www.hp.com/go/supportos>.

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## System Erase Utility



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**Caution**

If you start a previously configured server with SmartStart and it prompts you to run the System Erase Utility, do not run the System Erase Utility unless you want to clear all existing server configuration and data. The System Erase Utility destroys all configuration information and data by completely erasing all hard drives.

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### System Erase with SmartStart

SmartStart 6.x and later includes the System Erase Utility, which provides options to clean various areas of the system:

- Attached drives
- Nonattached drives
- BIOS
- Nonvolatile RAM (NVRAM)

You can select what to erase from these areas. The actual selections can be different, depending on the server configuration.

Unlike previous versions of SmartStart, the System Erase Utility for SmartStart 6.x and later does not erase the configuration of the Smart Array Controller.



# ProLiant Support Packs

United States-English

» HP Home    » Products & Services    » Support & Drivers    » Solutions    » How to Buy

» Contact HP    Search:    Management software    All of HP U.S.

**hp**    **HP ProLiant Support Pack for Windows and Linux**  
Overview & Features

» Server management

» ProLiant Support Pack

Components

- » ProLiant servers
- » Entry level servers
- » ProLiant clusters
- » ProLiant Essentials

Resources

- » SmartStart
- » Subscriber's Choice
- » System Management Homepage
- » ROM-BIOS updates

Services

- » How to buy

» New products

» Retired products

» Special promotions

» Site map

» What's new with HP ProLiant

QuickSpecs

- Worldwide: » HTML » PDF
- N. America: » HTML » PDF

Support

- » Download Software
- » Support & Documents
- » User Forum
- » HP Insight Foundation Suite for ProLiant

Overview    What's New    Ideal Environment    Key Benefits    Questions & Answers

**Overview**

ProLiant Support Packs (PSP) represent operating system (OS) specific bundles of optimized drivers, utilities, and management agents. These bundles are tested together to ensure proper installation and functionality. PSPs are released concurrently with HP's SmartStart, and can also be released outside of the SmartStart cycle and made available on the [HP ProLiant Support Pack download selection](#) pages or at [HP Insight Foundation website](#).

Each PSP consists of a deployment utility (HP Smart Update Manager), setup and software maintenance tools designed to provide an efficient way to manage routine software maintenance tasks. IT administrators can select PSP updates from a central software repository for deployment on local or remote servers, Windows or Linux. These deployment utilities remotely deploy driver and management agent updates to network attached servers and can be operated from an IT administrator's workstation.

For more information on PSPs, review the [HP ProLiant Support Pack User Guide](#).

ProLiant Support Pack home page

ProLiant Support Packs (PSPs) represent operating-system-specific bundles of ProLiant optimized drivers, utilities, and management agents.

**INTERNET** To access more information about PSPs, go to:  
<http://h18004.www1.hp.com/products/servers/management/psp.html>

## PSP overview

The PSP is used after installing the operating system to update drivers and to install HP utilities and agents on ProLiant servers. PSPs are operating-system-specific bundles of HP server support software. Each PSP includes multiple self-installable components known as Smart Components (optimized drivers, management agents, and utilities).

One reason why the individual PSP components are called “Smart” is that each component checks the system for its installation dependencies (including hardware, software, firmware, and operating system) before installing the software. If the dependencies are not met, the Smart Component does not install. This design improves and simplifies operating system integration, flexibility, and system configuration.

PSP deployment utilities include hardware setup and software maintenance tools that provide an efficient way to manage routine software maintenance tasks for:

- Microsoft
  - Microsoft Windows Server 2008 R2
  - Microsoft Windows Server 2008 R2 Foundation Edition
  - Microsoft Windows Server 2008 x64
  - Microsoft Windows Server 2008
  - Microsoft Windows Foundation Server 2008
  - Microsoft Windows Essential Business Server 2008
  - Microsoft Windows Small Business Server 2008
  - Microsoft Windows Server 2003 x64
  - Microsoft Windows Server 2003
  - Windows Server 2011 Small Business
  - Windows Server 2011 Small Business Essentials
  - Windows Server 2008 R2 SP1
- Novell
  - SUSE Linux Enterprise Server 11 (AMD64/EM64T)
  - SUSE Linux Enterprise Server 11 (x86)
  - SUSE Linux Enterprise Server 10 (AMD64/EM64T)
  - SUSE Linux Enterprise Server 10 (x86)
  - Novell NetWare 5.1, 6.0, and 6.5/Open Enterprise Server
    - Last support for Novell NetWare is on SmartStart 7.91

- Red Hat
  - Red Hat Enterprise Linux 4 (includes support for x86, AMD64, and Intel EM64T)
  - Red Hat Enterprise Linux 5 (includes support for x86, AMD64, and Intel EM64T)
  - Red Hat Enterprise Linux 6

PSPs and the PSP deployment utilities integrate with other software maintenance, deployment, and operating system tools. They provide the information and flexibility needed to efficiently install, upgrade, and manage system software and reduce server maintenance costs.

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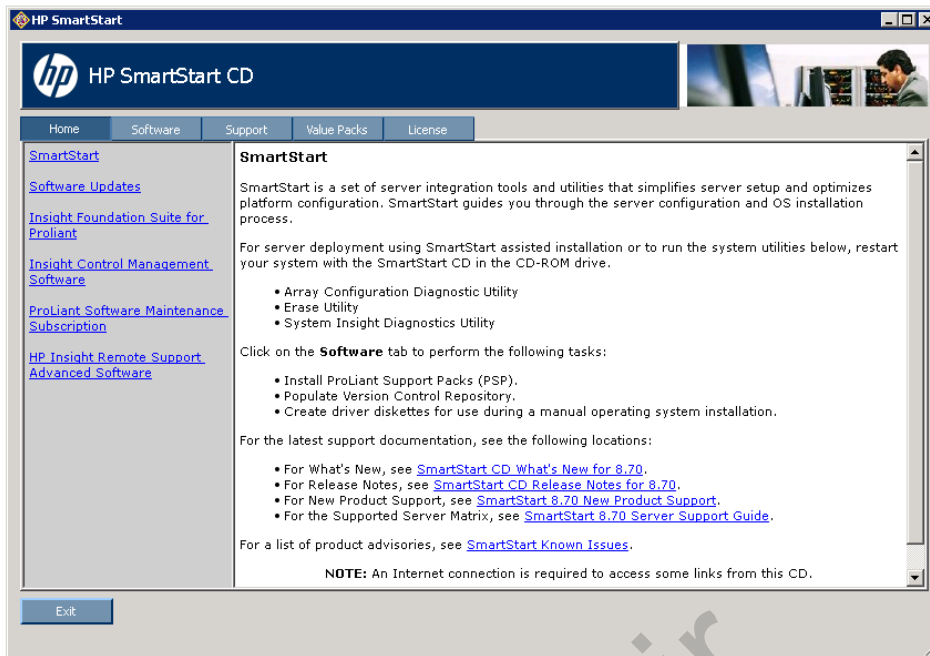
## PSP software maintenance benefits

The PSP deployment utilities provide the following software maintenance benefits to system administrators using Windows and Linux platforms:

- Self-installable components with easy-to-understand software update descriptions
- Components that can be installed individually or as part of a Support Pack
- Installation logic and version control that automatically checks for hardware, software, firmware, and operating system dependencies, installing only the correct software updates and latest drivers for optimal system configuration
- Silent command line options and return codes that enable scripting and enhanced integration of the PSP deployment utilities with HP SIM and the SmartStart Scripting Toolkit
- Common log files that provide easy access to a consolidated view of software installation history on target servers
- Content in ready-to-run native operating system file formats that save time by installing directly from a CD or from a shared network drive

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## Obtaining ProLiant Support Packs and deployment utilities

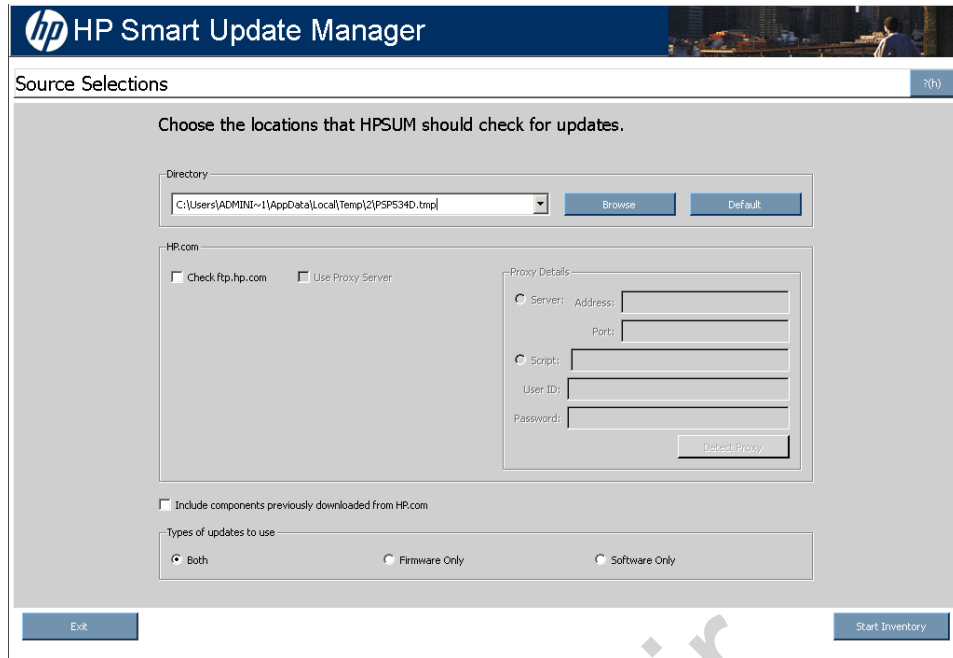


SmartStart CD containing PSP

PSPs and PSP deployment utilities can be obtained by:

- Accessing the HP website
- Downloading the PSP through the Version Control Repository Manager (VCRM)
- Using the HP SmartStart CD media

## Deploying ProLiant Support Packs in Microsoft Windows



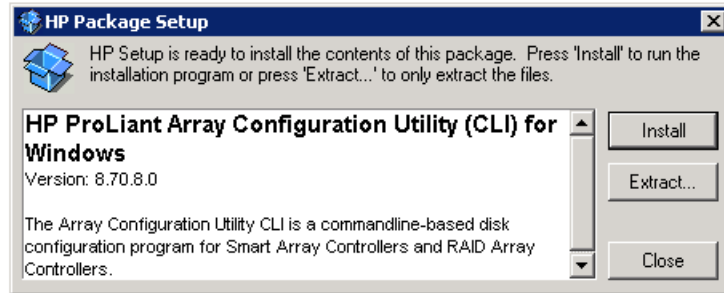
HP Smart Update Manager

HP Smart Update Manager is a utility used for PSP installation on Windows. It enables component preconfiguration, deployment of individual PSP components, updating from the HP ftp server, and installation on a remote server or group of servers.

## Installing single components

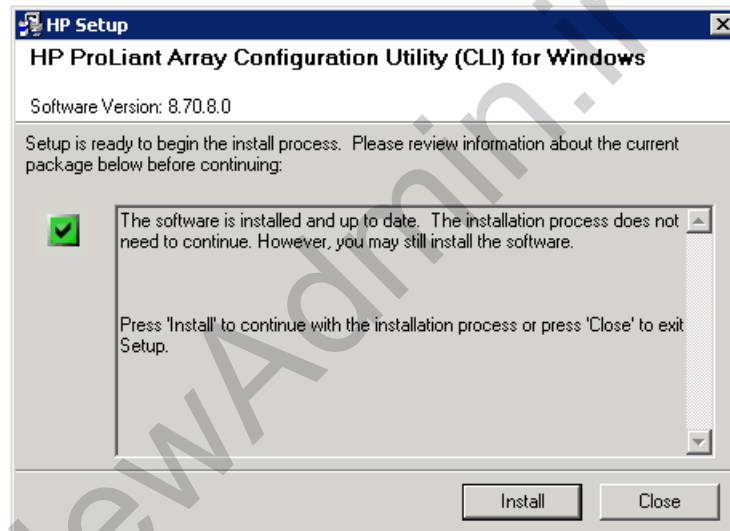
An administrator can install a single component manually rather than install an entire Support Pack. To install a single component on a local system:

1. Double-click the component to be installed, for example, **cpxxxxxx.EXE**, where the Xs represent the component number. The HP Package Setup screen displays.



Component installation screen

2. Click the **Install** button. The HP Setup screen displays.



Component installation confirmation screen

3. Click the **Install** button again and follow the instructions on the screen to complete the installation.

## Deploying ProLiant Support Packs in Linux

Starting from ProLiant Support Pack 8.40, HP Smart Update Manager (SUM) is also used to deploy ProLiant Support Packs for Linux systems. It provides an easy and efficient method to upgrade and manage system software. The utility enables you to deploy and maintain PSPs on local or remote servers.

**Important**

Root access is required for the Linux Deployment Utility. If you do not have root access, the installation will not proceed.

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### Modes of operation

In a Linux environment, HP SUM has two modes of operation:




- **Terminal window mode**—Enables nongraphical terminal window installation of a PSP or individual components. The terminal window mode is divided into three modes:
  - Silent
  - No user interface
  - Single step
- **Graphical mode**—Provides a graphical interface to guide the installation of a PSP or a subset of components in the PSP.



# Management DVD and HP Smart Update Firmware DVD

The Management DVD and HP Smart Update Firmware DVD are now part of the HP Insight Foundation Suite for ProLiant servers. The HP Smart Update Firmware DVD is replacing the Firmware Maintenance DVD and some tools designed for firmware deployment for server blades.

## Management DVD

<p>Key components: HP Systems Insight Manager, HP System Management Homepage for Windows, HP Version Control Repository Manager, HP Service Essentials Support Pack, HP BladeSystem Integrated Manager</p>	<p>Delivers a collection of Management software tools for your ProLiant Servers and options.</p>	<p>HP SIM is the clear choice for managing HP servers and storage by being the easiest, simplest and least expensive way for system administrators to maximize system uptime and health</p>
		
<p>As of 8.2 and beyond released as DVD in the HP Insight Foundation suite for ProLiant</p> 	<p>Available for free download from HP.COM</p> 	<p>Take full advantage of the capabilities of HP Systems Insight Manager, install WBEM providers on your managed systems.</p>



Management DVD overview

The Insight Management DVD contains (HP SIM. Additionally, the Insight Foundation Suite products website (which is independent of the actual media kit) contains tools such as:

- HP USB Key Utility for Windows
- SmartStart Scripting Toolkit
- HP SIM
- OpenSSH
- VCRM

Other basic management tools are also included on the DVD. This DVD is an alternative for customers that do not want to use Insight Control, but still want to use all free management features from HP.

## HP Smart Update Firmware DVD

<p>Delivers a collection of firmware for your ProLiant Servers and options. Update your ProLiant</p>	<p>Delivery methods; HP Smart Update Manager (HPSUM), ROMPags, or Online ROM Flash Components</p>	<p><b>HPSUM online</b> - running select Microsoft Windows or Linux operating systems, run the DVD from the drive or from a USB key</p>
<p><b>Online ROM Flash Components:</b> Online method for Windows, Linux, &amp; NetWare for performing FW updates for ProLiant Servers &amp; options.</p>		<p><b>HPSUM offline</b> - restart or boot your system with this DVD in the drive or from a USB key</p>
<p>As of 8.1 release it is a component of the HP Insight Foundation suite for ProLiant</p>	<p>Available for free download from HP.COM</p> 	<p><b>Supplemental updates</b> for ProLiant servers &amp; options without FW on the DVD can be done by using HPSUM</p>

HP Smart Update Firmware DVD overview

The HP ProLiant Smart Update Firmware DVD powered by HP SUM provides a collection of firmware for ProLiant servers and options. Beginning with the Firmware Maintenance CD 7.50, it includes the SUM utility that enables customers to deploy firmware components from a single, easy-to-use interface that is supported in both Microsoft Windows and Linux environments. This utility enables legacy support of existing firmware components while simplifying the firmware deployment process.

Major changes in the area of firmware and systems software maintenance are available with version 8.40. The Firmware Maintenance CD has been replaced by the Smart Update Firmware DVD 9.0, which includes:

- Support for ProLiant BladeSystem release sets
- Consolidation of separate firmware update utilities onto the DVD by eliminating the products that go away as separate, individual products: BladeSystem firmware deployment tool (FDT) and BladeSystem bundles
- Improved GUI for viewing offline firmware updates

The DVD also provides installation logic and version control that check for dependencies, installing only the correct updates for optimal system configuration. The Smart Update Firmware DVD can be downloaded at no cost from the HP website. The HP Smart Update Manager utility is available from the ProLiant Smart Update Firmware DVD.

The Firmware DVD and its contents should be used only by individuals who are experienced and knowledgeable in their use. Before using the SUM utility to update firmware, be sure to back up the target server and take all other necessary precautions so that mission-critical systems are not disrupted if a failure occurs. Smart Update Manager stores host and group information from session to session; however, user names, passwords, and existing credentials are not stored.

You can run the Firmware DVD either online or offline. When performing an online deployment, you must boot the server from the operating system that is already installed and running. When performing an offline deployment, you can boot the server from the Smart Update Firmware DVD or a USB drive key that contains the Firmware DVD contents.

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## HP Service Pack for ProLiant

The HP Service Pack for ProLiant is an enhanced repackaging of ProLiant system software and firmware and is based on the rich legacy of Windows and Linux PSPs and the HP Smart Update Firmware DVD that were found in the Insight Foundation suite for ProLiant. This service pack is a comprehensive systems software and firmware release offered as a tested solution for all ProLiant and BladeSystem servers.

It provides a single image for a single-step installation instead of a two-step installation of HP Windows and Linux PSPs and the HP Smart Update Firmware DVD. It repackages firmware, drivers, utilities, agents, nonagents, and other required utilities and improves the process for releasing these products to HP customers. VMware drivers and offline firmware will also be supported.

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**INTERNET**

You can download the HP Service Pack for ProLiant from the HP website at:

[http://www.hp.com/go/server/service\\_packs/updates](http://www.hp.com/go/server/service_packs/updates)

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## Benefits of the HP Service Pack for ProLiant

The Service Pack for ProLiant is supported on all HP ProLiant SL, ML, and DL 100, 300, 500, 700, and 900 series servers and on HP BladeSystem series servers that are supported with Insight Foundation 8.70. It will supersede and replace the Insight Foundation suite for ProLiant. It combines multiple products into a single image to provide:

- Radical simplification with a single-step update
- Right-sized packaging (40% smaller)
- Consolidation, as a single solution for all supported ProLiant servers
- A regular, defined release cycle

Base releases for the Service Pack for ProLiant are planned approximately three times a year (or approximately every four months), but interim update releases that capture hot fixes might be released between these base releases. The first release will be downloadable during the third or fourth week of July 2011. It will be downloadable as a web release only and will not be available on media.

With the introduction of the Service Pack for ProLiant, HP is increasing its support life cycle by providing support for the current release and two previous releases (or one year, whichever is longer) for customers requiring extended service durations. Because HP will be offering three base releases per year as well as interim updates as needed to capture hot fixes, customers requiring optimal performance, resiliency, and features have the ability to update when and as needed. The support period will be approximately one year because of the increased interval between base releases.

By simplifying the delivery of HP ProLiant systems software and firmware into a single PXE bootable ISO image, customers will reduce:

- Qualification cycles
- Resource usage
- Maintenance windows
- Downtime

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**INTERNET**

For more information on the specific contents of the HP Service Pack for ProLiant, go to:

[http://h18000.www1.hp.com/products/servers/management/spp/servicepack\\_proliant.html](http://h18000.www1.hp.com/products/servers/management/spp/servicepack_proliant.html)

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## Setup differences for ProLiant 100 series servers

The ProLiant 100 series servers are entry-level servers that use different setup, management, and diagnostic tools than other ProLiant servers.

The Startup CD ships with these servers instead of the HP Insight Foundation Suite for ProLiant. The 100-series servers use the BIOS Setup Utility instead of RBSU. These servers support the Intelligent Platform Management Interface (IPMI). HP Lights-Out 100 and Lights-Out 100i provide remote access for management and troubleshooting tasks.

### BIOS Setup Utility

This setup and configuration utility is used for ProLiant 100 series servers.

BIOS Setup runs from a small portion of a disk. Any changes made with the utility take effect each time the server boots and can be modified any time you run setup.

Its characteristics include:

- Ability to be run with or without an operating system
- Accessible during the power-on self-test (POST) by pressing the Delete key
- Storage of server configuration values in battery-backed CMOS and in flash memory
- Capable of viewing or modifying these features:
  - System devices and installed options
  - System information
  - Boot device and boot order

**Important**

To see POST messages, you must disable Quiet Mode. This is the default configuration.

---

Use the BIOS Setup utility to record the system serial number and to disable Hyper-Threading.

## Server Startup CD

The Server Startup CD ships with ProLiant 100 series servers. These entry-level servers do not ship with the higher-end tools for configuration and management.

The contents of the CD can be unique to a specific server model. For example, a ProLiant DL140 server offers a scripted install for supported Windows operating systems.

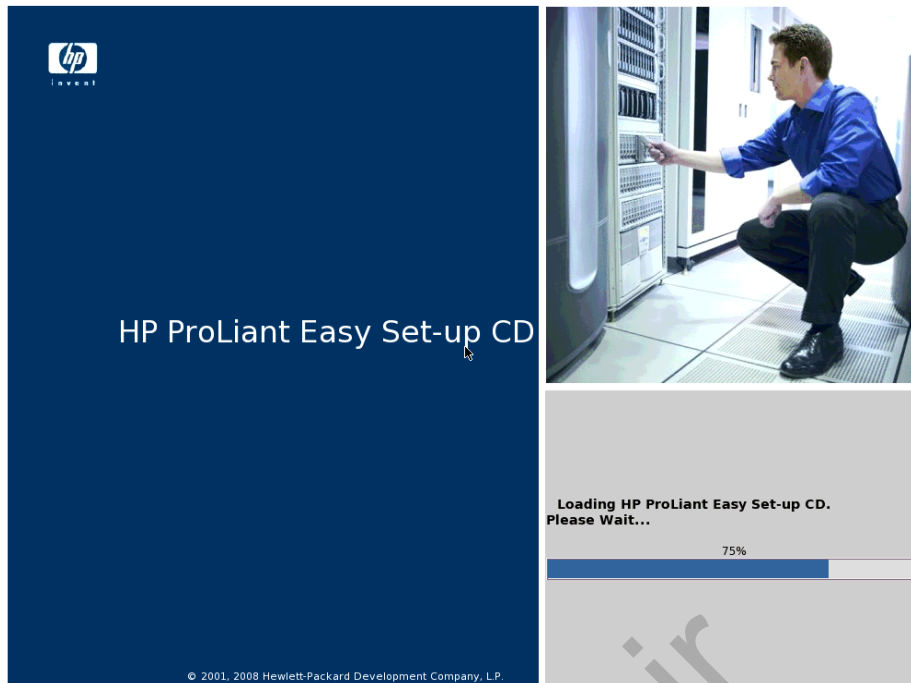
**Important**

Some 100 series servers do not usually ship with a CD-ROM drive. To view and access the contents of the Startup CD, you must install the optional CD drive, connect an external CD drive to the USB port, or download the drivers and documentation from the product support website to an HP Disk Key.

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## HP ProLiant Easy Set-up CDs for ProLiant 100 series servers



HP ProLiant Easy Set-up CD

The HP ProLiant Easy Set-up CDs provide easy, step-by-step, single and multiserver utilities for the ProLiant 100 series G6 and later servers. They offer a consistent user experience with SmartStart and feature one CD per server model where each CD offers:

- Boot environment and GUI
- Assisted installation: Windows 2003 Server and 2008 Server drivers
- Manual installation: Same drivers as assisted installation plus Linux drivers (specific operating system support varies by server so refer to the server QuickSpecs for supported versions)
- HP Insight Diagnostics
- The ACU to configure array controllers and storage devices

The ACU also contains a diagnostic function (previously packaged separately as the Array Diagnostics Utility) to perform array controller hardware tests.



# Learning check

1. SmartSetup CD for Integrity servers is part of the Insight Foundation Suite.
  - True
  - False
2. Which component of the Insight Foundation Suite is replacing the Firmware Maintenance DVD?
  - a. SmartStart CD
  - b. Management DVD
  - c. HP Smart Update Firmware DVD
  - d. ProLiant Support Pack Deployment Tool

3. List at least two ways how to obtain ProLiant Support Pack.

.....

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.....

.....

.....

4. List two components included on the Management DVD.

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5. What is the name of tool replacing ProLiant Support Packs and Firmware Smart Update DVD?
  - a. SmartStart CD
  - b. HP Service Pack for ProLiant
  - c. Management DVD
  - d. ProLiant Support Utility

6. HP ProLiant Easy Set-up CD contains Array Configuration Utility.
  - True
  - False

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# Data Availability and Protection for a ProLiant Server

Module 5

## Objectives

After completing this module, you should be able to:

- Explain how to increase availability through power protection
- Identify key features of HP Data Protector Express

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## Increasing availability through power protection

Businesses cannot rely on utility power as a source of continuous power for critical equipment. HP has developed a full line of power management products that protect and manage computer systems ranging from individual workstations to distributed enterprises:

- Uninterruptible power supplies (UPSs)
- Power distribution units (PDUs)

For applications that require a high level of fault tolerance, the power source for the equipment should be protected by a UPS. The UPS is connected between the equipment or PDU and the electrical outlet.

### Uninterruptible power supplies

A UPS can provide several benefits to a computing infrastructure. Planning and selecting the proper UPS system ensures:

- Maximum system backup time in the event of a power loss
- Consistent power voltage levels
- Protection from damaging power spikes
- Increased power efficiency, reducing power loss through heat and harmonic frequencies
- Power management capabilities of your power protection system

An HP UPS contains batteries that protect against power disturbances—natural or man-made—and circuitry that filters and enhances utility power to provide a more stable voltage. If a UPS determines that the utility voltage is within the nominal operating range, the UPS supplies the utility power to the output receptacles. If the utility voltage is outside the nominal operating range, or has failed, the UPS supplies battery power to the output receptacles.

HP UPSs are bundled with:

- **HP Power Manager software**— This software uses load segment control to schedule startups and shutdowns of less-critical devices, which extends the operation of the mission-critical devices. The software continuously manages and monitors HP UPSs.
- **HP UPS Management Module**—This module enables you to monitor and manage power environments through comprehensive control of HP UPSs.

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**INTERNET**

To view the entire HP power protection and management portfolio, go to:  
<http://h18004.www1.hp.com/products/servers/proliantstorage/power-protection/index.html>

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## HP power protection and management portfolio

The HP power protection and management portfolio consists of:

- Tower UPS models
- Rack-mountable UPS models

### Tower UPS models



HP tower UPSs provide advanced power protection and secure computer equipment and critical data against damage resulting from inconsistent and fluctuating power. Designed for small and medium businesses (SMBs), HP tower UPSs lower power protection cost by enabling you to safeguard all of your equipment.

Key benefits include increased power rating, an intuitive front panel display, Enhanced Battery Management (EBM), prioritized shutdown, a hot-swappable battery, Network Transient Protection, as well as serial and USB ports for data exchange with the host computer.

HP Power Manager software (free with all HP UPSs) provides the flexibility to monitor power conditions and control the UPS locally or remotely. It enables you to broadcast alarms, perform orderly shutdowns in the event of power failures, and schedule power-on and power-off to the UPS and attached equipment.

With HP Care Pack Services, your customers have the security of knowing that their HP UPS will be covered at the same service level and coverage period as their HP servers. HP UPSs are backed by a three-year limited warranty and an exclusive 30-day battery Pre-Failure warranty.

## Rack-mountable UPS models



R5500

R5500 UPS with ERM

HP rack-mountable UPSs are designed for dense data center environments. These UPSs offer the following features:

- Industry-leading power density (more watts per U-space)
- More true power (measured in watts) in smaller form factors (measured in rack U-space)
- More performance while saving valuable rack space

Bundled with the free HP Power Manager software, these UPSs are supported by Extended Runtime Modules (ERMs) that add increased system backup time.

The rack mountable UPS portfolio includes:

- HP R1500 G2
- HP R1500 G3
- HP R/T3000
- HP R/T3000 G2
- HP R5500
- HP RP36000/3

## HP UPS features

Other features of the HP UPS portfolio include:

- Performance
  - Increased power rating from the previous UPS generation
  - Automatic Voltage Regulation (AVR) with buck and boost
  - Hot-swappable battery
  - Enhanced battery management
  - Network Transient Protector
- Management
  - Remote, easy monitoring of multiple UPSs and servers
  - An orderly shutdown of attached devices during utility power failures
  - Scheduling of a prioritized shutdown or power-on of attached load devices
  - Ability to manage an unlimited number of servers through remote agents
- Communications
  - Serial and USB connectivity
  - Customized alert generation with modifiable dialog boxes, command execution, and email, pager, mobile phone, and broadcast messages
  - Intuitive front panel display
- HP quality and support
  - HP Care Pack Services
  - A three-year limited warranty, with the first year including parts and labor
  - Battery Pre-Failure Warranty

## UPS option

To scale capacity, you can connect additional UPSs to the original UPS through the UPS card slot.

The ERM option adds value and leverages control of the IT investment. It extends the ability of the UPS to power equipment during a failure. At the recommended 80% load, one ERM can extend the available UPS run time up to 30 minutes.

An ERM acts as an extra battery for a UPS and attaches to a power receptacle located on the UPS rear panel. A UPS can support up to four ERMs. You must install an ERM at the bottom of a rack, with the UPS directly above it.

The ERM Configurator ensures that accurate run-time predictions are reported to any network software communicating with the UPS. Network software uses run-time information to conduct a timely shutdown of attached servers.

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**INTERNET** For a complete list of UPS options, go to:  
<http://h18004.www1.hp.com/products/servers/proliantstorage/power-protection/options/index.html>

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## Enhanced battery management

Batteries that are constantly trickle-charged (a constant voltage feeding a low current to the battery) reach the end of their useful life in less than half the time of those charged using advanced techniques such as enhanced battery management technology.

HP enhanced battery management technology incorporates an advanced, three-stage battery charging technique that doubles battery service life, optimizes battery recharge time, and provides up to a 60-day advanced notification of the end of useful battery life.

- **Intelligent battery charging**—The HP UPS uses a three-stage charging process that doubles battery service life. First, the UPS rapidly charges the battery to 90%. A constant voltage (float charge) continues until the battery reaches full capacity. The charger is then turned off and the UPS goes into a rest mode, enabling the battery to be preserved for future power failures.

Most manufacturers use a trickle-charging method that dries the electrolytes and corrodes the plates, thereby reducing potential battery life by up to 50%.

- **Advance notification of battery replacement**—Because most other UPS batteries are valve-regulated and sealed, with lead-acid cells, a practical way to provide users with advance notification of battery failure has not been available. The only way to determine that batteries need replacement has been to wait until the power failed, which would take the servers and computers down with it.

HP enhanced battery management is the only technology available that reliably provides advance notification of battery failure. A microprocessor tracks the charge and discharge characteristics of the battery and compares these characteristics to an ideal battery state. By monitoring the battery, the user receives advance notice when battery replacement is necessary.

- **Superior voltage regulation**—Most UPSs correct input voltage variations as low as -25% but transfer to battery when a surge or sag must be filtered in the system. This type of voltage regulation shortens the battery service life of the UPS.

Innovative HP buck and double-boost voltage regulation ensures consistent input voltage to the load by automatically “bucking” it if it is too high or “boosting” it if it is too low. Voltage variations that are as low as -35% or as high as +20% of the nominal voltage are corrected—without transferring to the battery. As a result, the number of charge and recharge cycles is reduced, and the life of the HP UPS battery is extended.

## HP rack and power management software

Rack and power management software (including sizing tools) consists of three products:

- HP Power Manager
- HP Power Protector UPS Management Software
- Rack and Power Manager

### HP Power Manager

HP Power Manager is a web-based application that enables administrators to manage an HP UPS from a browser-based management console. Administrators can monitor, manage, and control a single UPS locally and remotely.

A familiar browser interface provides secure access to management servers anywhere on the network. Administrators can configure power failure settings and define UPS load segments for maximum uptime of critical servers.

The UPS can also be configured to extend runtimes for critical devices during utility power failures. For most UPSs, the receptacles on the rear panel are divided into one or more groups, called load segments, which can be controlled independently. By shutting down a load segment that is connected to less critical equipment, the runtime for more critical equipment is extended, providing additional protection.

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**INTERNET**

To access the HP Power Manager utility, go to:

**<http://h18004.www1.hp.com/products/servers/proliantstorage/power-protection/software/power-manager/index.html>**

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### HP Power Protector UPS Management Software

HP Power Protector is a web-based application that enables administrators to manage an HP UPS from a browser-based management console. Administrators can monitor, manage, and control a single UPS locally and remotely.

A familiar browser interface provides secure access to the UPS Administrator Software and UPS Client Software from anywhere on the network. Administrators can configure power failure settings and define UPS load segments for maximum uptime of critical servers.

Like Power Manager software, Power Protector can be used to configure extended runtimes for critical devices during utility power failures.

## Rack and Power Manager

This enterprise-class software provides comprehensive device control in data center environments where multiple users need to access and manage many devices, both locally and remotely.

A familiar browser interface provides secure remote access (up to 128-bit Secure Sockets Layer [SSL] encryption) to the management server anywhere on the network. Users can schedule system shutdowns, control power failure settings, and define UPS load segments to allow for maximum uptime of critical servers.

This software offers several new features, such as, the ability to configure redundant UPSs and system event handling, which allows users to establish power and environmental failure policies with programmed automatic responses.

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**INTERNET** The HP Rack and Power Sizer tool is available at:  
<http://www.hprackandpowersizer.com>

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## HP UPS Management Module



HP UPS Management Module

The HP UPS Management Module enables you to monitor and manage power environments through comprehensive control of HP UPSs. The UPS Management Module can support a single UPS configuration or it can be used to provide additional power protection to a dual-redundant UPS configuration for no single point of failure. The additional serial ports provide greater power management control and flexible monitoring.

The management module can be configured to send alert traps to HP Systems Insight Manager (HP SIM) and other Simple Network Management Protocol (SNMP) management programs, or it can be used as a stand-alone management system. This flexibility enables you to monitor and manage UPSs through the network. To facilitate day-to-day maintenance tasks, the embedded management software provides detailed system logs.

The HP UPS Management Module provides remote management of a UPS by connecting the UPS directly to the network. Configuration and management of the UPS is done through a standard web browser.

The management software is already embedded in the management module, eliminating the need for a management server. You can use this software to:

- Customize alerts
  - Send email notification messages
  - Send SNMP traps
- Monitor and manager UPSs
  - Manage independent UPS load segments to provide separate power control of connected equipment
  - Display text logs for analysis

## HP power distribution units



Monitored PDU

HP PDUs provide power to multiple objects from a single source. In a rack, the PDU distributes power to the servers, storage units, and other peripherals.

PDU systems:

- Address issues of power distribution to components within the computer cabinet
- Reduce the number of power cables coming into the cabinet
- Provide a level of power protection through a series of circuit breakers

### INTERNET

For more information about the HP power distribution unit portfolio, go to:  
<http://h18004.www1.hp.com/products/servers/proliantstorage/power-protection/pdu.html>

## PDU benefits

Benefits of the modular PDUs from HP include:

- Increased number of outlet receptacles
- Modular design
- Superior cable management
- Flexible 1U/0U rack mounting options
- Easy accessibility to outlets
- Limited three-year warranty

## HP 16A to 48A Modular PDUs

HP Modular PDUs have a unique modular architecture designed specifically for data center customers who want to maximize power distribution and space efficiencies in the rack.

Modular PDUs consist of two building blocks—the Control Unit (core) and the Extension Bars (sticks). The Control Unit is 1U/0U, and the Extension Bars mount directly to the frame of the rack in multiple locations.

Available models range from 16A to 48A current ratings, with output connections ranging from four outlets to 28 outlets.

## HP Monitored PDUs

The monitored vertical rack-mount power distribution units provide both single- and three-phase monitored power, as well as full-rack power utility ranging from 4.9 kVA to 22 kVA. Available monitored PDUs include:

- Full-rack models with 39 or 78 receptacles and half-rack versions
- Three-phase models with 12 C-19 receptacles
- Single-phase models with 24 C-13 and 3 C-19 receptacles

## HP Intelligent PDUs

Using the popular core-and-stick architecture of the HP Modular PDU line, the HP Intelligent PDU provides monitoring of power consumption at the core, load segment, stick, and outlet level, with unmatched precision and accuracy. Remote management is built in. This PDU offers power cycle ability of individual outlets on the Intelligent Extension Bars.

HP is the first to incorporate Intelligent Power Discovery. When combined with the HP line of Platinum-level high-efficiency power supplies, the Intelligent PDU actually communicates with the attached servers to collect asset information for the automatic mapping of the power topology inside a rack. This capability greatly reduces the risk of human errors that can cause power outages.

## HP Modular Cooling System G2



Modular Cooling System G2

The HP Modular Cooling System (MCS) is a self-cooled rack for high-density data center deployments. This new cooling technology enables deployment of up to 30kW in a single rack. It is designed to aid existing data center cooling by allowing the addition of computing power without increasing the current heat load in the data center.

The MCS helps to support hardware densities and power consumption levels that have previously been difficult to cool. With three times the kilowatt capacity of a standard rack, the MCS considerably extends the life of the data center.

Standard features of the MCS G2 include:

- Supports cooling two HP 42U racks at a time at 17.5kW per side or 35kW in a single rack
- 35kW of cooling capacity, up from 30kW
- Six hot-swappable high-airflow fans
- High-air-flow heat exchanger with bidirectional air distribution
- Configure to Order (CTO) capability of up to 2000 lb dynamic load for both the standard MCS G2 rack as well as the MCS G2 Expansion rack
- Support for a second rack with the MCS G2 Expansion rack
- Automatic door opening system

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**Note**

The automatic door opening system for both racks ships standard with every MCS G2. The automatic door opening mechanism is not CTO-capable and therefore ships in the accessories box to be installed on-site.

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- 42U rack height (2 meters) and 1.5 racks wide to maintain a data center tiling configuration
- Environmental Monitor with SNMP integration to HP SIM
- Power Input Redundancy for dual power sources
- Condensate evacuation system to prevent condensation from entering the air stream



## HP Data Protector Express

Keeping all the data safe is one of the top priorities of an administrator. HP Data Protector Express is one of the software components that can be used for this purpose.

Data Protector Express is backup and recovery software that is:

- Easy to install, easy to use, and easy to manage
- For organizations with limited IT resources
- Simple, yet robust
- For single machines and small networks
- For backup to disk, tape, and CD/DVD
- For Microsoft Windows, Linux, and Novell NetWare
- Attractively priced with HP support included

### Key features of Data Protector Express

Data Protector Express 5.0 offers the following features.

#### **Radically simple and all-inclusive massive value licensing scheme**

- Each server license includes all the functionality of Data Protector Express, unlike other backup and recovery software products that require understanding of a complex list of options. Every feature is included, so there is no need to purchase option licenses to enable advanced features, extend capacity, or add application integration.
- Customers purchase a license for each server to be protected, and they can stack additional licenses as needed. Licenses are sold in packs of 1, 3, and 10.
- The software provides protection for an unlimited number of Windows XP, Windows Vista, or Windows 7 machines.

#### **Network backup and centralized management**

- Each licensed machine joins the Data Protector Express Backup Domain to enable centralized management.
- All machines in the Backup Domain can be backed up using a single job, or multiple jobs can be created to meet the needs of different applications and data sets.
- All backup resources are visible and available to all machines in the Backup Domain.

### **Online application backup**

- Any licensed server running Microsoft Exchange Server or Microsoft SQL Server can be backed up without taking the application offline.
- Integration with Exchange and SQL Server removes the need for a backup window and enables various recovery options.
- Exchange can be recovered using Recovery Storage Groups, which enables the recovery of individual mailboxes without restoring the entire Exchange database.

### **Flexible backup device location, management, and sharing**

- Any backup device in the Data Protector Express Backup Domain is visible and accessible to all machines in the Backup Domain, and any machine can act as a local media server for high-performance backups or as a network media server for consolidated backups.
- Support for multiple-drive and multiple-slot backup targets (tape libraries, virtual tape libraries, and Data Protector Express Virtual Libraries) can be configured using the precise number of drives and media slots to meet backup needs, rather than to match the drive and slot licensing of the backup software.
- Automatic device discovery easily identifies available backup targets.

### **Simplicity, designed specifically for smaller organizations**

- The software is easy to install, expand, license, and manage, without training. The simple GUI provides the same view of the entire Data Protector Express Backup Domain, no matter which machine it is run on.
- A small number of powerful wizards is provided for the most common tasks.
- Predefined and customizable media rotation schemes make backup versions, recovery points, and media easy to manage.

### **Backup to disk**

- A Data Protector Express Virtual Library makes it easy to configure any available disk to be used as a backup target.
- The software supports backup-to-disk backup appliances such as the HP D2D Backup Systems for integration with services such as backup data deduplication and replication.
- You can easily integrate disk backup to tape using the D2Any2Any feature.

### **High-frequency, high-performance, automated backup**

- Automatic backups can be scheduled for each year, month, week, day, hour, or even each minute, in conjunction with a disk backup target or tape library, to manage exposure to data loss.
- The self-tuning parallel backup streams feature can multiplex up to eight concurrent data streams per device to keep high-performance backup devices streaming.
- The high-performance catalog scales as environments grow.

### **Backup data encryption**

- Support for hardware-based data encryption devices such as HP LTO 4 Ultrium, HP LTO 5 Ultrium, and HP DAT 320 tape drives is included.
- Data Protector Express software data encryption, for devices without data encryption, uses a configurable-length encryption key to manage the processor load. The encryption is easy to use—just a passphrase is entered, which is then combined with other parameters to create strong encryption keys that are managed by Data Protector Express.

### **Multitier backup and recovery (D2Any2Any)**

- The benefits of using disk or tape as backup targets are complementary.
- The D2Any2Any feature backs up to disk with an automated copy of backup data to tape. You can configure rotation schemes to retain backup data on disk for days or weeks and to retain the copy on tape for months or years.
- Direct recovery from tape is possible when the recovery of older data is required.

### **Automated disaster recovery**

- IT can quickly become productive again after a disaster or failure.
- The disaster recovery process returns the system to the state of the last full backup without requiring a reinstallation of the operating system, applications, service packs, and patches.
- You can use CD/DVD media as boot media, or you can use tape-based recovery, leveraging the HP One-Button Disaster Recovery feature of HP tape products on HP ProLiant servers running Windows or Linux.

## Operating systems supported with Data Protector Express 5.0

Operating systems supported with Data Protector Express 5.0 include:

- Microsoft Windows Server 2008 R2 (Enterprise, Standard, Foundation, Web Server)
- Microsoft Windows Server 2003 R2 SP2 (all editions)
- Microsoft Windows Small Business Server 2008 R2
- Microsoft Windows Enterprise Business Server 2008 R2
- Microsoft Windows Small Business Server 2003 R2 SP2
- Microsoft Windows Unified Data Storage Server 2003 R2 SP2
- Microsoft Windows Storage Server 2003 R2 SP2
- Red Hat Enterprise Linux (WS/ES/AS) 5.5
- Red Hat Enterprise Linux (WS/ES/AS) 4.8
- SUSE Enterprise Linux 11
- SUSE Enterprise Linux 10.2
- NetWare 6.5 SP8

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## Learning check

1. The \_\_\_\_\_ option for an uninterruptible power supply (UPS) functions as an extra battery for the UPS.
2. What are the two essential building blocks of a modular power distribution unit (PDU)?

.....  
.....

3. List three key features of HP Data Protector Express 5.0.

.....  
.....  
.....

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### Objectives

After completing this module, you should be able to:

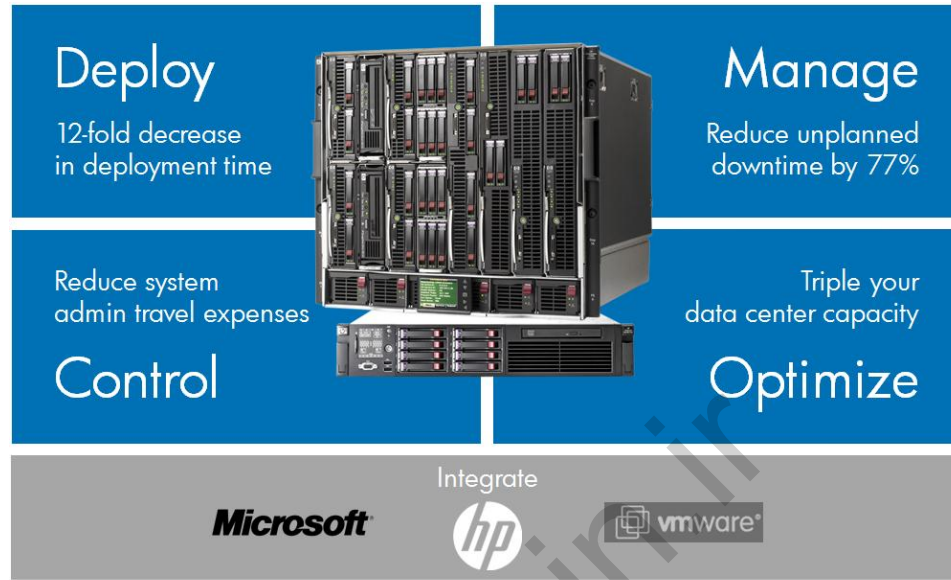
- Describe HP Insight Control 6.x components and its hardware and software requirements
- Describe the basic features of HP Systems Insight Manager (HP SIM)

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## Insight Control components

Insight Control 6.x is a comprehensive management tool that helps to deploy servers and manage different aspects of your IT environment, including power and cooling and fault management.

### Insight Control introduction



The graphic features a central image of an HP server rack. It is divided into four quadrants by a white cross:

- Top-Left (Deploy):** 12-fold decrease in deployment time
- Top-Right (Manage):** Reduce unplanned downtime by 77%
- Bottom-Left (Control):** Reduce system admin travel expenses
- Bottom-Right (Optimize):** Triple your data center capacity

At the bottom, a grey bar contains the text "Integrate" above the logos for Microsoft, HP, and VMware.

[www.hp.com/go/insightcontrol](http://www.hp.com/go/insightcontrol)

Insight Control management portfolio

Delivered on DVD media, Insight Control uses an integrated installer to deploy and configure HP SIM and essential infrastructure management software rapidly and consistently, reducing manual installation procedures and speeding time to production. It enables complete lifecycle management for the HP ProLiant, HP BladeSystem infrastructures and HP Integrity servers. HP Insight Control:

- Brings a single, consistent management environment for rapid deployment of the operating system and hardware configuration
- Includes full capabilities to migrate complete servers to new servers, supporting conversion from physical to virtual and vice-versa, and conversion between different virtualization environments

Provides proactive health and performance monitoring, power management, performance analysis, Lights-Out remote management, and virtual machine management



Insight Control also extends the functionality of Microsoft System Center and VMware vCenter Server by providing seamless integration of the unique ProLiant and BladeSystem manageability features into these management consoles.

Insight Control is available for ProLiant ML/DL 300, 500, 700, 900 series servers and BladeSystem solutions.

## Insight Control server deployment

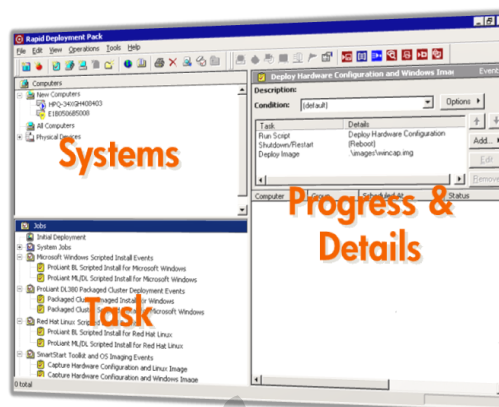
Save >65% in deployment time

### Core capabilities

- Configure once, deploy many times
- Integration with HP SIM; integral part of Insight Control
- Ready to run for HP ProLiant & Integrity servers (Windows & Linux)
- Also supports Microsoft System Center OS Deployment

### Key benefits

- Save >65% in deployment time
- Consistent processes and results
- Easy, fast and fool-proof install and upgrade of the CMS



The only deployment tool for HP servers that is **ready-to-run out of the box**, fully tested, supported and has a proven track record of **saving valuable customer time** during setup and operation

Insight Control server deployment benefits and capabilities

HP Insight Control server deployment is a complete deployment solution for ProLiant and HP Integrity servers. HP Insight Rapid Deployment software automates the process of deploying and provisioning server software, enabling companies to quickly and easily adapt to changing business demands.

Insight Control server deployment includes the ProLiant Integration Module (PIM) and Integrity Integration Module (IIM), which consist of software optimizations for HP servers, such as:

- HP scripting toolkits
- Configuration jobs for the leading industry-standard operating systems
- Sample unattended files
- HP server support packs that include software drivers, management agents, and important documentation

Insight Control server deployment provides a choice between a Microsoft Windows-based and a web-based management console. Both consoles both have an intuitive user interface, making deployment of a server or multiple servers easy and consistent. You can deploy servers through imaging or through scripting.

Insight Control server deployment is hosted on a Windows server and is intended for heterogeneous environments deploying Windows, Linux, VMware ESX, and Microsoft Hyper-V systems.

## Insight Control server migration

### Migrate your existing server to a new physical or virtual server - fast, easy and with confidence

**Core Features**

- Migrations from any x86 server to an HP ProLiant server
  - Source : any x86 server or VM
  - Destination: HP ProLiant or VM
- Heterogeneous virtualization platform migrations: VMware ESX, Microsoft Hyper-V and Citrix XenServer

**Key Benefits**

- Migrations are automated, accurate, affordable, and simple to use
- Confidently upgrade to new HP servers: migrates OS, apps, data and injects correct drivers

Insight Control server migration features

Insight Control makes it easy to upgrade or replace existing servers or to implement virtualization. It enables you to replicate a well-functioning, but underperforming or overprovisioned, server to a new physical or virtual server in an automated, accurate, and affordable way.

Until now, customers wanting to replace an existing server had to deploy a new server from scratch; that is, they had to load the drivers, install the operating system and applications, and transfer the data to the new server. Customers who have tried this with off-the-shelf ghosting products typically find that the process of capturing the image from an existing server and loading it onto a new server is filled with errors, often requiring several man-hours to troubleshoot. Insight Control server migration eases the complexity by automating the migrations from old servers to new ProLiant servers or virtual servers.

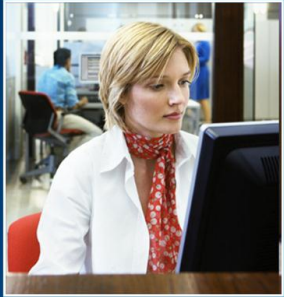
With Insight Control, you can perform physical to ProLiant (P2P), virtual to ProLiant (V2P), physical to virtual (P2V), or virtual to virtual (V2V) migrations from a single integrated user interface. From the Insight Control console, you simply identify the source server, identify the target server, and start the migration.

Migrations from any x86 server, regardless of vendor, to the latest HP ProLiant or BladeSystem server technologies are supported. This functionality supports migrations between virtualization environments from VMware, Microsoft, and Citrix.

During the migration process:







- Insight Control Checks the integrity of the source and target servers
- Automatically migrates the operating system, applications, and data from a source server to a new ProLiant or virtual server
- Injects the correct drivers required for the new server

## Manage health proactively



HP Systems Insight Manager

- Monitor devices continuously
- Manage inventory and contracts
- Track and update system software
- Easy integration with home-grown tools
- Role based access

**Insight Control users see real results**

- Server to administrator ratio doubled
- Administration costs declined by 29%
- Downtime reduced 77%

Source: IDC, "Gaining Business Value and ROI with HP SIM"

**Easiest, simplest and least expensive way for HP system administrators to maximize system uptime and health**

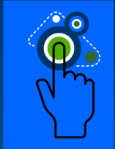
### Health management features

HP SIM is the clear choice for managing HP servers and storage because it is the easiest, simplest, and least expensive way for system administrators to maximize system uptime and health.

Advantages of HP SIM include:

- Provides the easiest-to-use single software tool to manage HP servers and storage
- Delivers a consolidated view of everything you need to manage your HP infrastructure—physical and virtual—from anywhere
- Automates repetitive tasks to help reduce errors and improve IT staff efficiency
- Provides an easy-to-use interface that enables administrators to view HP SIM and plug-ins as one tool
- Optimizes system uptime and health
- Provides proactive discovery, monitoring, and problem alerting to increase service levels
- Helps you to proactively avoid problems and streamline problem resolution to reduce downtime
- Helps to reduce the number of incidents and the impact of failures
- Provides the foundation for managing HP platforms and support services, plus it extends to the Operations Center
- Improves administrator productivity by providing the same base management platform for all HP servers and storage
- Provides the ability to automatically retrieve and download warranty and contract details

## HP Insight Remote Support

 <h3>HP Insight Remote Support</h3> <ul style="list-style-type: none"> <li>– Remote support diagnostics are accurate almost 100% of the time.</li> <li>– Issue resolution times reduced by 20% on average</li> </ul>	
<h3>HP Insight Remote Support Standard (HP Insight RSS)</h3> <ul style="list-style-type: none"> <li>– Ideal for small to mid-size environments with <b>little or no IT staff</b></li> <li>– Key Functionality:             <ul style="list-style-type: none"> <li>• Basic remote monitoring,</li> <li>• Notification/advisories</li> <li>• Dispatch</li> </ul> </li> </ul>	<h3>HP Insight Remote Support Advanced (HP Insight RSA)</h3> <ul style="list-style-type: none"> <li>– Mid-size to large environments with dedicated IT staff</li> <li>– Integrated with HP Systems Insight Manager (SIM)</li> <li>– Key Functionality:             <ul style="list-style-type: none"> <li>• All HP Insight RSS functionality, plus comprehensive product coverage, fault analysis, warranty / contract information, and proactive capabilities for HP Mission Critical Services customers</li> </ul> </li> </ul>

HP Insight Remote Support features

The HP Insight Remote Support Software is a portfolio of infrastructure software that automatically provides secure remote support for HP servers and storage, 24 x 7, so your customers can spend less time solving IT problems and more time focused on their business. Systems can be remotely monitored for hardware failure using secure technology that has been proven at thousands of companies around the world. In many cases, you can avoid server problems before they occur.

HP Insight Remote Support Standard (Insight RSS) is the ideal solution for small to mid-size environments with little or no IT staff. Insight RSS is easy to install, works automatically without a console, and does not require a dedicated server. It is included at no additional cost as part of an HP warranty, HP Care Pack Service, or HP contractual support agreement. Insight RSS helps you to do more with less.

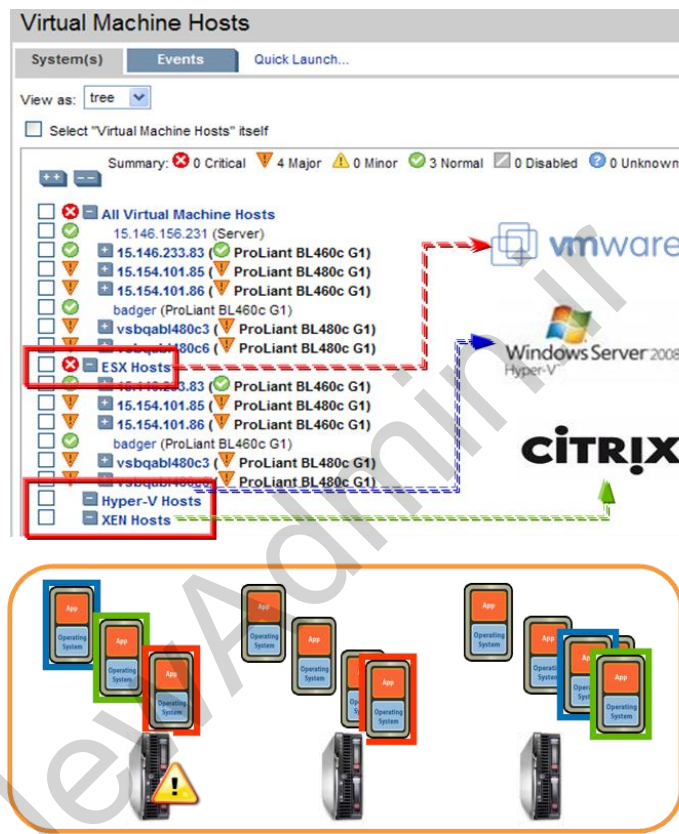
By integrating 24 x 7 secure, remote, and automated monitoring, with event notification and service dispatch through HP or local partners, Insight RSS provides:

- Remote monitoring so you gain control all of the time
- Automated notification every time so you can do more with less
- Automatic resolution in less time so your business stays up and running

Insight RSS requires access to an encrypted outbound initiated Internet connection (HTTPS/443) only. This secured Internet technology is considered acceptable within the security policies of most companies. For customer IT environments with up to 10 servers, HP recommends installing and using Insight RSS. If the customer has 11 to 50 servers with limited IT staff, HP recommends using HP Insight RSS, unless the customer prefers using HP SIM and the more advanced HP Insight Remote Support Advanced. When a customer environment grows more complex, it is easy to migrate from HP Insight RSS to support through HP SIM.

The HP Insight Remote Support Advanced is the comprehensive remote support software product in the HP Insight Remote Support software portfolio. It is ideal for use in mid-sized to large IT environments, where customers require a local management console. Incremental to the Insight RSS features, Insight RSA provides comprehensive remote support, including fault diagnostics, prefailure advisories, warranty, and service status. It has a console that is integrated with the HP SIM central management server console. The console allows the skilled IT operator to set boundaries and thresholds of the IT environment to be remotely supported. For IT environments with 50 or more servers with technical IT staff, HP recommends using the HP Insight RSP with HP SIM.

## Insight Control virtual machine management



Virtualization overview

Insight Control significantly extends HP SIM capabilities to manage virtual machines. Insight Control seamlessly merges hardware and heterogeneous virtualization management of virtual machines running VMware ESX, Microsoft Hyper-V, Citrix XenServer, and Citrix Xen (on Red Hat Enterprise Linux [RHEL] and SUSE Linux Enterprise Server [SLES] environments).

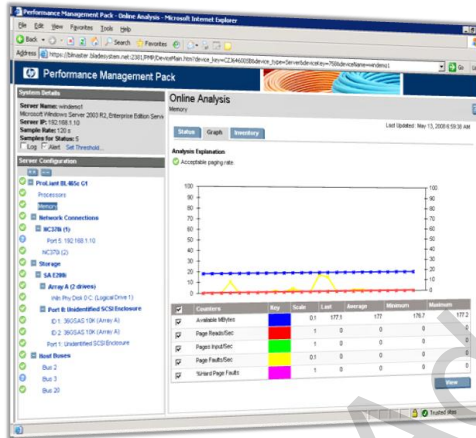
Insight Control enables you to get the most out of a unified physical and virtual server infrastructure. It is the only-out-of-the-box solution that can receive a predictive failure alert and automatically evacuate all virtual machines from a VMware ESX host server by initiating VMware Distributed Resource Scheduler.

Key virtual machine management features include:

- Provides associations between virtual machines and the physical host and integration into a single console. It enables all tasks to be run from the Insight Control console, leveraging existing discovery, identification and notification processes.
- Provides control functions for virtual machines in VMware ESX, Microsoft Hyper-V, Citrix XenServer, and Xen on RHEL and SLES from a central console that enables users to manage virtual machines in a consistent manner irrespective of the virtualization layer.
- Provides start, stop, pause, reset, move, copy, backup, create template, and restore functions for virtual machines remotely from the Insight Control console.
- Includes flexible move capabilities that support multiple usage scenarios.
  - In high-availability situations that do not allow service interruptions, Live Move can be used (for VMware ESX hosts only). Live Move initiates VMware vMotion technology from Insight Control (requires VMware vCenter).
  - Where flexibility is required to execute fast moves between dissimilar host hardware, storage area network (SAN)-based fast moves can be enabled (VMware ESX hosts only).
  - In high-availability situations, quick move capabilities can be used for HP integrated Citrix XenServer 5.0 or later (resource pool environment only) and Microsoft Hyper-V (Microsoft clusters only).
  - Where the virtual machine host is not connected to a SAN, a file-copy move can be used.
- Enables Failed Host Recovery situations when alternate hosts are assigned to virtual machines. If a host fails, you can quickly restart the virtual machine on a new host.
- Enables IT staff to make informed decisions about workload optimization with a single view of virtual machine and associated host server performance. You can set usage thresholds for CPU, memory, and disk usage and then proactively receive alerts in HP SIM when thresholds are exceeded so you can take corrective action.

- Enables you to automatically respond to predictive hardware failures on VMware ESX host servers by relocating virtual machines before a server fails, reducing downtime.
- Launches VMware vCenter or Microsoft System Center Virtual Machine Manager from Insight Control to perform tasks as needed. You can view VMware ESX host cluster and resource pool properties from VMware vCenter in the Insight Control console.
- Collects events from VMware ESX and VMware vCenter to use Insight Control as the central event consolidation and alerting tool.
- Enables the safe and orderly shutdown of VMware ESX hosts when the VMware Distributed Power Management decided to shut down VMware host for power-saving purposes. Insight Control communicates with VMware vCenter (and DPM) and prevents HP SIM from setting the host status to "critical."

## Insight Control performance management



Discover and resolve server performance bottlenecks based on resource usage, independent of server application

### Core capabilities

- Real-time, hardware-based performance bottleneck detection
- Suggestions for bottleneck resolution
- Server configuration anomaly reports
- Supports HP ProLiant and Integrity\* servers and MSA storage devices

### Key benefit

- Know about and solve performance bottlenecks before they impact productivity

Insight Control performance management benefits and capabilities

Insight Control detects, analyzes, and explains hardware bottlenecks on HP servers (Insight Control does not require Integrity servers to be licensed in order to provide the performance management functionality for Integrity servers). Insight Control provides the tools you need to receive proactive notification of building bottleneck conditions, and debug existing performance issues. The performance information is analyzed to determine if there is a building or existing performance bottleneck issue. You can interactively display this information, log the information to a database for later analysis or reporting, and set up proactive notification using the HP SIM notification mechanism.



## Insight Control Remote Management

**Nothing else is remotely close**

**You...**

**...your servers**

**Collaborate**

**Update**

**Control**

"Having to visit a remote server can easily cost \$500 to \$1,500 per incident. For many customers, iLO Advanced **pays for itself on first use.**"  
 —Jon Honeyball, President, Woodleyside IT Ltd

### Remote management benefits and features

Insight Control remote management, featuring HP integrated Lights-Out (iLO) Advanced, provides comprehensive Lights-Out remote management capabilities for ProLiant servers, including high-performance virtual keyboard, video, mouse (KVM) for routine and emergency remote administration, remote access to server power control and event logs, virtual media for simple deployment and update of remote servers, and single-server power measurement and regulation.

Insight Control helps distributed IT teams effectively collaborate to solve complex IT problems. The shared console capability allows up to four team members to view and share control of a single virtual KVM session. In addition, "console replay" captures and saves screen video to enable review of failure sequences and easily document complex configuration administrative tasks.

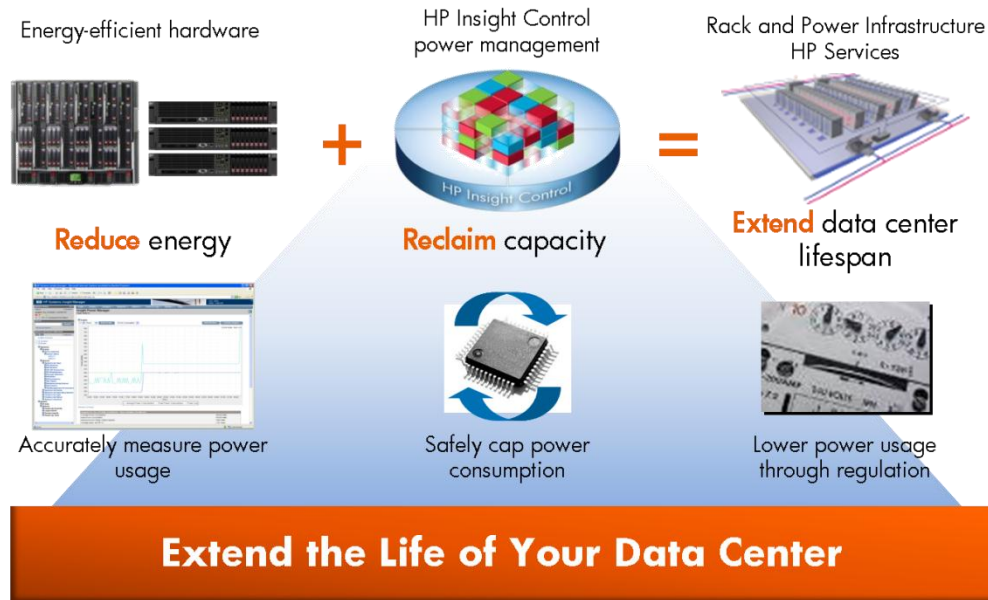
HP iLO Advanced remote management features include:

- Provides embedded hardware graphical remote console capabilities that can turn a supported browser into a virtual desktop, giving the user full control over the display, keyboard, and mouse of the host server. The operating system-independent console supports graphic modes that display remote host server activities, such as shutdown and startup operations. It works with a standard browser and no additional software is required on the remote server or client system.

- Provides the USB-based Virtual Media feature, which enables an IT administrator to boot the remote server using a standard 1.44MB diskette on the client machine, a DVD/CD drive or USB flash drive on the client machine, or the image of a diskette or DVD/CD from anywhere on the client network. After the remote server has booted a USB-capable operating system, the virtual device or ISO 9660 image is available as if it were a local USB device. The Virtual Media features save time and increase efficiency by eliminating the need to visit the remote server just to insert and use a diskette or DVD/CD. This feature enables administrators to carry out any of the following functions remotely from an applet user interface, command line, or script.
- Integrates with enterprise-class directory services to provide secure, scalable, and cost-effective user management. Directory services, such as Microsoft Active Directory and Novell eDirectory, can be used to authorize directory users with assigned user roles to iLO processors. With Active Directory, customers have the flexibility to integrate with or without a schema extension. An easy and reliable installation program is available to install a management console snap-in and extend an existing directory schema to enable directory support for the HP Lights-Out management products. A directory migration tool is available to automate setup for both methods of integration. Also supports the Active Directory nested groups feature.
- Provides advanced user authentication with two-factor authentication using digital certificates embedded on smartcards or USB flash drives. Using this form of strong authentication, iLO access can be restricted only to IT individuals possessing a certificate bearing smartcard or flash drive and a PIN.

The new generation of HP servers is equipped with iLO 3 cards.

## Insight Control power management



Power management components

Insight Control power management is an integrated power monitoring and management application that provides centralized monitoring and control of data center power consumption and thermal output. This software solution provides new energy instrumentation levers into HP SIM for greater infrastructure management, and it is compatible with any operating system residing on the managed server. The power management functionality provides efficient and effective tools needed to increase the capacity of a data center by reducing power and cooling requirements of ProLiant servers to an amount that accurately reflects the workload of the server. Built on ProLiant Power Regulator technology, it provides performance when you need it, and cost savings when you do not.

Key power management features include:

- Provides a central location where power and thermal data for tens, hundreds, or thousands of servers can be viewed and managed.
- Limits the server power consumption to an average level, so power capping can be set to minimize overall power consumption and heat output.
- Uses Dynamic Power Capping, which represents a significant advancement in power management. Unlike previous power capping technologies, Dynamic Power Capping safely limits power usage with no performance degradation and without risk to electrical infrastructure.
  - For single-rack servers, power caps applied through the iLO management processor will limit power usage to a specific Watt or Btu/hr level.
  - For enclosures of blades, users can set an enclosure level power cap, and the Onboard Administrator dynamically adjusts individual server power caps based on their specific power requirements.

By capping power usage at historical peak power usage instead of significantly higher face-plate, ROM burn, or power calculator default values, IT organizations can fit up to 36% more servers in their existing rack infrastructure.

- Summarizes key information for selected servers in an Analysis dashboard. The data displayed varies for each graph and includes total power consumed in kWh, the estimated costs of powering and cooling the selected servers, and the estimated costs saved through the use of policy-management based on HP Power Regulator technology.
- Supports taking action on the selected servers. Insight Control can change the HP Power Regulator settings on a single server or on multiple servers simultaneously. These actions can be executed immediately or scheduled to occur at a future time or on a recurring basis. Action scheduling can be used to set time-based power policies on single servers as well as collections of servers.

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## Hardware and software requirements

Insight software has some important hardware and software requirements. If any of the requirements are not met, the performance and software functionality might be limited.

### Insight Software server hardware requirements

This table presents hardware requirements for the server that will be used for the Insight Control installation.

Component	Specification
Server	HP ProLiant BladeSystem c-Class, HP ProLiant ML110 G7 or ML300 series server, HP ProLiant DL120 G7, DL300, DL500, or DL700 G3 or higher series server
Memory	Between 4GB-24GB (depends on the operating system and number of components installed)
Processor	At least 1.6 GHz (2 GHz or faster recommended). For Insight Dynamics, four or more processing cores are required with a minimum of 1.6 GHz processors. The recommended configuration is eight processing cores at 2.4 GHz or higher.
Disk space	Between 10GB-20GB
File system	NTFS
Optical drive	DVD drive local or remote

Insight Control hardware requirements

### Memory requirements

The maximum addressable memory space of a Microsoft Windows Server 2003 or 2008 x86 operating system is 4GB. For editions that support it, the Physical Address Extension (PAE) needs to be enabled to support minimum and recommended memory on x86 systems:

- On a Microsoft Windows Server 2003 Enterprise Edition operating system, edit the boot.ini file and add /PAE on a new line in the file and then reboot the Central Management Server (CMS).
- On a Microsoft Windows Server 2008 Enterprise Edition operating system, run the bcdedit.exe /set PAE ForceEnable command and then reboot the CMS.

## Disk space requirements

The amount of available disk space depends on the software products you select as well as the type of installation that is being performed (that is, a new installation of a product, an upgrade of an existing product, or reusing the same version an existing installed product).

If you are installing Insight software on an alternate drive (that is, not the system drive where the operating system is installed), the HP Insight Software Installer needs 8GB of temp space. The Installer looks in the User temp location, so if 8GB is not available, change the User temp variable to point to another location that has 8GB of available space.

When you are installing Insight software on an alternate drive, the system drive still needs at least 1GB of available disk space.

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**INTERNET**

For more information about hardware requirements, refer to the *HP Insight Software 6.x Support Matrix* available at:

<http://h20000.www2.hp.com/bc/docs/support/SupportManual/c02786379/c02786379.pdf>

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## Services

Some additional software components are required:

- Microsoft Internet Information Services (IIS) installed and running
- FTP service running on IIS (for Linux or VMware deployment)
- Acrobat Reader and Adobe Flash Player
- ASP.NET 1.1
- .NET 3.5 SP1 Framework (other versions might be also required)
- Simple Network Management Protocol (SNMP)
- Microsoft iSCSI Initiator
- Windows Automated Installation Kit (WAIK) 1.1
- TCP/IP, with Domain Name Service (DNS) installed
- Windows Installer 4.5

## Database

The supported database is a major Insight Control component. Currently, Insight Control 6.x supports one of the following database engines:

- SQL Server 2008 Standard and Enterprise SP1/SP2
- SQL Server 2005 Standard and Enterprise SP3/SP3
- SQL Server 2008 Express Edition SP1/SP2
- SQL Server 2008 R2 Express, Standard and Enterprise

Oracle and PolyServe are supported only by HP SIM.

## Web browser

The following web browsers are supported by Insight Control 6.x:

- Microsoft Internet Explorer 7.0 or 8.0
- Mozilla Firefox 3.x (server migration supports only 3.0)

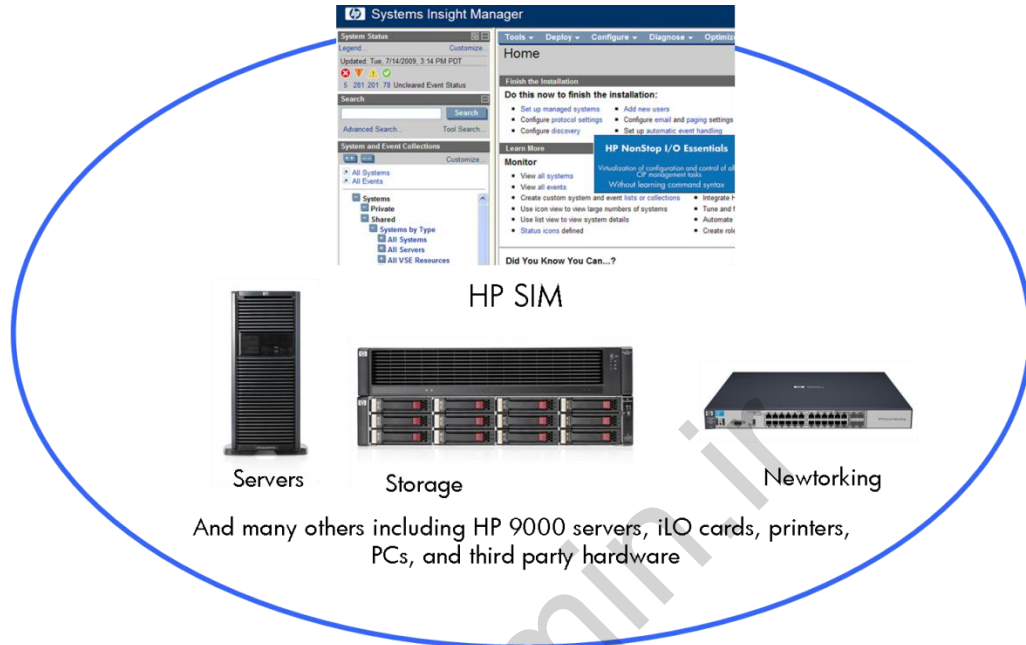
## Virtualization platform

Support for the virtualization in HP SIM includes HP SIM installation in a virtual machine and management of the virtual machines. For details, refer to the Insight software Support Matrix document.

# HP Systems Insight Manager

HP SIM is a free application that helps customers to manage their environment. HP SIM is a powerful tool that can be used to automate many processes, and even more importantly, provide information about hardware events in near real time.

## HP SIM overview



HP Systems Insight Manager diagram

HP SIM is the foundation for the HP unified server-storage management strategy. HP SIM is a hardware-level management product that supports multiple operating systems on HP ProLiant, Integrity, and HP 9000 servers and HP Storage Modular Smart Arrays (MSAs), Enterprise Virtual Arrays (EVAs), XP arrays, and third-party arrays. Through a single management view of Microsoft Windows, HP-UX 11i v1, HP-UX 11i v2, HP-UX 11i v3, and Red Hat, and SUSE Linux, HP SIM provides the basic management features of:

- System discovery and identification
- Single-event view
- Inventory data collection
- Reporting

The core HP SIM software uses Web-Based Enterprise Management (WBEM) to deliver the essential capabilities required to manage all HP server platforms. HP SIM can provide systems management with plug-ins for HP clients, storage, power, and printer products.



HP SIM can be installed on the Windows, Linux, and HP-UX operating systems. Basic functionality is the same for all versions, but the Windows version has the greatest scalability and expansion possibilities.

## HP SIM features

HP SIM represents the next generation of HP management technology. You can use HP SIM to diagnose system faults, execute performance and configuration management, and to facilitate system software maintenance throughout the server life cycle.

HP SIM is accessible through a web browser and provides seamless access to management information from several sources, ensuring that critical management information is available from any location that is accessible through a LAN, WAN, or secure remote connection.

Key features of HP SIM include:

- Easy and rapid installation
- Two user interfaces
- Automatic system discovery and identification
- Fault management and event handling
- Data collection and inventory
- Role-based security
- HP Version Control

## Easy and rapid installation

HP SIM can be installed in two ways:

- As a stand-alone application
- As a part of Insight software installation

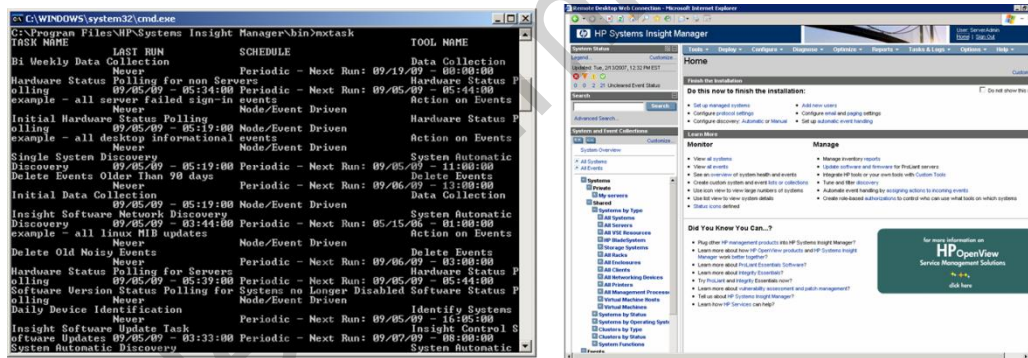
When installing HP SIM as a stand-alone product, no other optional licensed Insight software components are installed.

The second option is to install HP SIM using the Insight Software DVD. During this process, users can decide which management suite will be installed. HP SIM will be installed as a foundation of the HP management suite despite the management suite selection.

The configuration process will also be different for each type of installation. When installed as a stand-alone product, HP SIM must be configured after the first run. The First Time Wizard will appear when a user is logged in to HP SIM for the first time. This wizard must be completed before you can use HP SIM.

When HP SIM is installed using the HP Insight Software DVD, all configuration parameters are supplied before installation. The First Time Wizard will not run automatically, because there is an assumption that all parameters were supplied during the installation phase.

## Two user interfaces



HP SIM graphical interface and CLI

The HP SIM graphical user interface has been designed for information efficiency and ease of use. Extensive usability tests with HP-UX, Linux, and Windows administrators have enabled HP to design an interface that is easy to use yet powerful in the amount of detail that is easily located and quickly understandable.

HP SIM supports Secure Sockets Layer (SSL) encryption for secure communication between a browser and the web server, and an authentication module authenticates the user using native operating system authentication calls (PAM for Linux, Win32 for Windows). SSL communication provides secure remote access to HP SIM. Plug-ins can extend the user interface by adding new options to the HP SIM menu and new web applications to the engine.

## Accessing HP SIM

You can access HP SIM from using one of the following methods:

- Click the icon created on the desktop during installation
- Enter **https://<MachineName>:50000** in the browser address bar, where <MachineName> is the fully qualified DNS name of the CMS server

A command line interface (CLI) provides access to much of the functionality of HP SIM. Each CLI command is a separate executable with a set of parameters. Typically the executable is implemented in Java and communicates with the core system to perform the requested operation. CLI commands use the authorizations of the user logged in to HP SIM to perform these requests. Some administrators prefer to use the CLI for tasks such as exporting an HP SIM certificate or automating tasks. This requires access to the file system where HP SIM is installed.

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**INTERNET**

To access HP SIM Command Interface Guide and other HP SIM documentation, go to:

**<http://h18013.www1.hp.com/products/servers/management/hpsim/infolibrary.html>**

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## Automatic system discovery and identification

Discovery is the process of finding systems in the management domain so that they can be managed from the CMS by HP SIM. You can only perform discovery if you have administrative rights.

### Discovery

HP SIM can automatically discover and identify HP servers, desktops, clusters, workstations, and portables, as well as other SNMP, Distributed Management Interface (DMI), Storage Management Initiative Specification (SMI-S) and WBEM-instrumented systems attached to the network.

The discovery component is responsible for determining IP addressable systems on the network. This performs a ping sweep (ICMP echo) of defined subnets when the Internet Control Message Protocol (ICMP) discovery is selected. Any addresses that respond to the discovery sweep are queued for system identification. A user can also specify a list of systems to discover manually through a standard host formatted file or an Extensible Markup Language (XML) file.

Event-based automatic discovery is disabled by default. You can enable this feature during the configuration phase. Event-based automatic discovery adds any systems that send SNMP traps, WBEM indications, or other events to HP SIM that do not have a matching IP address in the database.

### **Identification**

Users can control the type of systems that are added to the HP SIM database. Enabling discovery filters prevents HP SIM from discovering unmanageable systems or systems that do not need to be managed. The system identification component is responsible for finding additional information about a given network address. The identification process for a system has three phases:

- SNMP, DMI, SMI-S, and WBEM management protocols are used to gather basic information from the system such as the type of system (server, workstation, or printer), and serial number.
- A filter is applied to discard any systems that are not required, based on the type of system.
- Associations are then built between systems using information from the supported management protocols. For example, management processors are associated with the containing server, virtual machines are associated with the virtual machine host, BladeSystem servers are associated with their rack (provided that the BladeSystem Management Processor is in the discovery range) and systems in a cluster are associated with the cluster.

The data gathered by identification is stored as attributes of the system objects in the database.

#### **Example**

Clusters can be discovered and displayed by name or members and server blades can be discovered and displayed by enclosure or installed server blades.

## Data collection

After HP SIM discovers, identifies, and polls a system, it attempts to perform initial data collection, which gathers information from systems to store in the database. Data collection uses DMI, SNMP, or both protocols to retrieve information, which provides a comprehensive profile on a system. Typically DMI is used to interrogate desktops and laptops, while SNMP is used for servers and other networking systems. When HP SIM discovers a system on the network, it attempts to identify the system with queries. The responses are compared to answers stored in the database to categorize the system.

To use a management application to monitor or control a system, an agent must interact with the system. The agent usually resides in the system RAM, but manufacturers can implement agents in different ways. For example, some routers implement the agent function in firmware.

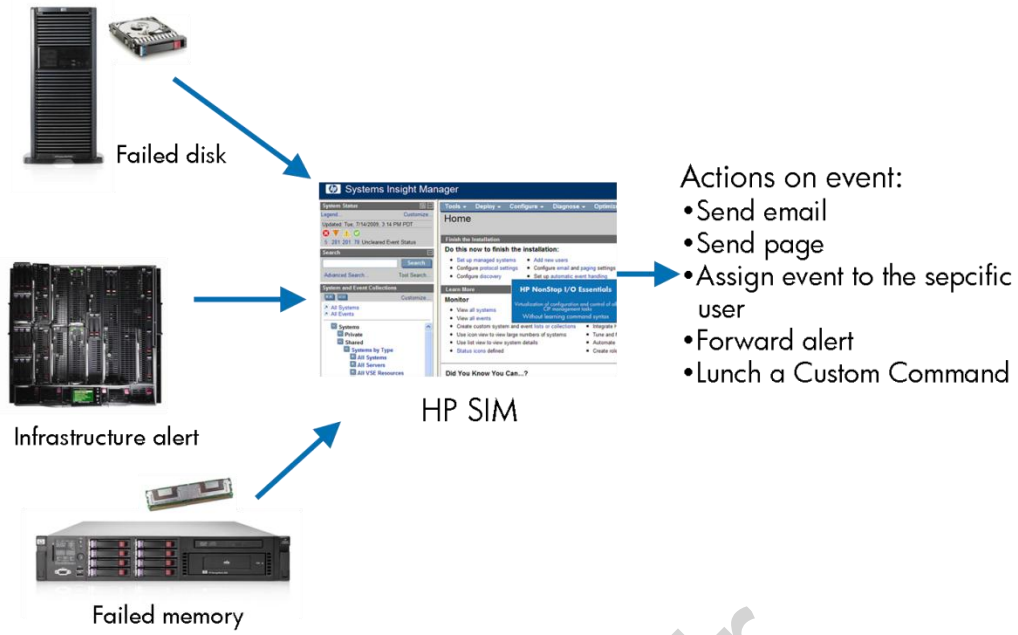
Before newly found systems are added to the database, any configured discovery filters are applied. Systems that do not match the discovery filter are not added to the database, and no additional requests are made to that system. When a system passes the filter, it is added to the database; and the system is available to any polling tasks, views, or configuration operations.

## Polling tasks

HP SIM has multiple tasks built-in. Two major status polling tasks are:

- **Hardware Status Polling task**—This task checks communication with all devices discovered by HP SIM. Servers are checked with the default interval of 5 minutes. Non-server devices are checked every 10 minutes.
- **Software Status Polling task**—All servers that have Version Control Agent configured provide software status to HP SIM once per week. The current software status is indicated in the Software (SW) column in HP SIM.

## Fault management and event handling



Fault management with automatic event handling

Managed systems can send alerts to the CMS through:

- SNMP traps or notifications
- WBEM and DMI indications
- HTTP events

HP SIM components can also generate their own alerts. Each alert is formatted and logged in the database with an associated time stamp and severity. Managed systems might need to be configured to send appropriate alerts to the CMS, which requires configuring the SNMP trap destination and community name. Windows Management Instrumentation (WMI) does not send indications. HP SIM provides a component to configure the managed system Common Information Model Object Manager (CIMOM) to send specific indications to the CMS.

Queries are based on stored alerts and generate tasks. HP SIM provides an alert viewer to display logged alerts. Alerts can also be sent as an email or pager message or assigned to a specific HP SIM user. Automatic event handling features can also be used to run a custom command or script as a response for a specific alert. Combinations of these functions are also supported.

### Example

When a specific event is received by HP SIM, appropriate information can be sent to the pager of an administrator and a custom script can be run on the system at the same time.

## Role-based security

<input type="checkbox"/>	Toolbox	↑	Enabled	Description
<input type="checkbox"/>	All Tools		Yes	Master toolbox added automatically
<input type="checkbox"/>	AMC Tools		Yes	Toolbox for AMC links access
<input type="checkbox"/>	Full Rights		Yes	Full Rights toolbox added automatically
<input type="checkbox"/>	HPIC		Yes	HPIC Tools
<input type="checkbox"/>	iLO Tools		Yes	toolbox for iLO links access
<input type="checkbox"/>	Limited Rights		Yes	Limited Rights toolbox added automatically
<input type="checkbox"/>	Monitor Tools		Yes	Monitor toolbox added automatically

Toolbox creation screen

Security in HP SIM is based on the role of the user in the system. Two components build the access control system:

- **Toolboxes**—Contain a specific set of tools and functions from HP SIM. Administrators typically have access.
- **Authorizations**—Associations of users, systems, and toolboxes. Authorizations determine to which systems a specific user can have access and which tools (Toolboxes) he can run on a managed system. You can also determine when a specific user can run these tools on a managed system.

HP SIM enables you to configure authorizations for specific users or user groups. Authorizations give the user access to view and manage systems. Each authorization specifies a user or user group, a toolbox, and a system or system group.

A specific set of tools can be run on a system that is specified in the assigned toolbox. It is important that you plan which systems each user will manage and which specific set of tools each user is authorized to execute on managed systems. A user with no toolbox authorizations on a particular system cannot view or manage that system.

Authorizations are cumulative. If a user is authorized for both Toolbox1 and Toolbox2 on the same system, the user is authorized for all tools in both Toolbox1 and Toolbox2 on that system. Similarly, a user authorized for the All Tools toolbox on a system requires no other toolbox authorizations on that system because the All Tools toolbox always includes all tools.

The following toolboxes are created during installation:

- The All Tools toolbox contains all tools in the CMS.
- The Monitor Tools toolbox contains tools that display the state of the managed systems but not tools that change the state of the managed systems. For example, the Monitor Tools toolbox permits viewing installed software but does not permit installing software.
- The Full Rights toolbox contains all tools in the CMS.
- The Limited Rights toolbox contains only the create and edit reports and tools.
- When HP Storage Essentials is installed, a Toolbox for Storage Essentials tools is added to this page. See your HP Storage Essentials documentation for more information.

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# HP Version Control

**Software Status**

**Overall Software Status:** ▲

**Reference Support Pack:** [ProLiant Support Pack for Microsoft Windows Server 2003 version 8.25A \(English \(US\), Japanese\)](#)

**Installed Software**

Name	Installed Version	Support Pack Version	Latest Version
HP Insight Management Agents for Windows Server 2003/2008	8.20.0.0	<span style="color: yellow;">▲</span> <a href="#">8.26.0.0</a>	<span style="color: yellow;">▲</span> <a href="#">8.26.0.0</a>
ATI ES1000 Video Controller Driver for Windows Server 2003	6.14.10.6744	<span style="color: yellow;">▲</span> <a href="#">6.14.10.6746</a>	<span style="color: yellow;">▲</span> <a href="#">6.14.10.6746</a>
HP ProLiant Smart Array SAS/SATA Event Notification Service for Windows Server 2003 and Windows Server 2008	6.12.0.32	<span style="color: yellow;">▲</span> <a href="#">6.14.0.32</a>	<span style="color: yellow;">▲</span> <a href="#">6.14.0.32</a>
HP ProLiant Array Configuration Utility for Windows	8.25.5.0	<span style="color: yellow;">▲</span> <a href="#">8.28.13.0</a>	<input checked="" type="checkbox"/> <a href="#">8.28.13.0</a>
HP ProLiant Integrated Lights-Out Management Interface Driver for Windows Server 2003/2008	1.14.0.0	<input checked="" type="checkbox"/> <a href="#">1.14.0.0</a>	<input checked="" type="checkbox"/> <a href="#">1.14.0.0</a>
HP ProLiant Integrated Management Log Viewer for Windows	5.22.0.0	<input checked="" type="checkbox"/> <a href="#">5.22.0.0</a>	<input checked="" type="checkbox"/> <a href="#">5.22.0.0</a>
HP ProLiant Remote Monitor Service for Windows Server 2003/2008	5.21.0.0	<input checked="" type="checkbox"/> <a href="#">5.21.0.0</a>	<input checked="" type="checkbox"/> <a href="#">5.21.0.0</a>
HP Network Configuration Utility for Windows Server 2003	9.50.0.0	<span style="color: yellow;">▲</span> <a href="#">9.60.0.0</a>	<input checked="" type="checkbox"/> <a href="#">9.60.0.0</a>
HP ProLiant Array Configuration Utility (CLI) for Windows	8.25.5.0	<span style="color: yellow;">▲</span> <a href="#">8.28.13.0</a>	<input checked="" type="checkbox"/> <a href="#">8.28.13.0</a>
HP ProLiant Array Diagnostics Utility	8.25.5.0		
HP ProLiant Smart Array SAS/SATA Controller Driver for Windows Server 2003	6.14.0.32	<input checked="" type="checkbox"/> <a href="#">6.14.0.32</a>	<input checked="" type="checkbox"/> <a href="#">6.14.0.32</a>
HP Insight Diagnostics Online Edition for Windows Server 2003/2008	8.2.0.3058	<span style="color: yellow;">▲</span> <a href="#">8.2.5.3157</a>	<span style="color: yellow;">▲</span> <a href="#">8.2.5.3157</a>
High Precision Event Timer Identifier for Windows Server 2003	1.0.1.0	<input checked="" type="checkbox"/> <a href="#">1.0.1.0</a>	<input checked="" type="checkbox"/> <a href="#">1.0.1.0</a>
HP Lights-Out Online Configuration Utility for Windows Server 2003/2008	2.1.0.1	<input checked="" type="checkbox"/> <a href="#">2.1.0.1</a>	<input checked="" type="checkbox"/> <a href="#">2.1.0.1</a>
HP ProLiant iLO 2 Management Controller Driver for Windows Server 2003	1.9.0.0	<span style="color: yellow;">▲</span> <a href="#">1.11.0.0</a>	<span style="color: yellow;">▲</span> <a href="#">1.11.0.0</a>

Version Control Agent view (configured)

Keeping track of current software versions can be a daunting task. With hundreds of possible Smart Components, HP ProLiant Support Packs (PSPs), and new revisions appearing daily, HP strives to provide software maintenance tools that integrate with various organizational models. These software maintenance tools are based on two components:

- Version Control Repository Manager (VCRM)
- Version Control Agent (VCA)

## Version Control Repository Manager (VCRM)

The practice of updating PSPs and components from a single or multiple repositories saves time and is important for standardizing software maintenance and update procedures on distributed systems. For maximum manageability and flexibility across operating system platforms, each repository that is created should conform to the following requirements:

- Located on a local drive with write access
- Updated automatically by the VCRM
- Managed by the VCRM

When a repository has been created, the repository must be populated with PSPs and components before being updated on the target HP servers. The easiest and most efficient way to update a repository is by using the automatic update feature of the VCRM. The automatic update feature of the VCRM enables you to schedule an automatic population of the repository. However, the repository can be updated using any of the following methods, or a combination of these methods:

- Using the automatic update feature of the VCRM
- Uploading the PSP feature of the VCRM, which allows users to easily copy PSPs from a SmartStart CD or other accessible media
- Manually downloading the software from the HP website into the repository
- Manually copying updates from the SmartStart CD, or any other available media that contains ProLiant updates

The combination of VCA and VCRM provides one-to-one deployment capability. One-to-one deployment refers to the ability of the VCA to update system software to a single system, such as BIOS, drivers, and agents. Administrators can use these web-based applications to browse to the target machine from a single screen. In addition, administrators can view and print a list of the installed software and new versions that are available from the VCRM.

## Version Control Agent

Version Control Agent (VCA) is the first step in using HTTP to automatically consolidate and integrate management data and display information on demand. The VCA is available for Windows and Linux operating systems. The VCA is an integrated part of the System Management Homepage (SMH) and is designed to display the available software inventory of the server on which it is installed. The VCA allows the installation, comparison, and update of server software from a repository that is managed by a Version Control Repository Manager (VCRM).

Users with administrator or operator privileges can access the VCA to maintain the software inventory of the server manually. The installation of components and configuration activities is logged to a log file at the server; however, installations performed outside the VCA are not displayed in this log.

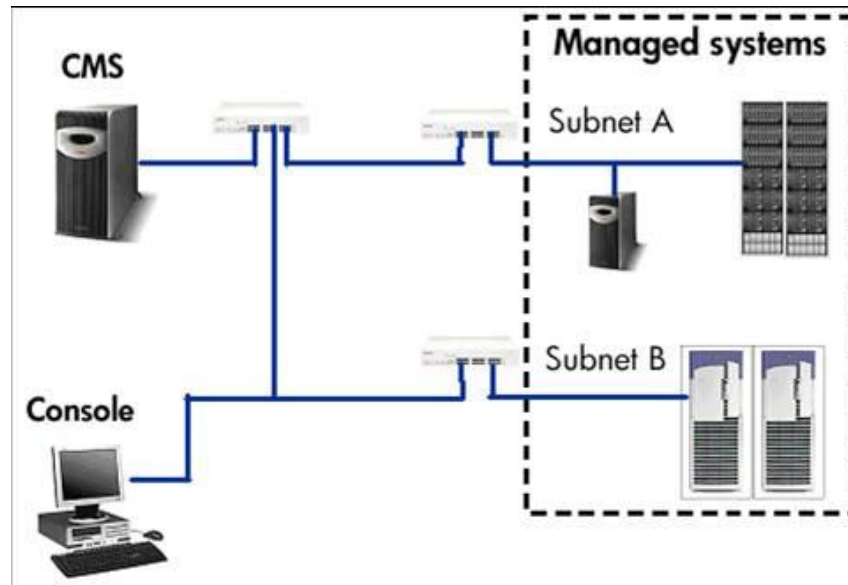
The VCA enables administrators and operators to perform the following tasks to maintain the software inventory of the server:

- View the currently installed software.
- Select a VCRM as a reference point for obtaining software updates.
- Select whether to use a Custom Software Baseline or PSP as a managed baseline.
- View whether any applicable updates are available in the version control repository.
- View the details associated with a Custom Software Baseline, PSP, or individual software component that is in the version control repository.
- Install a Custom Software Baseline, PSP, or individual software component from the version control repository.
- View and clear the VCA log.
- Configure the log to automatically delete older entries, reducing maintenance activity for administrators.
- Change the log settings.

In addition to maintaining the software inventory of the server, the VCA integrates with HP SIM. This integration enables administrators to take advantage of the software update capabilities of the agent.

When connecting the VCA agent to the machine where VCRM is installed, you cannot use the administrator account. It must be a user with a different login name. However, this user must still be in the Administrator group. The Administrator account was used with legacy VCRM, but for security reasons it cannot be used with the newest release.

## HP SIM architecture



HP SIM sample architecture

HP SIM is built from three major components:

- CMS
- Managed systems
- Management console

### Central Management Server

The CMS is a machine on which HP SIM (or whole Insight software product) is installed. This machine must meet specific prerequisites, which can be checked using Insight Control Advisor (when installing from Insight Software DVD).

A supported database is a main component of the CMS. All the data, events, hardware information, and so on are stored in the database. The supported database engines depend on the operating system (database support differs for Linux, HP-UX and Windows). Along with HP SIM, VCRM is installed to provide a software maintenance mechanism. After VCRM is installed, you must populate it.

## Management console

The management console is a machine from which you are accessing HP SIM. It is typically a laptop or a PC with one of the supported web browsers installed:

- Internet Explorer
- Mozilla

## Managed systems

Managed systems include all systems managed by HP SIM. If you want to manage a ProLiant server, it must have the SNMP protocol installed and properly configured.

This configuration involves the following steps:

- Configuring community strings (community strings on target machine must match community strings on the CMS)
- Setting the trap destination (it should be the HP SIM server, but multiple destinations can be configured)

Another required component is the HP Insight Management Agent and the System Management Homepage. The SMH enables you to access information from agents and to configure the Version Control Agent.

If you plan to perform remote software installations on target machines (for example, a PSP installation), OpenSSH should be installed on both the CMS and the target machine. This task can be performed from HP SIM after the server is properly discovered and identified.

## Software availability

HP SIM is a free product that can be downloaded from the HP website. Two download forms are available

- As a stand-alone product (HP SIM package or the Management CD)
- Through HP Insight software DVDs, which provide functionality in addition to HP SIM, such as the rapid deployment functionality

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**INTERNET**

To access HP SIM and other management products, go to:

**<http://hp.com/servers/manage>**

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## New features in HP SIM 6.3

New features added in HP SIM 6.3 include:

- Support for ProLiant ML110 G7 and DL120 G7 servers
  - 3PAR storage array discovery and identification
  - IDP/IBRIX discovery and identification
  - Matrix enclosure identification
  - Polyserve Support
- Federated CMS (multi-CMS search)
- Expose ping status for status polling
- Automatic retrieval of SAR field for contract and warranty report
- Field tools
- DMT support for migrations to 6.3

## Learning check

1. Which software component from HP provides real-time, hardware-based bottleneck detection?
  - a. Insight Control server migration
  - b. Insight Control performance management
  - c. Insight Control remote management
  - d. Insight Remote Support
2. Insight Control is supported on Windows Server 2000 Advanced.
  - True
  - False
3. Which two components are used to build an access control system? (Select two.)
  - a. Toolboxes
  - b. Power User accounts
  - c. Authorizations
  - d. Assignments
  - e. Access Control Lists

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## Objectives

After completing this module, you should be able to:

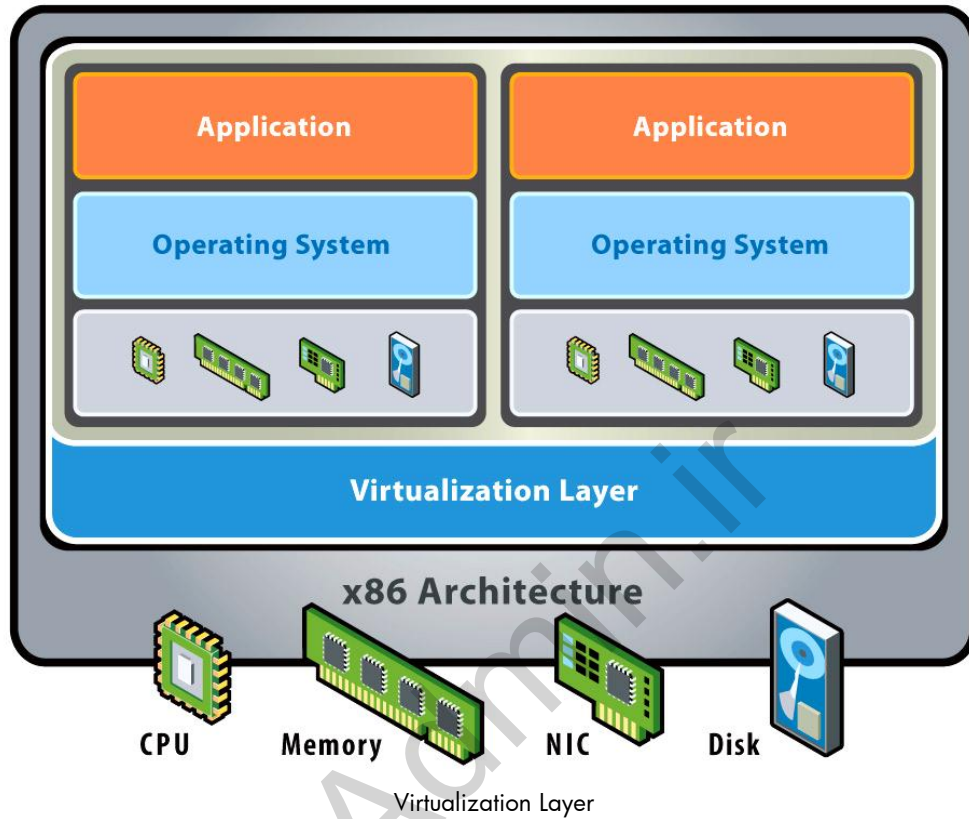
- Describe virtualization with VMware
- Explain virtualization with Citrix XenServer
- Describe virtualization with Microsoft products

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# HP ProLiant Virtualization with VMware

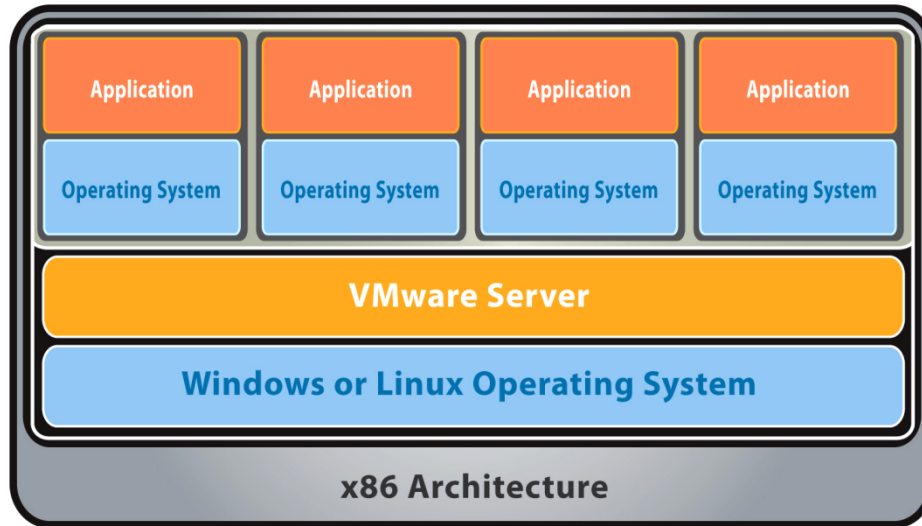
HP ProLiant server supports multiple virtualization solutions including VMware portfolio.

## How does virtualization work?



Virtualization is a proven software technology that is rapidly transforming the IT landscape and fundamentally changing the way that people compute. Today's powerful x86 computer hardware was designed to run a single operating system and a single application. This leaves most machines vastly underutilized. Virtualization lets you run multiple virtual machines on a single physical machine, sharing the resources of that single computer across multiple environments. Different virtual machines can run different operating systems and multiple applications on the same physical computer.

## Host operating system-based virtualization



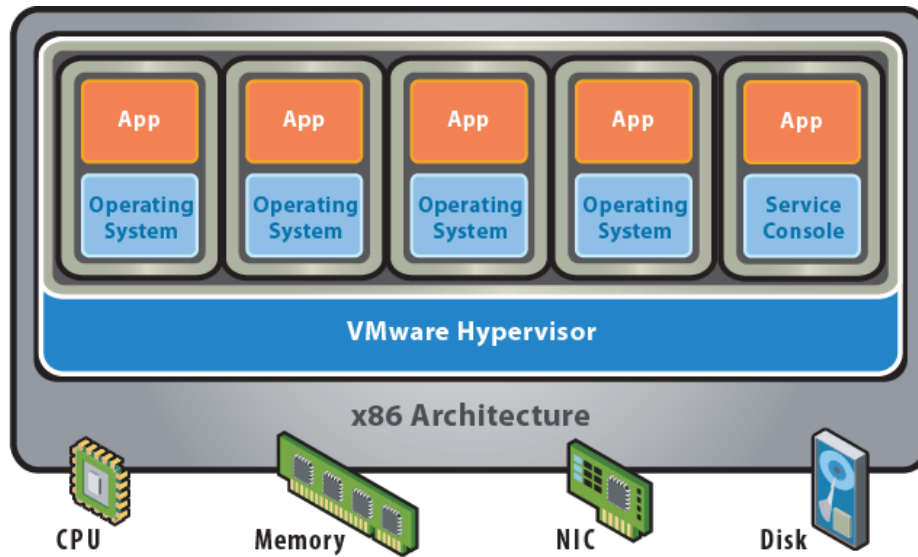
Host operating system-based virtualization

A host-based virtualization system requires an operating system (such as Windows or Linux) to be installed on the computer.

Install and run VMware Server as an application on top of a host Windows or Linux operating system. A thin virtualization layer partitions the physical server so you can run multiple virtual machines simultaneously on a single server. Computing resources of the physical server are treated as a uniform pool of resources that can be allocated to virtual machines in a controlled manner.

VMware Server isolates each virtual machine from its host and other virtual machines, leaving it unaffected if another virtual machine crashes. Your data does not leak across virtual machines and your applications can only communicate over configured network connections. VMware Server encapsulates a virtual machine environment as a set of files, which are easy to back up, move, and copy.

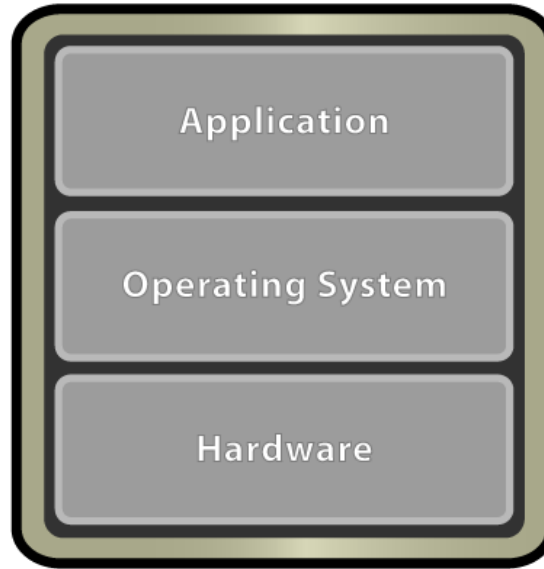
## Virtualization using a bare-metal hypervisor



Virtualization using a bare-metal hypervisor

Hypervisors are software systems that run directly on the host hardware as a hardware control and guest operating system monitor. A guest operating system therefore runs on another level above the hypervisor.

## What is a virtual machine?



Virtual machine

System virtual machines (sometimes called hardware virtual machines) allow the sharing of the underlying physical machine resources between different virtual machines, each running its own operating system. The software layer providing the virtualization is called a virtual machine monitor or hypervisor.

A hypervisor can run on bare hardware (Type 1 or native VM) or on top of an operating system (Type 2 or hosted VM).

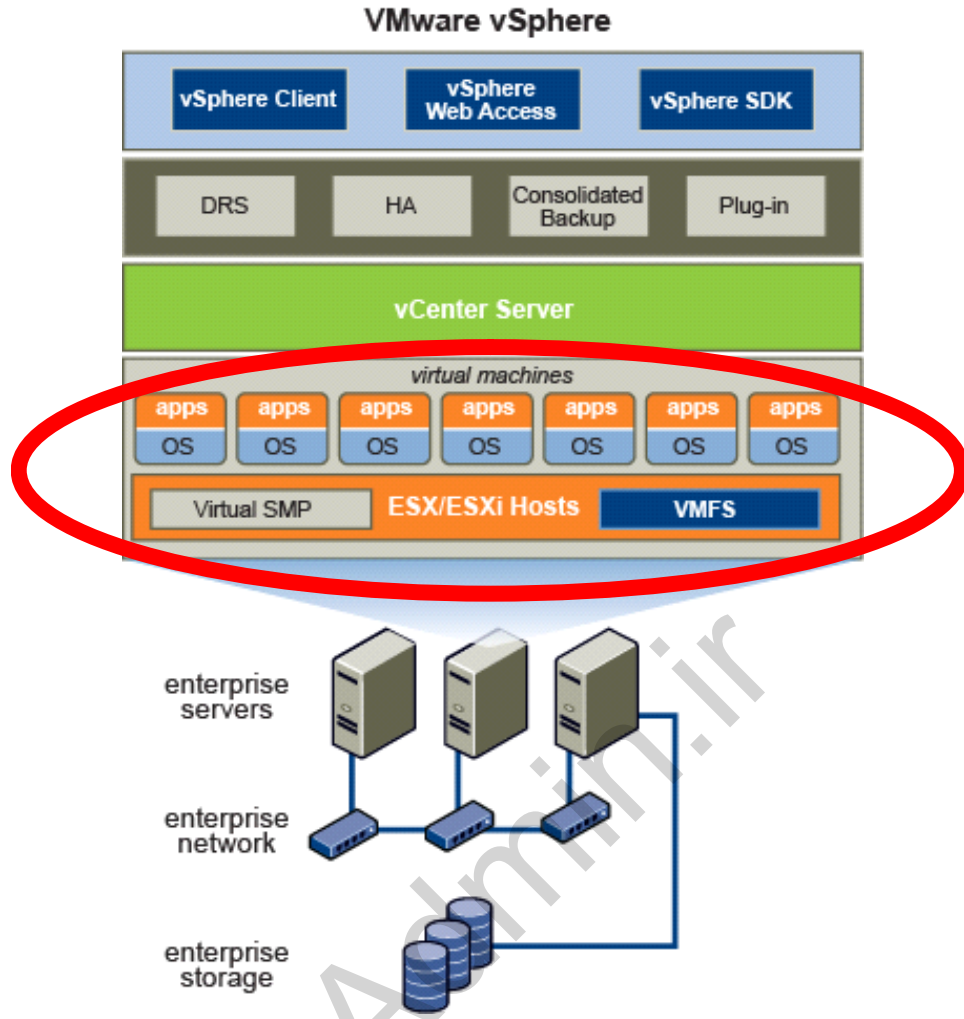
The main advantages of system VMs include:

- Multiple operating system environments can co-exist on the same computer, totally isolated from each other.
- The VM can provide an instruction set architecture (ISA) that is somewhat different from that of the real machine.
- The VM provides application provisioning, maintenance, high availability, and disaster recovery.

Virtual machines normally use a discrete set of files.

- Configuration file
- Virtual disk file
- NVRAM settings file
- Log file

## VMware ESXi: Virtualization platform



VMware ESX/ESXi: Virtualization platform

VMware ESXi provide a virtualization layer that abstracts the processor, memory, storage, and networking resources of the physical host into multiple virtual machines. ESXi are hypervisors that create the foundation for a dynamic and automated data center.

## What's New in vSphere 5.0?

vSphere 5.0 is the first release to offer only the ESXi hypervisor architecture.

- vSphere 5.0 does not include ESX.
  - The service console no longer exists.
  - VMware vSphere Command-Line Interface and VMware vSphere PowerCLI are available for command-line administration.
- vCenter Server 5.0 can still manage ESX hosts (3.5 and 4.x).

The upgrade process upgrades ESX/ESXi 4.x to ESXi 5.0.

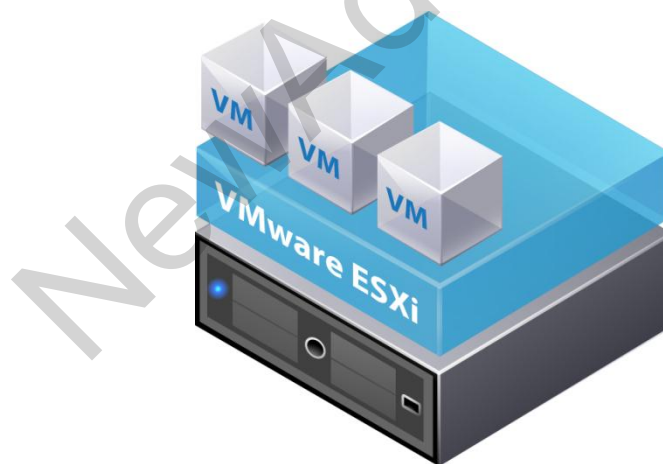
vSphere 5.0 includes also many updates to the existing technologies, like virtual machines, networking, storage and availability features.

## VMware ESX/ESXi features

Features of VMware ESX/ESXi features include:

- Uses standard and distributed virtual switches, NIC teaming, and VLANs
- Uses the VMware vStorage VMFS for storing virtual machines
- Managed by VMware vCenter Server
- Takes advantage of various VMware vSphere features, such as VMware VMotion
- Can be accessed using the VMware vSphere Client

### VMware ESXi



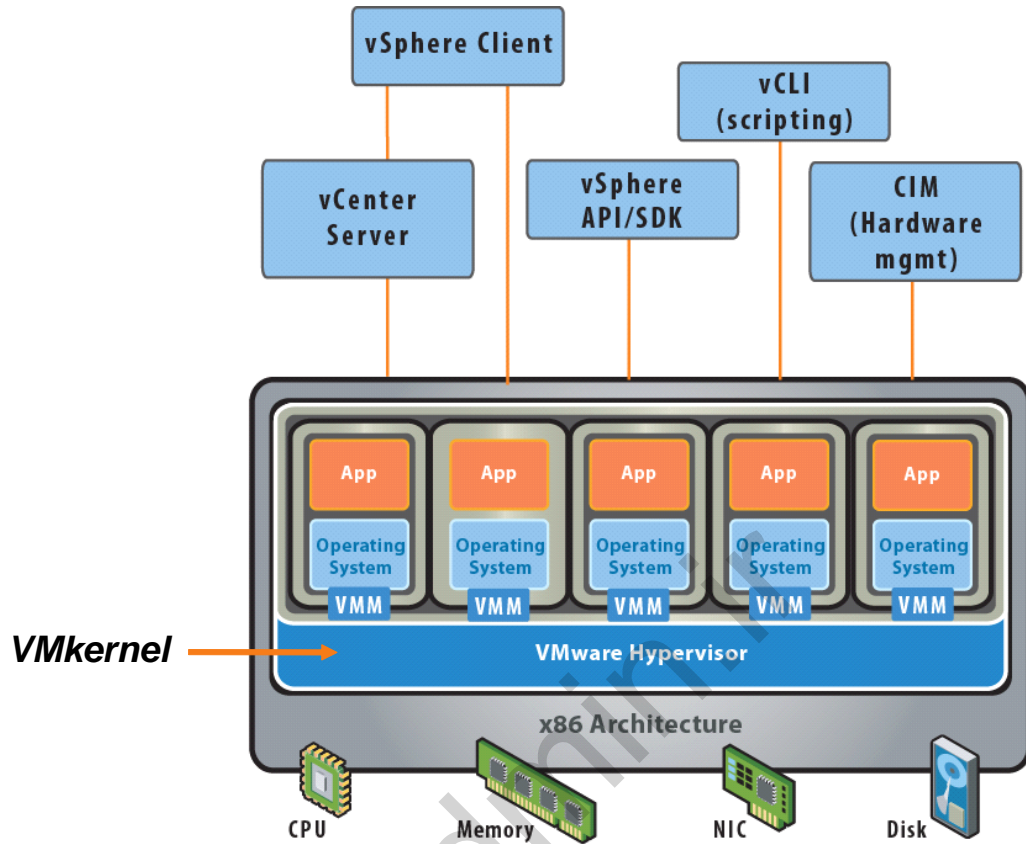
VMware ESXi

VMware ESXi features include:

- Managed with a BIOS-like direct console or vCLI
- A high-security, 32MB footprint
- ESXi Installable—Available as an installable CD-ROM boot image

- ESXi Embedded—ESX image preinstalled as firmware or burned onto an external USB key by the hardware vendor

## VMware ESXi architecture



VMware ESXi architecture

ESXi is an enterprise-class hypervisor with a thin 32MB footprint for added security and reliability.

An ESXi host can be accessed using a number of interfaces, such as:

- vSphere Client (connected directly to the host or to vCenter Server)
- vSphere Command-Line Interface (vCLI)
- vSphere API/SDK
- Common Information Model (CIM)

CIM is a management standard promoted by the Distributed Management Task Force. Much of the information that you can find using the CIM interface is also available through the vSphere API. However, some information can be found only through CIM—most important, the health status of the hardware hosting ESXi.

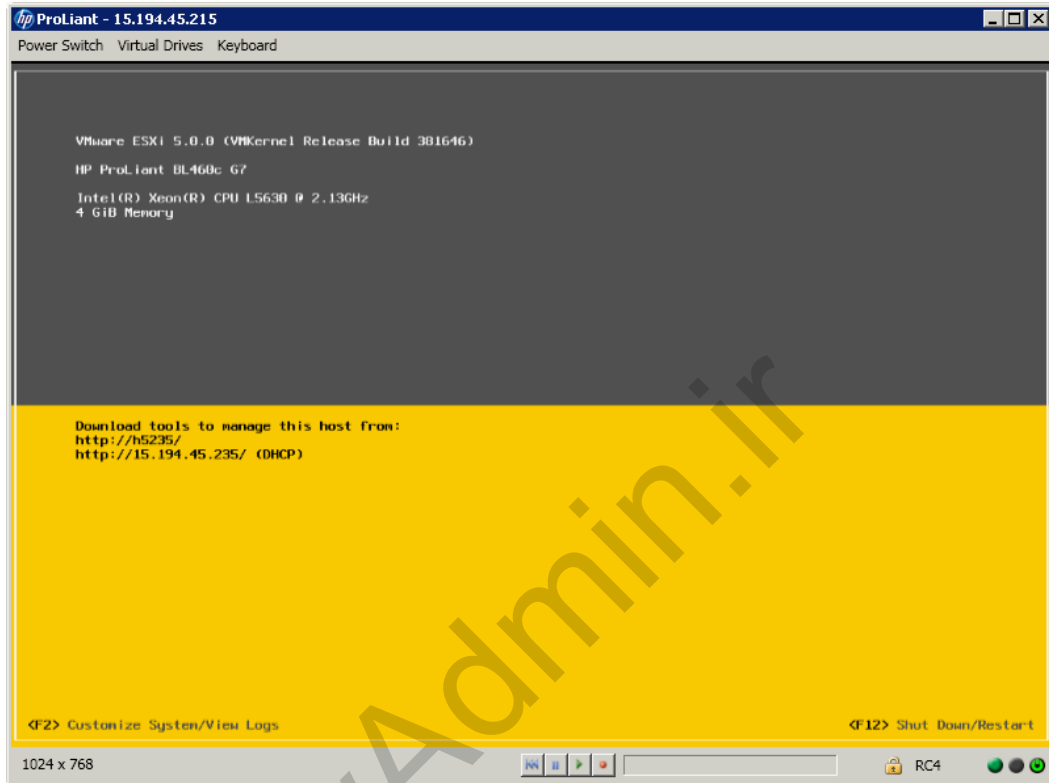
Under ESXi, applications running within virtual machines access CPU, memory, disk, and network interfaces without direct access to the underlying hardware. The ESXi hypervisor is known as the VMkernel. The VMkernel receives requests from virtual



machines for resources from the virtual machine monitor (VMM) and presents them to the physical hardware.

ESXi is supported on Intel processors, Xeon and above, or AMD Opteron (32-bit-mode) processors. ESXi includes a 64-bit VMkernel. As a result, servers with 32-bit-only processors are not supported. ESXi offers support for a number of 64-bit guest operating systems.

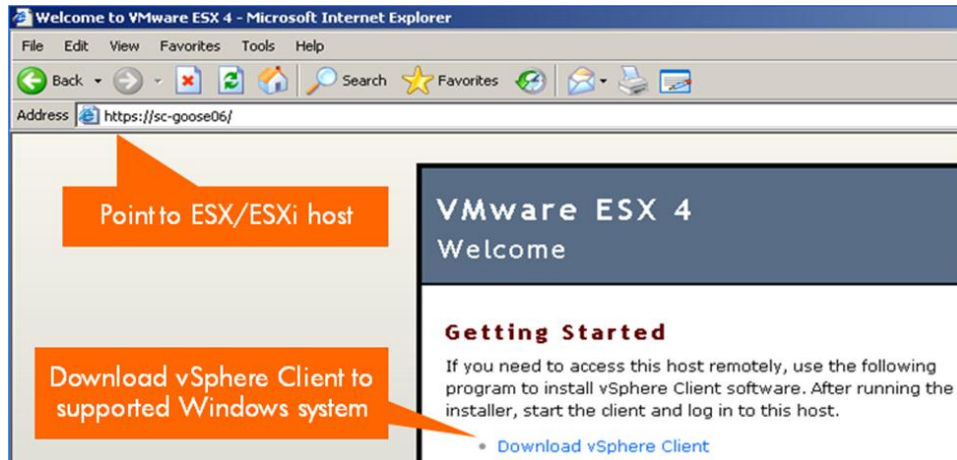
## Configuring ESXi



Configuring ESXi

The direct console user interface is used to configure certain settings for ESXi Embedded and ESXi Installable. The direct console, like the BIOS of a computer, has a keyboard-only user interface. The direct console can be accessed from the ESX console. To start customizing system settings, press **F2**.

## Using the vSphere Client

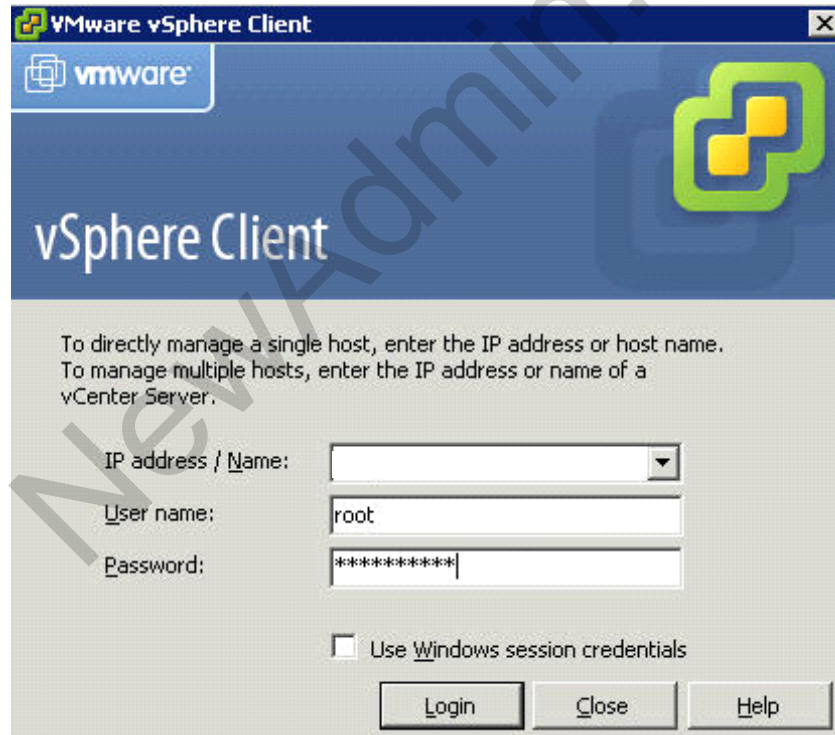


Using the vSphere Client

The vSphere Client is an interface used to connect remotely to ESX/ESXi or vCenter Server from any Windows PC.

Download software from the main page of ESX/ESXi.

### Logging in to ESX/ESXi



Logging in to ESX/ESXi

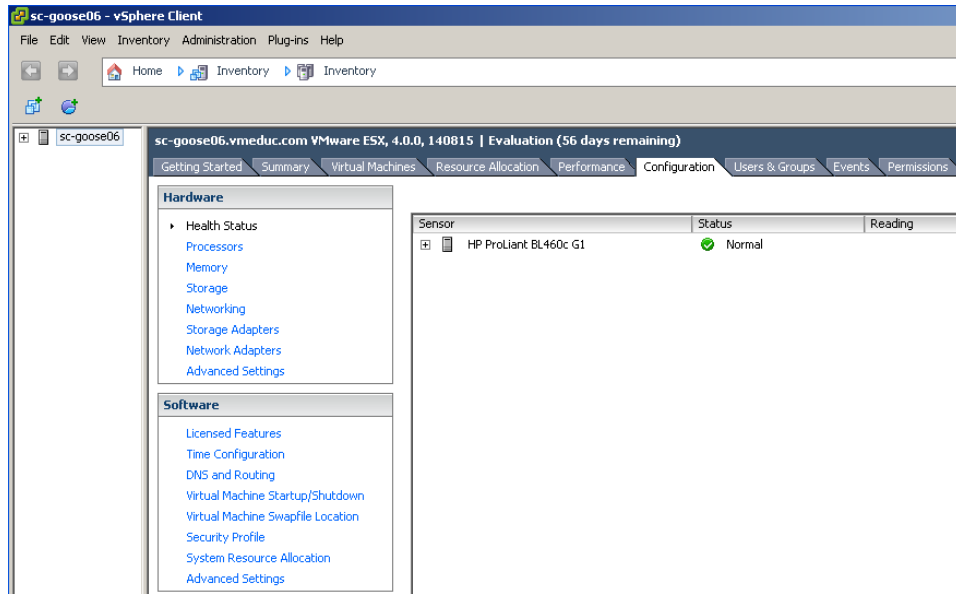
At the vSphere Client login screen, enter:

- Host name or IP address of the ESXi host

- User name `root`
- Password for user `root`
- vSphere Client can be used also to access vCenter Server.

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## VMware vSphere Client view



VMware vSphere Client: Configuration tab

The VMware ESXi/ESX server configuration can be changed or modified from the Configuration tab.

### VMware ESX/ESXi licensing

Before purchasing and activating licenses, you can install ESX/ESXi in evaluation mode.

- Intended for demonstration and evaluation purposes
- Allows software to be completely operational immediately after installation
- Does not require any licensing configuration
- Provides full functionality of ESX/ESXi for 60 days from the time you install it
- Allows the software to notify you of the time remaining in the evaluation period

# HP ProLiant Virtualization with Citrix XenServer

## Xen and XenServer

The three key components of the Xen and XenServer relationship are:

- Xen open source project
- Xen hypervisor
- XenServer products

The Xen project is the foundation on which the XenServer products are built. A large and active Xen community, including hundreds of developers and testers from companies such as IBM, HP, Intel, AMD, Red Hat, and Novell, contribute code.

## Comparing Xen platforms

The Xen hypervisor runs on bare metal and provides the core virtualization engine for the Citrix XenServer products. It supports next-generation virtualization through paravirtualization and hardware virtualization assistance. With paravirtualization technology, the virtual servers and hypervisor cooperate to achieve very high performance for I/O, as well as CPU and memory virtualization.

### Xen Open Source

- Xen supports the following hypervisor versions:
  - 32-bit
  - 32-bit-PAE
  - 64-bit
- Xen has the following theoretical memory and CPU limits:
  - Terabytes of memory
  - 128 CPU cores
- Xen requires Linux experience to install. Installation usually takes 1 day.

### XenServer

- Citrix XenServer Enterprise Edition 5 supports the 64-bit hypervisor version,
- Citrix XenServer supports the following CPU and memory limits:
  - 32 CPU cores
  - 128GB RAM
- XenServer is easy to use because 75% of the code is proprietary. Installation usually takes less than 1 hour.

## Identifying the XenServer product line

Citrix XenServer is available in four editions, as well as OEM editions:

- Express Edition
- Standard Edition
- Enterprise Edition
- Platinum Edition
- OEM Editions

## XenServer five-product line

Feature	Express Edition	Standard Edition	Enterprise Edition	Platinum Edition
Native 64-bit Xen hypervisor	•	•	•	•
Windows and Linux guests	•	•	•	•
XenAPI	•	•	•	•
XenCenter	•	•	•	•
XenConvert	•	•	•	•
Multi-server management		•	•	•
Subscription Advantage 1 <sup>st</sup> year			•	•
VLAN configuration			•	•
XenMotion live migration			•	•
Shared IP-based storage			•	•
Resource pools			•	•
Resource QoS controls			•	•
Server Provisioning				•

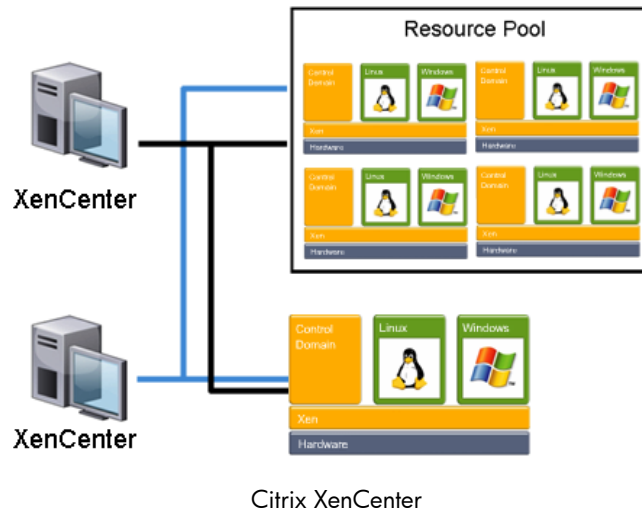
## Citrix XenCenter overview

XenCenter manages:

- XenServer hosts
- Virtual machines
- Physical and virtual resources

Multiple XenCenter clients can also connect to the same server or resource pool. The event mechanism keeps each client updated.

## Citrix XenCenter



The graphic shows how XenCenter is able to connect to multiple servers and resource pools.

## Citrix XenCenter performance data

XenCenter displays real-time status and trending of:

- CPU usage
- Memory usage
- Disk and network I/O

Performance data:

- Starts tracking when XenCenter opens and connects to one or more servers
- Available for the last 10 minutes to the last year
- Is persistent

Performance data starts tracking when XenCenter opens, connects to one or more servers, and is available for the last 10 minutes to the last year. Smaller amounts of metric data become available as time passes. Installing XenServer Tools on the VMs is required to return performance data to XenCenter.

## Citrix XenServer architecture overview

Xen provides a next-generation x86 virtualization platform using a combination of two technologies:

- Paravirtualization
- Hardware virtualization

All of the major x86 vendors have adopted paravirtualization as the virtualization technology of choice. The future of virtualization is a combination of paravirtualization and hardware-virtualization assist. Older-generation virtualization solutions use hardware emulation to trick an operating system into thinking it is running on its own piece of hardware. This hardware is actually a large software system that emulates the entire PC.

The Xen engine uses a technique called paravirtualization to allow the virtual machine to understand it is being virtualized and to cooperate with the system to ensure the best performance. Xen pioneered paravirtualization on the x86 platform. XenServer VMs use paravirtualized drivers for storage and network devices, which improves performance over emulated drivers

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## Citrix XenServer hardware requirements

Component	Requirements
<b>CPU</b>	64-bit x86 CPUs. Intel VT or AMD-V processors are required to run Windows VMs.
<b>Physical memory</b>	1 GB of RAM minimum but 2GB of RAM recommended.
<b>Network</b>	100Mb/s minimum but 1Gb/s recommended.
<b>Storage</b>	16GB to install; 4GB is for the control domain, 4GB is reserved for in-place upgrades and 8GB is reserved for VM storage. Both local disks and remote storage are supported.

## Virtualization with Microsoft products

Windows Server 2008 R2 Hyper-V, the next-generation hypervisor-based server virtualization technology, is available as an integral feature of Windows Server 2008 R2 and enables implementing server virtualization with ease. Hyper-V allows making the best use of HP server hardware investments by consolidating multiple server roles as separate virtual machines (VMs) running on a single physical machine.

Administrators want flexibility in allocating computing resources for specific tasks. Virtualization technologies provide this flexibility by decoupling the hardware from the workload being performed. Windows Server 2008 Hyper-V R2 offers a robust, scalable hypervisor-based virtualization platform allowing enterprises to provision and manage virtual server workloads.

Hyper-V in Windows Server 2008 R2 includes five core areas of improvement for creating dynamic virtual data centers:

- Increased availability for virtualized data centers through Live Migration, which allows you to move a virtual machine between two virtualization host servers without any interruption of service
- Improved management of virtualized data centers through the Hyper-V Management Console and support of PowerShell cmdlets
- Increased Performance and Hardware Support for Hyper-V Virtual Machines – up to 64 processors per host, plus second level address translation and core parking for optimum performance
- Improved Virtual Networking Performance through new networking technologies – VM Chimney (also called TCP Offload) and the use of Jumbo Frames.
- A simplified method for physical and virtual computer deployments, including adding, removing, and booting from .vhd files

HP ProLiant and HP BladeSystem servers and StorageWorks storage – part of the industry's most complete platform designed for virtualization – broadly support Microsoft virtualization technologies, including Microsoft Windows Server 2008 Hyper-V R2 and Microsoft Hyper-V Server R2. HP ProLiant is Microsoft's development platform for testing and development of Windows Server 2008 Hyper-V R2.

Most G6 and G7 servers are supported and certified for Hyper-V, including SL and ML/DL100 series.

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**INTERNET**

Support matrix is located at

<http://h71028.www7.hp.com/enterprise/cache/458915-0-0-0-121.html>

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Microsoft Windows® Server 2008 with Hyper-V is rapidly gaining market share and many new customers are implementing this new technology which allows cost effective virtualization on the HP ProLiant platform. As a four time Global Enterprise Partner of the Year, and a preferred development platform, HP offers a complete

portfolio of complementary technology and services to help customers get the most out of their Hyper-V implementations. In addition HP provides integrated management with Insight Control for Systems Center.

Here is a list of free features in Hyper-V Server 2008 R2

- Host clustering
- Live Migration
- Large Memory support (Host OS) =1TB
- Support for up to 8 Processors (Host OS)

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## Learning check

1. A host-based virtualization system requires an operating system (such as Windows or Linux) to be installed on the computer.
  - True
  - False
2. What is the name of the application that is used to access vCenter Server or standalone ESXi host?
  - a. vSphere Client
  - b. VMware Access Point
  - c. Virtualization Agent
  - d. Virtual Machine Management Software
3. Which components are managed through XenCenter? Select three.
  - a. XenServer hosts
  - b. VMware hosts
  - c. Virtual machines
  - d. Physical and virtual resources
  - e. Fibre Channel and iSCSI arrays
4. Write down example of host operating system-based virtualization.

.....

.....

.....

.....
5. Where can HP Management Agents be installed?
  - f. VMware ESX
  - g. VMware ESXi
6. What technology is required on processor to support full virtualization?
  - h. Hyper-threading
  - i. AMD-V
  - j. Intel VT
  - k. RBSU

7. How many CPUs does Hyper-V Server 2008 R2 supports?
- l. 2
  - m. 4
  - n. 8
  - o. 32

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## Objectives

After completing this module, you should be able to:

- Describe the basic features of P4000 solution
- Describe P4000 Centralized Management Console

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## HP P4000 Introduction & Features

SAN solutions formerly required high-speed connections using Fibre Channel (FC) networks. The FC networks required a lot of specialized and expensive hardware (and specialized and expensive expertise) to configure and maintain.

HP re-defined shared network storage in 2002 with the introduction of the first full-featured IP SAN. Instead of using single-purpose FC networks, HP solution connected to the SAN using a company's existing LANs. With current gigabit (or faster) LANs, IP SANs can meet or exceed the performance available with fibre channel.

By building a SAN utilizing the existing Ethernet infrastructure, the HP solution eliminates the learning curve, expensive components, and complexity associated with fibre channel SANs. HP IP SAN is ideal for Microsoft Exchange, Microsoft SQL Server, server consolidation, local or geographic disaster recovery, and disk-to-disk backup projects.

### Introducing HP IP SANs

HP P4000 G2 products are ideal as network storage for many scenarios and applications, such as:

- Microsoft Exchange
- Microsoft SQL Server
- Server consolidation
- Local or geographic disaster recovery
- General file services
- Disk-to-disk backup projects
- Server Virtualization

### Introducing the product suite

P4000 is based on a few components:

- Storage Node — Either a physical Ethernet-based storage device (HP P4300, P4500, P4800) or a Virtual Storage Appliance (VSA)
- HP SAN/iQ Software — Combines with storage node to provide IP SAN solution
- Centralized Management Console — Centralized storage management facility
- Standard iSCSI support — Provides access to storage



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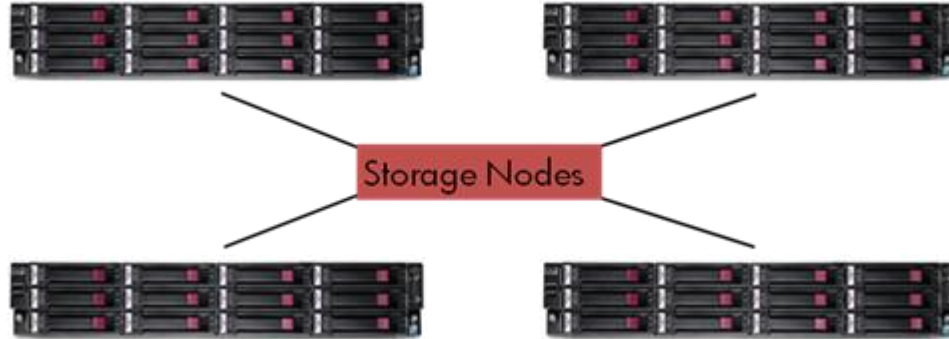
- Microsoft Exchange
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- Server consolidation
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## HP P4000 SAN



HP P4000 SAN

With the HP IP SAN, any number of clustered Storage Nodes are managed as one storage pool, and additional capacity can be added to the cluster with no downtime. Adding a Storage Node is as simple as adding any other Ethernet device; the intelligence within the IP SAN automates the process of adding the capacity to the storage pool.

The storage pool is carved into volumes (LUNs) using a simple GUI. Creating or resizing a volume takes only minutes and doesn't require downtime – you're able to add and manage storage during normal business hours. An HP IP SAN supports a true "pay as you grow" architecture that eliminates the need for capacity planning and complicated budgeting.

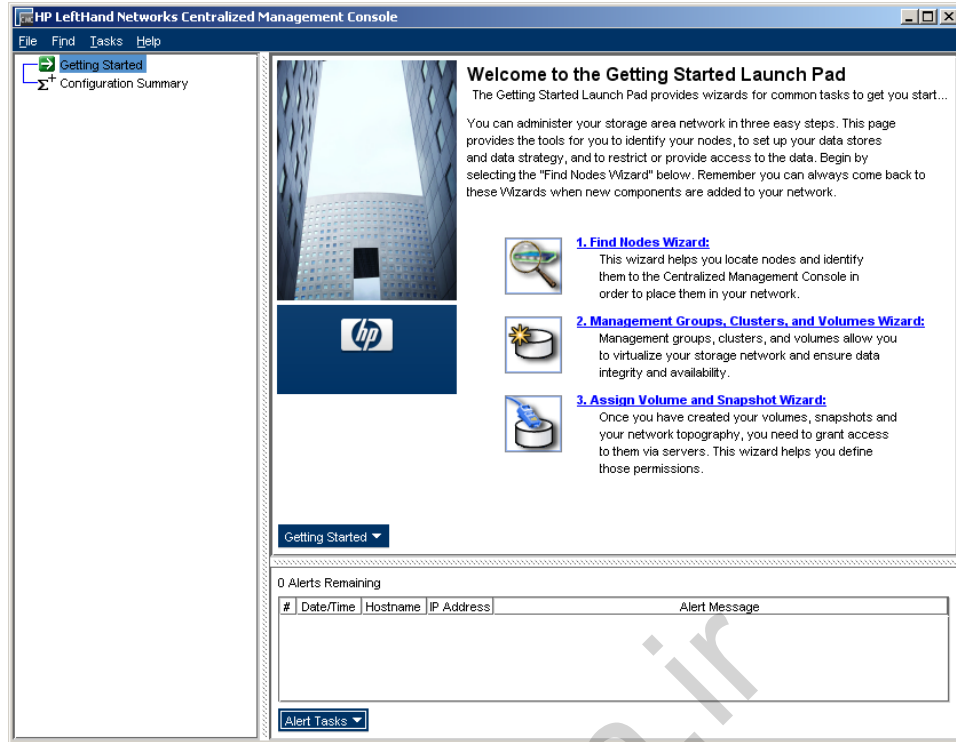
The capacity of the IP SAN storage pool can be assigned to application servers as needed, completely eliminating the issue of inefficient provisioning common in other storage environments. As a particular application requires more storage, you simply resize the volume associated with that application. Similarly, underutilized capacity can be reassigned, allowing administrators to double the capacity utilization over a typical direct-attached storage.

## HP SAN/iQ Software

SAN/iQ manages the Storage Nodes to provide a complete yet simple to use IP SAN solution. SAN/iQ virtualizes multiple storage modules into an extremely flexible, redundant, and simple to manage storage pool that scales from half a terabyte to hundreds of terabytes.

The software provides sophisticated data management features such as replication, snapshot, storage pooling, virtualization, and automated failover through an intuitive GUI user interface that dramatically simplifies the user experience.

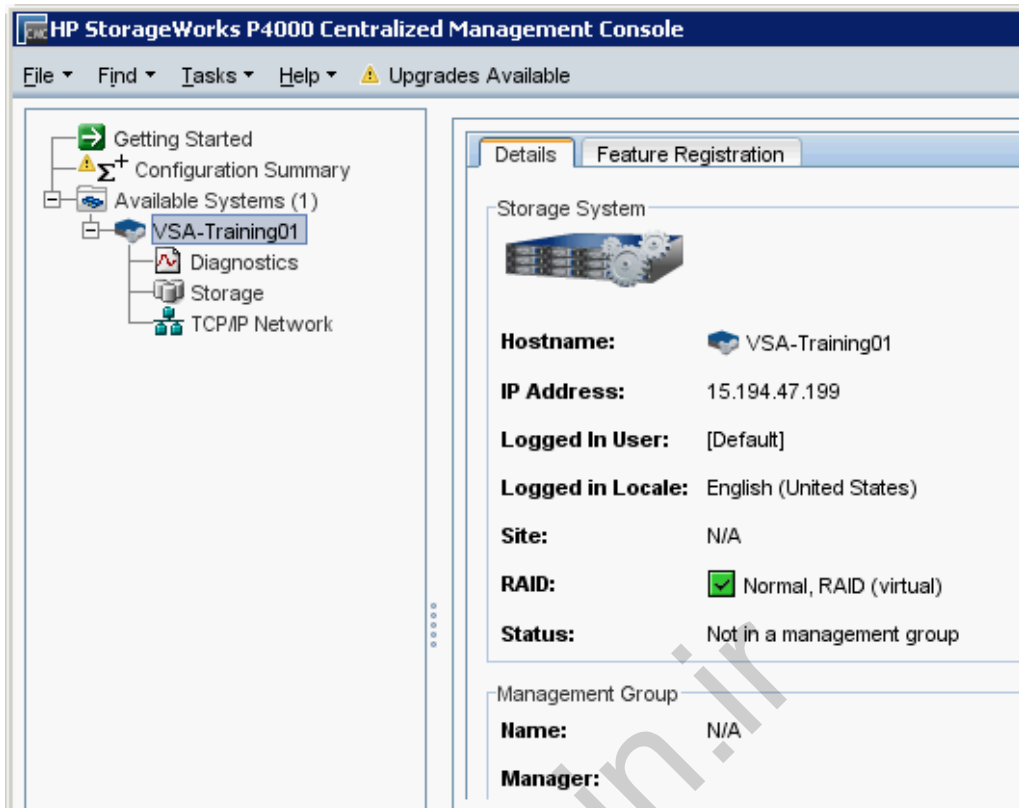
## Centralized Management Console (CMC)



Centralized Management Console (CMC)

The Centralized Management Console is the intuitive, GUI-based administrative interface for the HP SAN/iQ software. You use the Centralized Management Console to configure and manage storage volumes spanning clustered Storage Nodes.)

## Hardware RAID setup



Centralized Management Console

Most HP SAN platforms default to RAID 5 for their internal RAID settings. RAID is supported in hardware, and different platforms support different sets of RAID options.

**INTERNET** Current details are in the Storage section of the SAN/iQ User Guide or at <http://www.hp.com/go/P4000>.

The RAID Status is located at the top of the RAID Setup tab in Storage. RAID status also displays on the main CMC window when a storage node is selected in the Network view. The status displays one of four RAID states:

- Normal — all disks functioning properly.
- Rebuild — a disk or storage node was replaced or moved, and the SAN is rebuilding the RAID array on the disks.
- Degraded — one or more disks or storage nodes are unavailable. The data is still available due to the RAID data recovery, but the SAN is in an endangered state. If it loses another drive, data loss may occur.
- Off — RAID is disabled.

The CMC monitors the health of all disks (using SMART, SMTP, RAID status, etc.) and summarizes each drive's health.

Powering drives on and off is part of removing and replacing disks in the Storage Node. A bad drive should be powered off in the Centralized Management Console before you remove it from the module. If the Storage Node detects a failed drive, it will automatically power that drive down for removal. Then, after the replacement disk is inserted in the drive bay, it must be powered on.

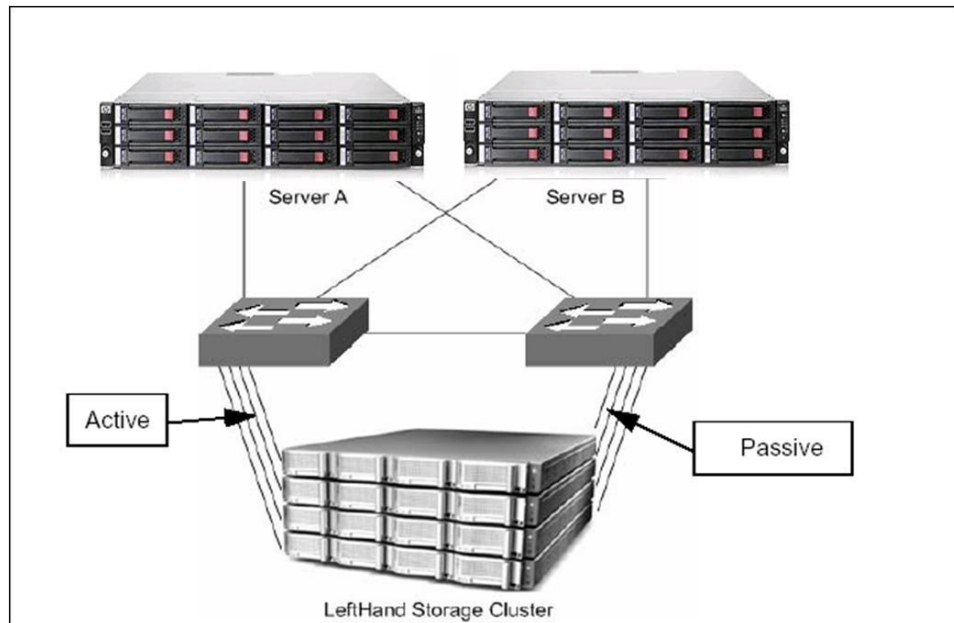
## Networking enhancements

Network interface bonding provides high availability, fault tolerance, load balancing and / or bandwidth aggregation for the network interface cards in the storage node. Bonds are created by bonding physical NICs into a single logical interface. This logical interface acts as the master interface, controlling and monitoring the physical slave interfaces.

Bonding two interfaces for failover provides fault tolerance at the local hardware level for network communication. Failures of NICs, Ethernet cables, individual switch ports, and / or entire switches can be tolerated while maintaining data availability. Bonding two interfaces for aggregation provides bandwidth aggregation and localized fault tolerance. Bonding the interfaces for load balancing provides both load balancing and localized fault tolerance.

Note that VSAs have only one virtual NIC, and so do not support NIC bonding.

## Network interface failover



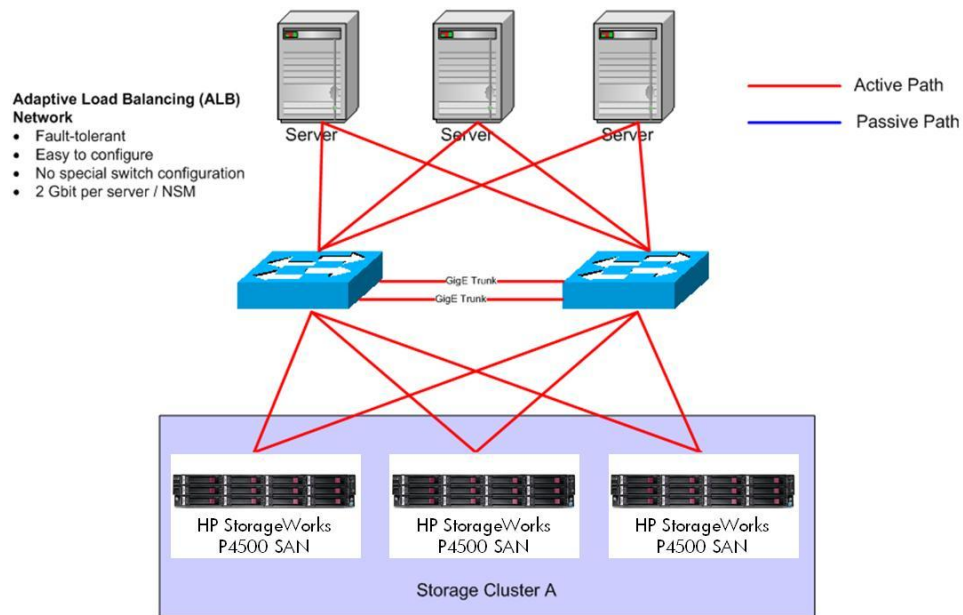
Network interface failover

Network interface failover provides high availability fault tolerance for the network interface cards in the storage node. Failover is created by “bonding” the two NICs into a single logical interface. This logical interface acts as the “master” interface, controlling and monitoring the “slave” interfaces.

If both NICs are plugged in and available when the bond is created, then one of the slave interfaces is “active” and the other slave interface is available for failover. Its status is “passive (ready).” If the active interface link goes down, the interface that was passive (ready) becomes active, and the failed interface becomes “passive (failed).”

Bonding two interfaces for failover provides fault tolerance at the local hardware level. Failures of NICs, Ethernet cables, local switches and/or individual switch ports can be tolerated while maintaining data availability.

## Adaptive Load Balancing (ALB)



Adaptive Load Balancing

Adaptive Load Balancing allows the storage node to use both interfaces simultaneously for data transfer. Both interfaces have an active status. If the interface link to one NIC goes offline, the other interface continues operating. Using both NICs also increases network bandwidth.

However if both NICs are connected into a single switch, network is vulnerable to failure at that single switch. Best practice is to implement ALB with two switches corresponding to the two NICs on each storage node.

## Data Protection Levels

Redundancy Level	# Copies of Data	Minimum # Nodes
Network RAID-0	1	1
Network RAID-10	2	2
Network RAID-10 +1	3	3
Network RAID-10 +2	4	4
Network RAID-5	Data striped on 3 nodes with parity on 4 <sup>th</sup> node	4
Network RAID-6	Data striped on 4 nodes with parity on 5 <sup>th</sup> ,6 <sup>th</sup>	6

The different levels of Network RAID protection require different minimum numbers of nodes in order to distribute the mirrored or striped data blocks across a sufficient number of nodes. With each data/parity block on a separate node, it is guaranteed that no single (or double, in the case of RAID-6) node failure will endanger data.

Note that Network RAID-0 stripes data across multiple storage nodes, just like hardware RAID-0 stripes data across disk drives. However a hardware RAID implementation normally requires a minimum of two disks, else it is just a single non-RAID disk drive. Strictly speaking you should also have a minimum of two storage nodes for Network RAID-0, but SAN/iQ supports a minimum of one storage node for the “non-RAID” case.

## Network RAID Mirroring and Striping

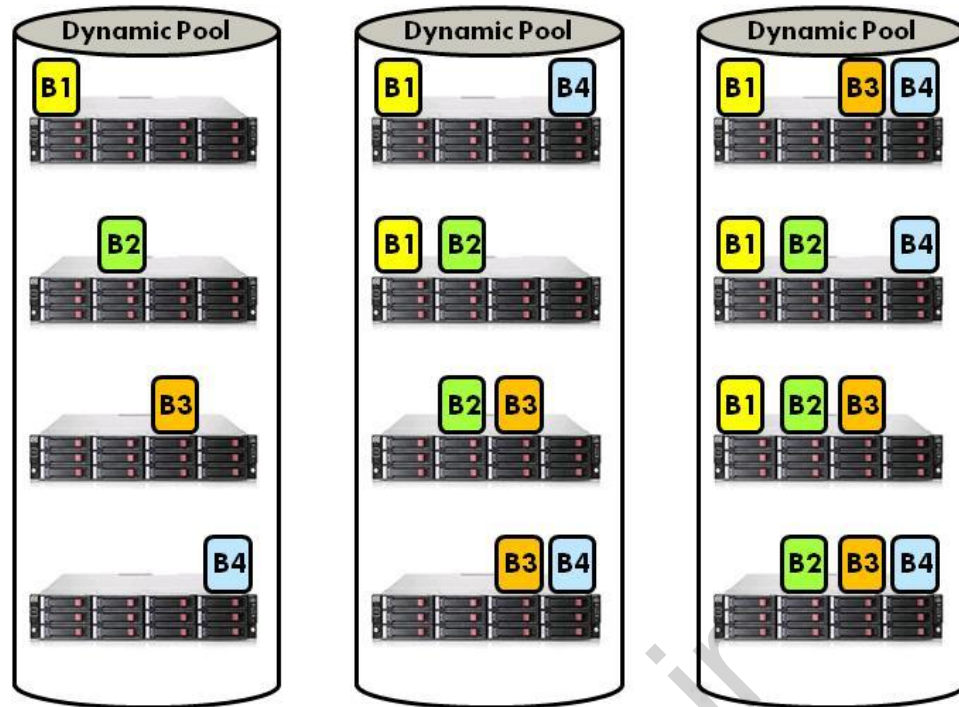
Mirroring offers a unique and unprecedented data protection solution for Storage Area Network solutions at the volume level. Volume level data protection schemes that seamlessly integrate with application availability policies and can keep up to 8 synchronous copies of data on the SAN (With RAID 10 on storage units and the HA/DR solutions pack).

Added data protection is allowing an administrator to decide what to do in the event of a fault on the SAN. Data is available OR data is mirrored OR both.

Additionally, Remote IP Copy can mirror snapshot data to target storage subsystems for added data protection.



## Network RAID-10 Mirroring



Network RAID-10 Mirroring

Hardware RAID creates multiple copies of data within a storage node, protecting your data in case of a hard drive failure.

Network RAID provides an additional level of protection by writing each block to 2 or more storage nodes. This greatly increases reliability, since an entire storage node (or even multiple storage nodes) could fail without losing access to data. Mirroring can be selected on a volume-by-volume basis.

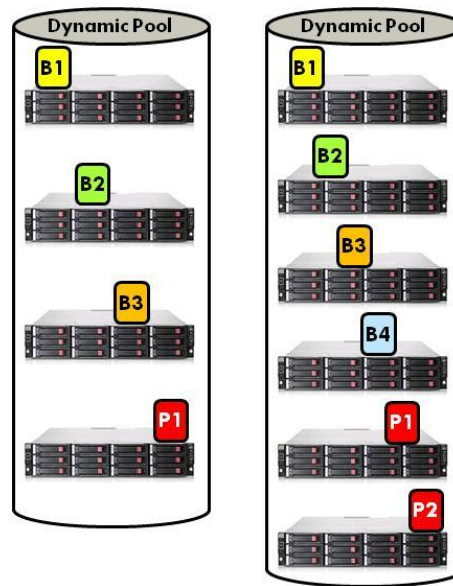
Network RAID-10 (2-way mirroring) is the minimum recommended best practice. Not only does this increase your data safety, it does it without incurring any performance penalty. SAN/iQ was engineered to execute two simultaneous authoritative writes at the same performance level as a single write. Network RAID-10 +1 and +2 can incur some performance penalty during writes. SAN/iQ always reads two authoritative blocks (assuming at least 2-way mirroring) so there is no performance penalty on reads.

If customer has multi-site installation, add storage nodes to the cluster in alternating order. Add the first node from site A, second node from site B, third from site A, and so on. Alternating the addition of storage nodes by site location ensures that data is written to each site as part of the mirroring level configured when the volume is created.

### Note

If storage nodes are added to a cluster in any order other than alternating order by site, there will be not a complete copy of data on each site.

## Network RAID-5 and RAID-6 Striping



Network RAID-5 and RAID-6 Striping

Just as Network RAID-10 mirroring is analogous to hardware RAID-10 mirroring, Network RAID-5 and Network RAID-6 are analogous to hardware RAID-5 and RAID-6. SAN/iQ writes several blocks of data one unit, and it computes one or two blocks of parity to write along with the data. Any one (RAID-5) or two (RAID-6) storage nodes can be lost in the cluster without losing data.

Network RAID-5 and RAID-6 require less disk space overhead than Network RAID-10. RAID-10 writes 2, 3, or 4 complete copies of all data, so it requires 2, 3, or 4 times as much storage space. Network RAID-5 adds one parity block per 3 blocks of data, and Network RAID-6 adds two parity blocks per 4 blocks of data.

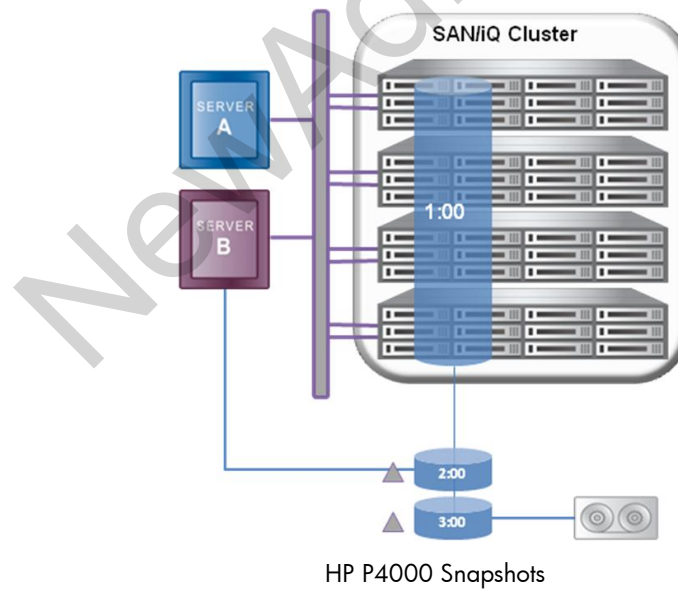
As with Network RAID-10 mirroring, RAID-5 and RAID-6 striping occur at the storage node level. They offer protection in addition to the hardware RAID inside the storage nodes. Hardware RAID protects against a failed disk drive inside a storage node, while Network RAID protects against the loss of entire storage nodes.

RAID level	Recommendation
Network RAID-0	No protection. Recommended only for single-node clusters.
Network RAID-10	Default protection level. Best balance of performance and protection. Recommended for use with any applications.
Network RAID-10+1	Recommended only for applications with a requirement for the highest and redundancy available regardless of capacity or performance.
Network RAID-10+2	Recommended only for applications with a requirement for synchronous replication between two sites or locations that must remain fully redundant even after an entire site failure.
Network RAID-5	Recommended for use with applications that primarily do sequential read operations such as file shares and archives.
Network RAID-6	Recommended for same applications as Network RAID-5 on larger P4000 clusters. Provides additional failure protection.

Network RAID Recommendations Prioritized for HA & Performance

SAN/iQ offers different levels of Network RAID protection for different applications. The table above summarizes the recommended Network RAID levels for different applications.

### HP P4000 Snapshots



Snapshots are an instant point in time copy of the volume. Simply right click on a volume, choose "Create Snapshot", hit ok, and the snapshot of the volume appears.

The original volume is preserved and no further changes are made to it. Subsequent writes are written to the snapshot and reads are drawn from a combination of the new changes and the original data.

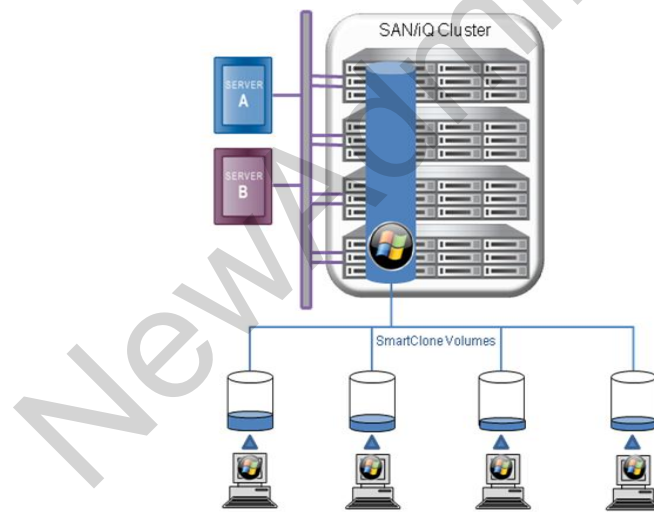
The snapshot is thinly provisioned and requires no reserve space, so snapshots are extremely space-efficient.

Snapshots can be scheduled. They can also be created manually through the CMC, scripted, and created through programmable APIs.

At any time a volume can be instantly rolled back from a snapshot. If there is a data loss or corruption on live volume, simply select the snapshot to restore from, and an instant rollback occurs, restoring volume to a known good state.

Additionally, any past snapshot can be mounted to any server that can access the SAN. So for example, the “last Friday 5pm” snapshot can be mounted as a separate volume, making the status as of that snapshot available in parallel with the current active state of the volume. This is useful for recovering files, creating test environments, or mounting to a backup server to have a centralized backup environment. Snapshot consistency groups are supported with the Microsoft VSS provider. If there is a backup application that works with VSS, SAN/iQ will natively work with backup application.

## HP P4000 SAN/iQ SmartClone



HP P4000 SAN/iQ SmartClone

Snapshots create a new empty volume that builds upon an underlying snapshot. Any changes happen in the new volume.

SmartClone volumes are essentially identical, except many new volumes can depend on the underlying snapshot volume – called a “clone point.”

Each of the new SmartClone volumes is thinly provisioned, so a SmartClone volume consumes very little space. Any new changes are stored in the new SmartClone volume, independently of the parent volume or any other SmartClones.

SmartClones are very valuable if administrator needs to provide a repeatable environment or data set. This might be useful in a repetitive testing environment or in a situation where identical login environments should be provided.

Be aware, however, that some operating systems do not behave well with multiple identical copies. Windows requires a unique identifier (the SID) in each system. Administrator might create a base Windows install, then create SmartClone volumes for each system he wants to deploy. Within those SmartClones a new SID can be generated and any other changes should be made (such as hostname) required to make the system unique.

SmartClone volumes are multiple volumes that share a common subset of data as a base template to make copies from. SmartClone volumes can be used to duplicate configurations or environments for widespread use.

SmartClone volumes are created instantaneously and are fully featured, writeable persistent volumes.

SmartClone volumes help minimize space used on the SAN. For example, administrator might create a volume with a specific OS configuration. Then, using the Smart-Clone process, he creates multiple volumes with access to that same OS configuration, and yet only needs a single instance of that configuration. Only as additional data is written to the different SmartClone volumes do those volumes consume additional space within the SAN cluster.

Planning SmartClone volumes must take into account multiple factors, such as space requirements, server access, and how to manage multiple SmartClone volumes, source volume and snapshot.

SmartClone volumes inherit the size and mirroring level of the source volume and snapshot. By default SmartClone volumes are thin provisioned but can be made fully provisioned after created if desired.

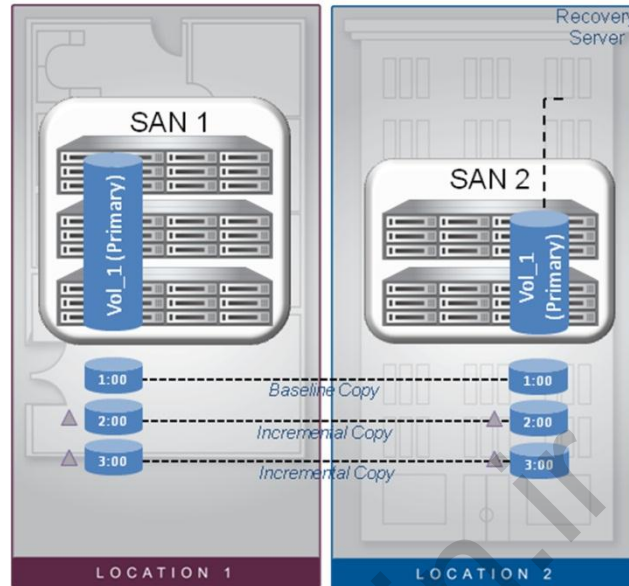
Characteristics for SmartClone volumes are the same as for regular volumes, however, certain characteristics are shared among all the SmartClone volumes and snapshots. If administrator wants to change one of these shared characteristics for one SmartClone volume, that change will apply to all related volumes and snapshots, including the original volume and snapshot from which the SmartClone volumes are created.

Some characteristics for SmartClone volumes are the same as for regular volumes. These characteristics can be changed like with any normal volume.

However, certain characteristics are shared among all the SmartClone volumes and snapshots. If administrator wants to change one of these shared characteristics for one SmartClone volume, that change will apply to all related volumes and snapshots, including the original volume and snapshot from which he created the SmartClone

volumes. Simply use Edit Volume on the selected volume, and make the change to the volume. A message opens, stating that the change will apply to all of the associated volumes, which are noted in the message.

## HP P4000 SAN Remote Copy



HP P4000 SAN Remote Copy

Remote Copies are based on snapshots. A Remote Copy is essentially a snapshot that is copied to a remote cluster. Because they're based on snapshots, they also take advantage of thin provisioning and do not require reserve space.

If there is a primary site with volumes and snapshots and a second DR site, the volume and snaps can be copied to the remote site via your WAN link.

Remote copies can be scheduled based on DR needs. The initial data copy copies the entire volume – Each additional remote copy sends only the changed data to the remote site.

Remote Copies can be run over most any WAN link, and can take advantage of WAN encryption (VPN) and/or compression (Riverbed). Bandwidth can be managed through the CMC by editing the management group properties. Like snapshots, no space needs to be reserved ahead of time on the remote cluster.

These remote copies can be mounted as fully readable and writable volumes, so that if the primary site goes down, the remote copy can be simply attached to a host and continues to work.

A wizard guides administrator through both the failover and failback scenarios.

The initial baseline copy is usually the largest, since it must copy over the contents of the entire volume. After the baseline copy, subsequent updates transfer only the

contents of the subsequent snapshots of the source SAN. This is normally much smaller than the baseline copy, so the bandwidth requirements are minimized.

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## P4000 Centralized Management Console

The CMC is the primary management interface for your SAN cluster. In this module you will see how the CMC works, and how to use it to control your SAN installation.

### Installation procedure

Installing the CMC is very simple. Just set up and configure Storage Nodes, and install the CMC on desired management system(s).

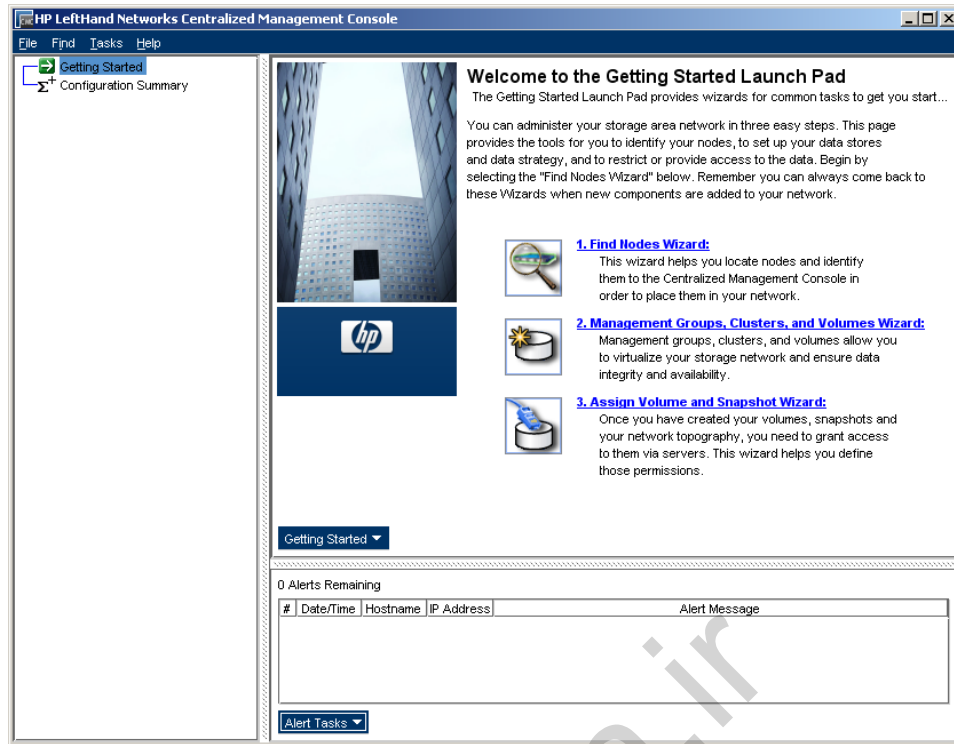
The Windows installer wizard can install several utilities. Choose “Centralized Management Console” on the Home tab to install CMC. The default values are suitable for many installations, so unless administrator has particular needs, he can just step through the wizard and accept the defaults.

Other tools that can be installed include:

- Failover Manager – a utility to help keep your data available if one or more Storage Nodes are lost
- Service Console – enables remote hardware and software support for the HP LeftHand storage system
- CLI – the Command Line Interface enables you to control your SAN through a scripted interface



## Opening the Management Console



Management Console

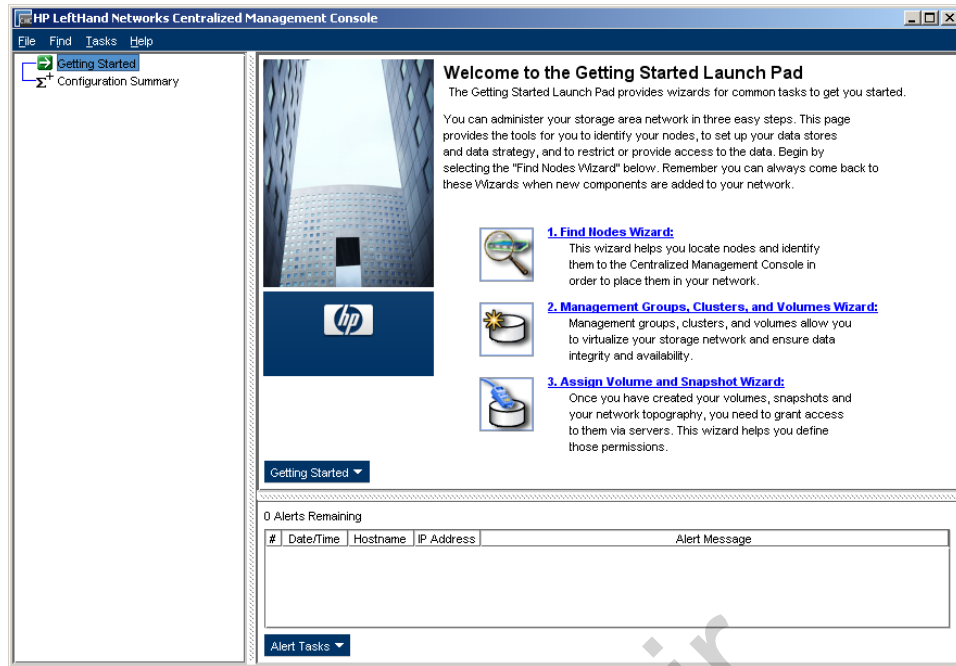
This slide shows the Launch Pad that opens when Centralized Management Console (CMC) is run for the first time. “Find Nodes Wizard” can be selected in the Content Pane and search by Subnet and Mask or by Module IP and Host Name to locate a particular Storage Node.

When administrator opens the CMC the first time, it automatically searches the subnet for Storage Nodes. Any Storage Nodes it discovers appear in the navigation window on the left side of the CMC. If no Storage Nodes are found, the Find Nodes Wizard opens, and takes through the steps to discover the Storage Nodes on the network. As the CMC finds Storage Nodes, it displays them in the Navigation Pane listed by host name. When the search is complete, a message listing appears that shows the Storage Nodes found.

If the Search function is run again, only previously undiscovered or new Storage Nodes are displayed.

Search by Module IP or Host Name for distance discovery. Searching an entire IP range may be impractical over a long connection.

## Centralized Management Console main window



Centralized Management Console main window

The Menu Bar lists a few tasks that are available. Administrator can also access the tasks in a context-sensitive manner by right-clicking on objects in the Navigation Pane or Content Pane.

Four available sections are:

- Menu Bar — Provides a list of all the tasks that can be performed.
- Navigation Pane — Displays all the nodes, Management groups, clusters, etc... on the Network
- Content Pane — Presents the functions and tab information associated with the selected item in the Navigation Pane.
- Alerts Pane — Presents any alerts that are configured with each storage node

The menu bar provides the following task menus:

**File** — Exit the CMC gracefully.

**Find** — Find Storage Nodes on the network that can be managed through the CMC.

**Tasks** — Access all storage configuration tasks. The tasks in this menu are grouped by logical or physical items. Tasks are also accessible through right-click menus and from the Tasks button in the tab window.

**Help** — Access online help and other information about the CMC and the SAN/iQ software.

## Learning check

1. Which software component is used to manage and configure HP P4000 Solution?
  - a. Central Management Console
  - b. iSCSI Manager
  - c. SAN/IQ Insight Manager
  - d. Storage Management Utility
2. The HP P4000 Virtual SAN Appliance Software is a VMware Certified SAN/Storage device.
  - True
  - False

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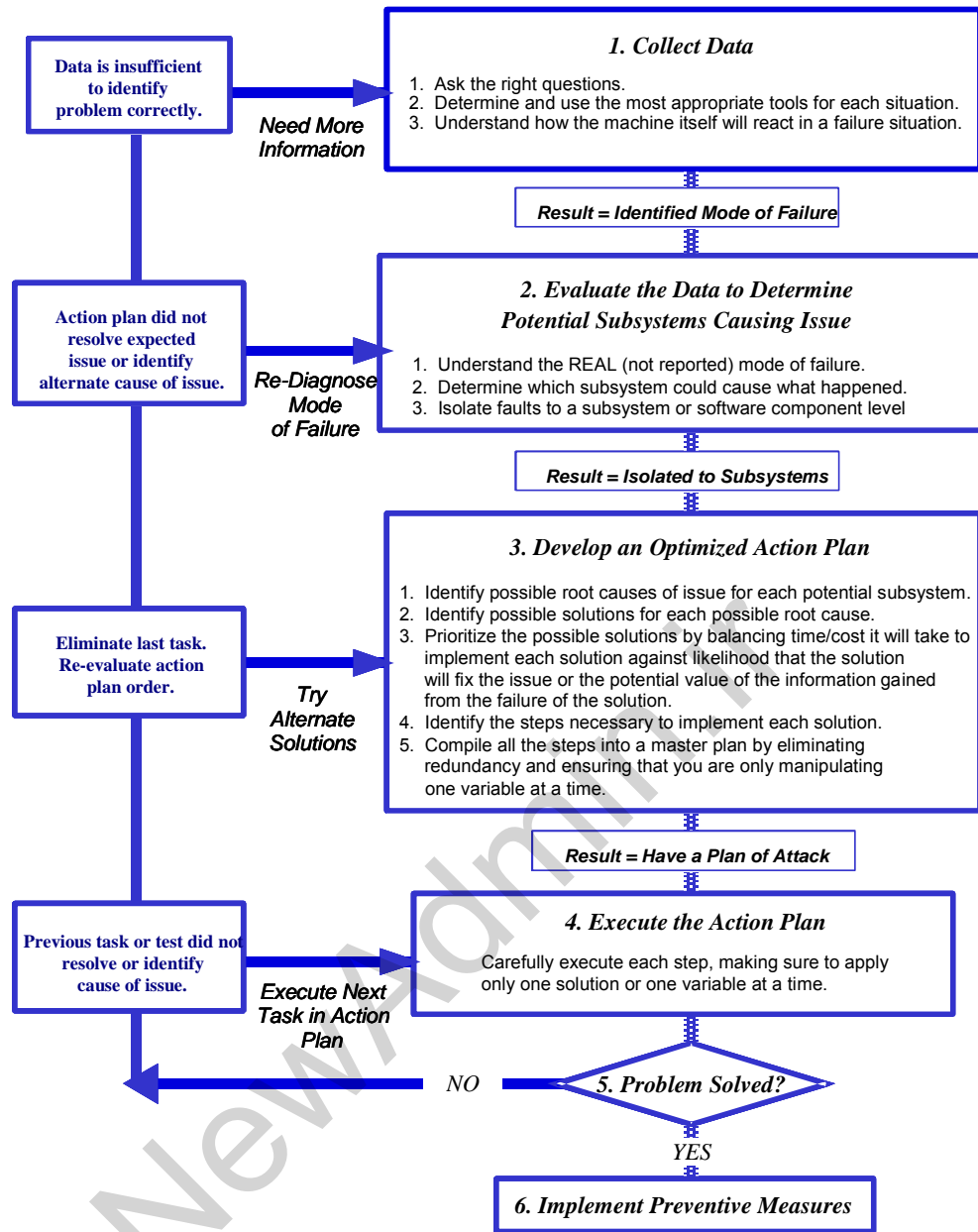
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### Objectives

After completing this module, you should be able to describe the six-step HP troubleshooting methodology.

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# HP troubleshooting methodology



Troubleshooting flow chart

The high degree of interaction between the system, hardware options, operating system, and application software can make it difficult to isolate the root cause of a problem. Problems that are intermittent or are generated by multiple subsystem malfunctions can be especially difficult to troubleshoot.

HP has developed a six-step methodology to systematically get to the core of a problem, resolve it, and take steps to limit the possibility of it happening again. These six steps are:

1. Collect data.
2. Evaluate the data to determine the potential subsystems causing the issue.
3. Develop an optimized action plan.
4. Execute the action plan.
5. Determine if the problem has been solved.
6. Implement preventive measures.

As part of any change management process, altering only one variable at a time can slow the impact of that change. If manipulating one variable does not result in any performance increase, revisiting the data to determine the next variable to manipulate is the next step. By following the HP troubleshooting methodology, you can use a standard approach to reduce possibilities until a solution set is found.

Using this methodology enables service providers to distinguish themselves in the marketplace by being able to provide a higher level of customer satisfaction. This methodology provides a logical framework to troubleshoot system problems and reach problem resolution. A logical framework also provides a consistent and solid foundation for other technicians and system engineers to work from when escalation is necessary.

## Step 1—Collect data

Troubleshooting a problem involves spending time and effort gathering helpful information. To arrive at an accurate problem description, you must:

- Ask the right questions.
- Determine and use the most appropriate tools for each situation.
- Understand how the system will react in a failure scenario.
- Set a performance baseline.

Collecting data includes:

- Identifying the hardware and software components in the system
- Asking questions to determine what failed and in what context
- Continuing to ask questions to learn as much detail as possible
- Gathering failure information such as:
  - Failure conditions from LED indicators
  - LED indicators on the System Insight Display
  - Power-on self-test (POST) messages
  - Diagnostic, test, and log reports from HP Insight Diagnostics
  - Critical error log messages from the Integrated Management Log (IML)
  - HP integrated Lights-Out (iLO) log messages
  - Stop, append, and trap messages
  - Status and error reports from the HP Systems Management Homepage
  - HP Systems Insight Manager (HP SIM) error conditions
  - Status information reported by HP Insight Management Agents
- Organizing the collected data



## Establishing a baseline

Before you can begin to identify a system failure, you must understand how the system should operate under normal circumstances. Recognizing when a system is performing normally and understanding what a system requires to operate properly will help you to identify a malfunctioning system.

You also should be able to recognize the warning signs of a failing component. These signs or symptoms might include consistent or intermittent error codes, loss of functionality, or a change in the time required to perform a task.

Among other topics, you should understand:

- When, why, and which LEDs illuminate
- In what order system components power up, especially when external storage enclosures are configured
  - **Power-up**—External storage enclosures first, then the servers
  - **Power-down**—Servers first, then external storage enclosures
- The importance and methods of SCSI termination
- The boot load order of files

Not understanding how a system or subsystem operates can lead to unnecessary part replacement, software upgrades that might not address the problem being reported, and wasted time and effort. These actions lead to unnecessary downtime and reduced customer satisfaction.

Creating a performance baseline is essential in determining normal operating parameters for a server. A baseline is a set of critical data used as a control. When creating a performance baseline, you capture the current state of your server or network performance and use this information as the starting point for comparing future performance levels.

**Important**

This baseline should be captured after the initial installation of the equipment, during normal daily operation. The baseline should be updated after any hardware or software additions to the system.

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The HP Insight Performance Manager Module is an integrated management software solution that enables the monitoring of performance on one or more servers and supported shared storage solutions. The performance information is analyzed to reveal a building or existing performance bottleneck issue.

The manuals and CDs that ship with HP systems and options can help you to identify normal activity and proper system setup. Other useful references from HP include:

- **Maintenance and service guides (MSGs)**—Provide system specifications as well as symptoms of failures and troubleshooting hints
- **Setup and installation guides (SIGs) and reference and troubleshooting guides (RTGs)**—Provide essential information needed for setup, installation, and troubleshooting of ProLiant servers
- **ProLiant Servers Troubleshooting Guide**
- **PartSurfer**—Provides access to parts information for a wide range of HP products
- **Onsite Agents Reference Set (OARS)**
- **Services Media Library**

Depending on your situation, the online or printed reference might be more useful for finding a part number, upgrade information, jumper setting, or other details.

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## Collecting system data

To identify the source of the problem and suggest a solution, you must gather data from hardware subsystems and the operating system. HP and original equipment manufacturers (OEMs) provide a variety of tools to help you collect data.

- **HP**—Provides several methods for viewing system data. Some of these utilities are integrated into the server, and all complement each other.
  - **System Management Homepage**—Provides a consolidated view of all system health and configuration information and simplifies access to HP web-enabled management software running on ProLiant servers
  - **Insight Management Agents**—Enable you to view subsystem and status information from a web browser, either locally or remotely
  - **Diagnostics functionality of Array Configuration Utility**—Runs from SmartStart or from the operating system (Microsoft Windows or Linux)
  - **ProLiant Network Configuration Utility**—Enables you to configure and monitor HP network interface controllers (NICs) running in a Windows environment
  - **Integrated Management Log**—Records significant events that occur during system operation
  - **Insight Diagnostics online and offline editions**—Gathers critical hardware and software information and provides comprehensive server configuration information
  - **Intelligent Platform Management Interface (IPMI) Event Log**—Monitors and reports events on ProLiant 100-series servers, depending on the server, and might be called the Event Log
  - **BladeSystem Onboard Administrator**
- **Red Hat and Novell**—These OEMs offer Linux products—Red Hat Linux Advanced Server and Novell SUSE Linux Enterprise Server (SLES)—and monitoring tools that provide information about the running kernel:
  - **iostat**—Measures I/O and processor statistics for devices and partitions
  - **vmstat**—Reports virtual memory information
  - **netstat**—Monitors network information
  - **top**—Measures top processor processes

- **sar**—Measures system activity information and compiles cumulative statistics over a specified period of time

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**Note**

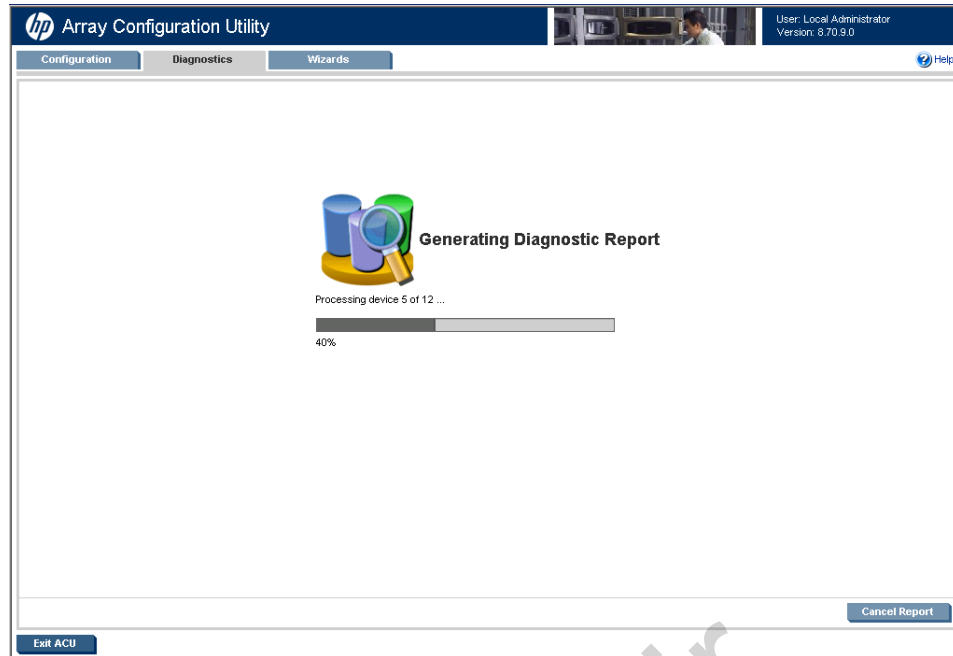
To use `iostat` and `sar` in SLES, you must install the `sysstat` package.

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- **Microsoft**—Windows Server feature tools for event management, monitoring and alerting, reporting, and trend analysis:
- **System Monitor**—Used to monitor local or remote system performance and to set counters as needed. You can collect and view extensive data about the usage of hardware resources and the activity of system services on the computers you administer. This tool provides a general, customizable mechanism to view various counters and other metrics within a running application.
- **Task Manager**—Provides information about programs and processes running on your computer.

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## Array Configuration Utility—Diagnostics functionality



Array Configuration Utility—Generating a diagnostic report

HP now includes diagnostics functionality in the Array Configuration Utility (ACU) to help quickly identify such problems as:

- An incorrect version of firmware
- Drives installed in the wrong order
- Inappropriate error rates
- A failed battery on the array accelerator board

Now, both configuration and diagnostic features are combined in a single tool.

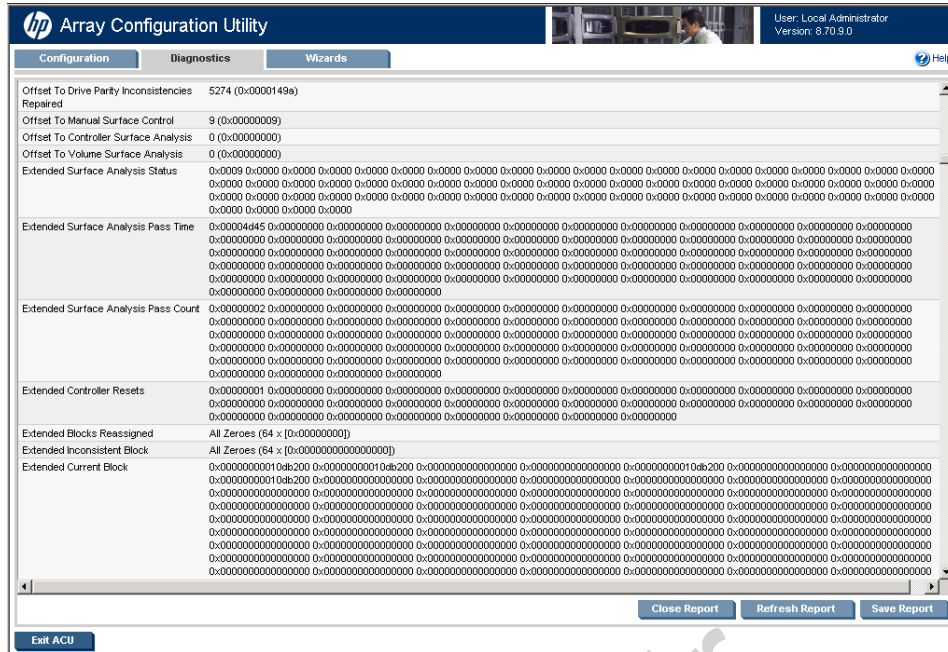
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**Note**

The Array Diagnostics Utility (ADU) is also available as a stand-alone component accessible from the Windows operating system, but is no longer updated.

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## Using the ACU



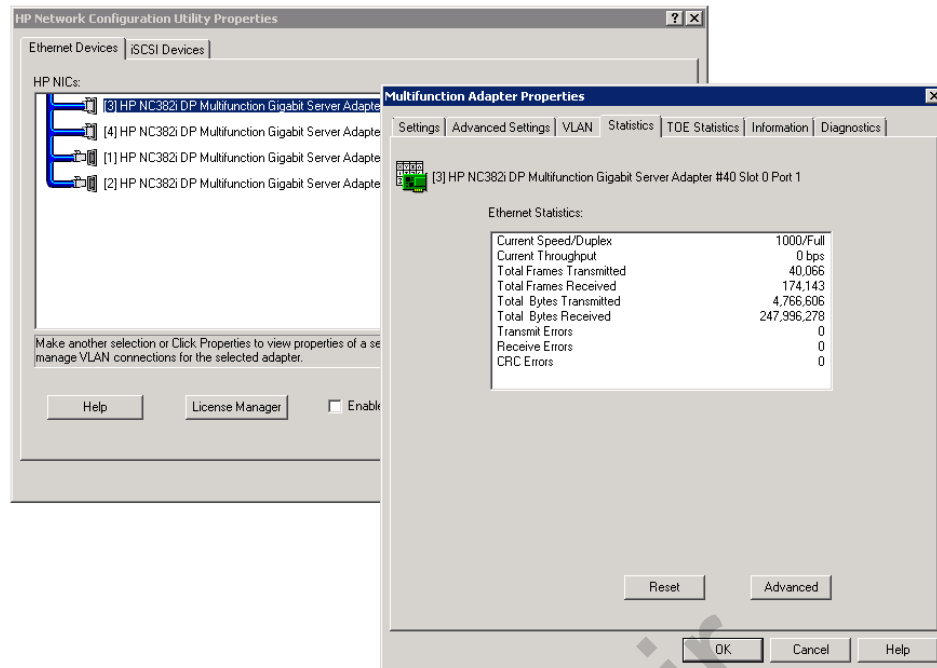
Diagnostics screen in ACU

To run the ACU, start the system from the SmartStart CD and then run the utility.

When you start the ADU, a window displays any errors that are detected. If no errors are detected, the ADU main dialog box displays information about the array controllers, SCSI bus, and physical drives.

Use diagnostics functionality of the ACU or the ADU to diagnose array controllers and generate a list of detected problems. If the cause of a problem is still not apparent, the ADU can generate a full report that administrators can fax or email to HP Customer Service for phone support.

## HP Network Configuration Utility



HP Network Configuration Utility

With the HP Network Configuration Utility, you can configure and monitor ProLiant NICs.

The Network Configuration Utility displays a list of recognized NICs and statistics regarding their current state. This information includes the current speed, duplex settings of the NIC, and the current throughput of Gigabit NICs.

If you see the cable fault icon next to the NIC, recheck the network connections and ensure that the switch or hub is working properly. After the connection is restored, you should no longer see this icon.

To install the Network Configuration Utility, download the Smart Component to a directory on your hard drive and change to that directory.

There are two ways to access the ProLiant Network Configuration Utility:

- From the Windows Control Panel, double-click the **HP Network** icon.
- Double-click the **HP** icon in the Windows system tray.

## Integrated Management Log

The IML utility is integrated into the server to record all server-specific events. Events are unusual system occurrences. The log tracks events recorded by the health drivers, such as operating system information and ROM POST codes.

This Nonvolatile RAM (NVRAM) Log records events and errors for a post-diagnosis review, helping to promptly identify server failures. The information displayed for each log entry includes a description of the event, the number of times the event has occurred, the initial time and date the event occurred, and the time and date the event was last updated.

The preceding graphic shows the type of information that can be viewed in the IML.

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## HP ProLiant Integrated Management Log Viewer

Description	Class	Severity	Count	Update Time
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	1	6/26/2011 2:02 AM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	1	6/26/2011 2:02 AM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	3	6/25/2011 2:57 PM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	3	6/25/2011 2:57 PM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	2	6/25/2011 1:11 PM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	2	6/25/2011 1:11 PM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	1	6/25/2011 12:16 PM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	1	6/25/2011 12:16 PM
POST Error: 1729-Background Parity Initialization Not Yet Complete	POST Messages	Caution	6	6/25/2011 11:38 ...
POST Error: 1794-Slot X Drive Array - Array Accelerator Battery is ch...	POST Messages	Caution	2	6/25/2011 11:21 ...
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	1	6/21/2011 8:43 AM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	1	6/21/2011 8:43 AM
POST Error: 1729-Background Parity Initialization Not Yet Complete	POST Messages	Caution	1	6/21/2011 8:41 AM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	1	6/21/2011 2:28 AM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	1	6/21/2011 2:28 AM
POST Error: 1794-Slot X Drive Array - Array Accelerator Battery is ch...	POST Messages	Caution	1	6/21/2011 2:27 AM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	3	6/20/2011 2:19 AM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	2	6/20/2011 2:19 AM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	3	6/13/2011 3:57 PM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	3	6/13/2011 3:57 PM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	1	6/13/2011 2:06 PM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	2	6/13/2011 2:06 PM
Network Adapter Link Down (Slot 0, Port 4)	Network Adapter	Critical	1	6/13/2011 1:24 PM
Network Adapter Link Down (Slot 0, Port 3)	Network Adapter	Critical	1	6/13/2011 1:24 PM

IML view

The HP ProLiant Integrated Management Log Viewer utility enables you to view and manage IML system event entries on a local or remote system. The IML entries can be:

- Sorted by description, class, severity, count, update time, and initial time
- Filtered by class, severity, update time, and initial time
- Printed
- Exported to a comma-separated file for importing into third-party applications such as spreadsheets
- Saved in a binary format for viewing at a later date or different location

The IML can also be viewed from the Insight Diagnostics online and offline (SmartStart) editions. In addition to manipulating the displayed entries, you can effect changes to the IML on a system. With appropriate administrator privileges, you can:

- Enter maintenance notes
- Mark selected entries as repaired
- Clear the IML of all entries, effectively deleting the log from nonvolatile memory

The IML Viewer is available for Microsoft Windows, Novell NetWare, and Linux server platforms.

**INTERNET**

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For the latest information about operating system support, refer to the support matrix at:

**<http://www.hp.com/go/supportos>**

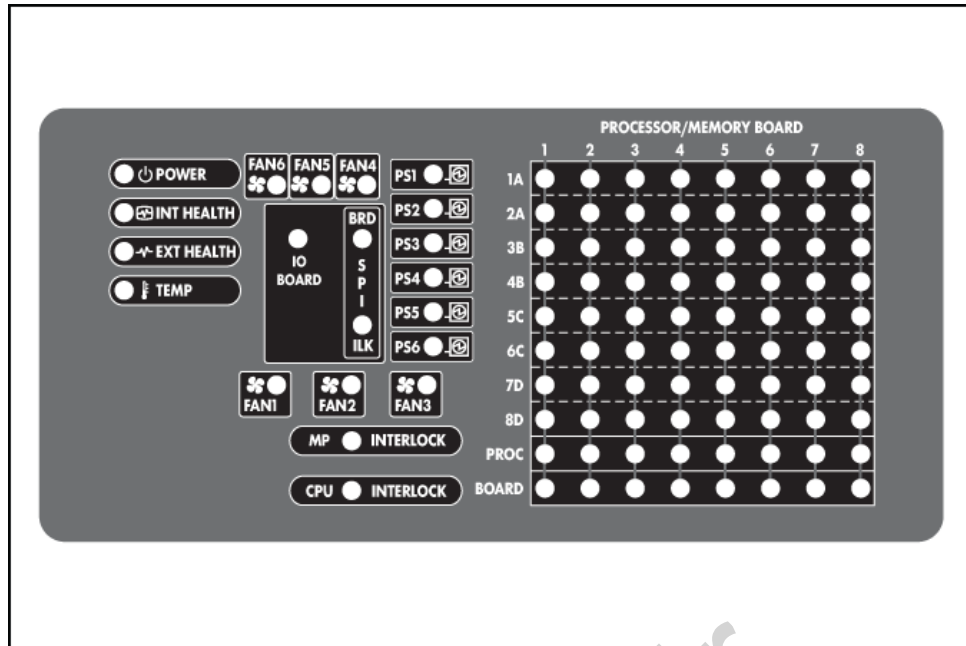
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The IML Viewer is based on a client/server architecture. It can run on any machine and connect to any machine on the network that is running the HP ProLiant Remote Monitor Service.

The ProLiant Remote Monitor Service provides support for HP PCI Hot-Plug devices and remote management utilities. This service gives hot-plug device drivers a way to communicate among themselves and a way to log events to the Microsoft Windows Server Event Logs. In addition, this service enables client utilities to gain access to remote machines.

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## System Insight Display



System Insight Display for a ProLiant DL785 G5 server

The System Insight Display provides an easy front view of system component health and at-a-glance server diagnostics. It is available in most ProLiant servers.

The front panel health LEDs indicate only the current hardware status. In some situations, HP SIM might report server status differently than the health LEDs because the software tracks more system attributes. The System Insight Display LEDs identify components experiencing an error, event, or failure.



### Caution

Do not block airflow by pushing the System Insight Display (SID) flush against the server while it is in the down position.



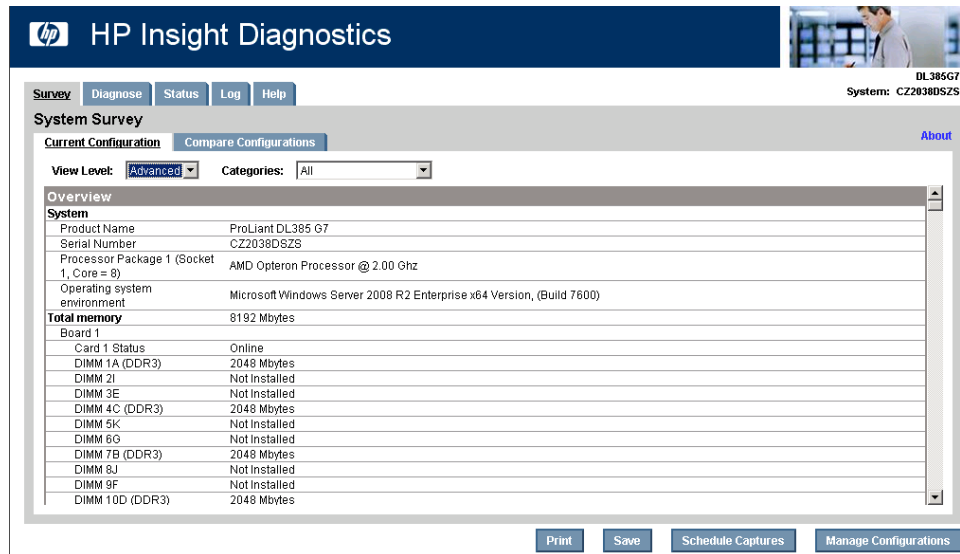
### Important

When removing the access panel to view the Systems Insight Display LEDs, leave the server powered on. The Systems Insight Display LEDs are cleared when the server is powered off.

### Note

The system management driver must be installed for the internal system health LED to provide prefailure and warranty conditions.

## HP Insight Diagnostics



The screenshot displays the HP Insight Diagnostics interface. At the top, there is a navigation bar with tabs for 'Survey', 'Diagnose', 'Status', 'Log', and 'Help'. The 'Survey' tab is active. Below the navigation bar, the system ID 'DL385G7' and 'System: C22038DSZ5' are visible. The main content area is titled 'System Survey' and includes a 'Current Configuration' section with a 'View Level' dropdown set to 'Advanced' and a 'Categories' dropdown set to 'All'. Below this is an 'Overview' section with a table of system details:

System	
Product Name	ProLiant DL385 G7
Serial Number	C22038DSZ5
Processor Package 1 (Socket 1, Core = 8)	AMD Opteron Processor @ 2.00 Ghz
Operating system environment	Microsoft Windows Server 2008 R2 Enterprise x64 Version, (Build 7600)
<b>Total memory</b>	<b>8192 Mbytes</b>
<b>Board 1</b>	
Card 1 Status	Online
DIMM 1A (DDR3)	2048 Mbytes
DIMM 2I	Not Installed
DIMM 3E	Not Installed
DIMM 4C (DDR3)	2048 Mbytes
DIMM 5K	Not Installed
DIMM 6G	Not Installed
DIMM 7B (DDR3)	2048 Mbytes
DIMM 8J	Not Installed
DIMM 9F	Not Installed
DIMM 10D (DDR3)	2048 Mbytes

At the bottom of the screen, there are buttons for 'Print', 'Save', 'Schedule Captures', and 'Manage Configurations'.

HP Insight Diagnostics main screen

HP Insight Diagnostics simplifies the process of effectively identifying, diagnosing, and isolating hardware issues.

You can choose to run this tool in either the Online Edition or the Offline Edition, depending on the service situation or your preference. The features in the two editions are somewhat different.

Use Insight Diagnostics as a step in standard troubleshooting procedures. When a server problem occurs:

1. Ensure that all firmware is current.
2. Check the server health and status LEDs.
3. Use Insight Diagnostics Survey report to verify the hardware configuration.
4. Use the IML to look for system errors.
5. Use the online diagnostics or the offline tests to help validate the hardware.

Insight Diagnostics provides higher system availability through the following features:

- **Online installation and operation**—You do not need to take the system offline or restart the system to use Insight Diagnostics.
- **Comprehensive configuration capture under a single tool**—Insight Diagnostics gathers detailed hardware and operating system configuration information under a single tool.
- **Automatic configuration audit trail**—Insight Diagnostics automatically maintains a configuration history for the system. By storing multiple configuration snapshots and highlighting changes and differences, the utility can provide a detailed record of the system history.
- **IML**—Insight Diagnostics can manage the system IML on supported systems.
- **Remote capability**—Insight Diagnostics allows remote access to a server through a browser interface.

This combination of features simplifies the service process and minimizes the downtime experienced by a system.

Typical uses of the Insight Diagnostics utility are to:

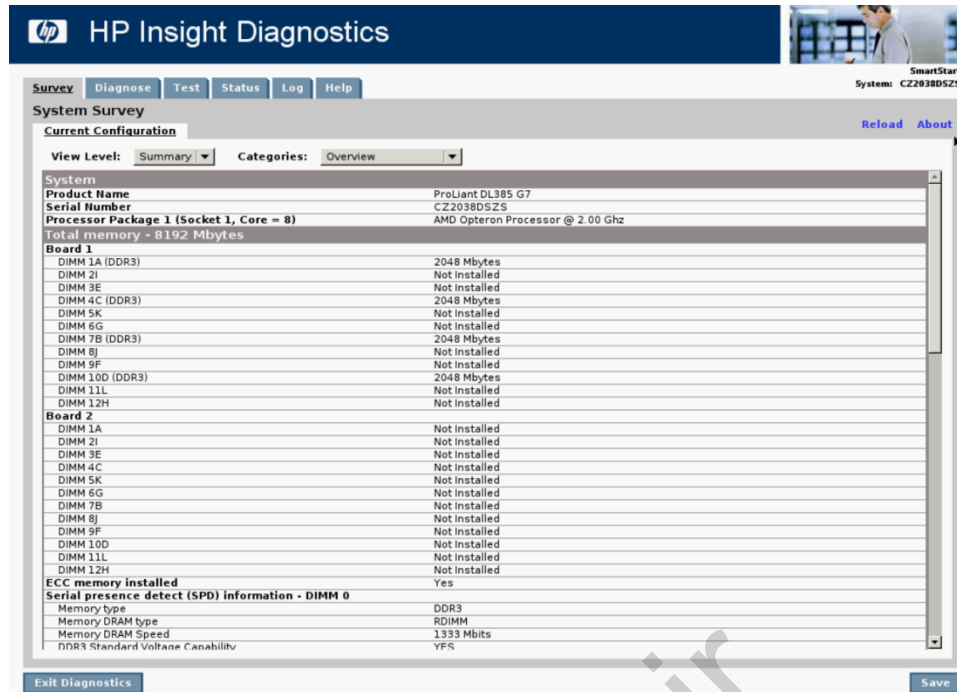
- Document system configurations for upgrade planning, standardization, inventory tracking, disaster recovery, and maintenance
- Compare historical configurations on the same system
- Save configuration information for in-depth troubleshooting

## Using HP Insight Diagnostics Offline Edition

The HP Insight Diagnostics Offline Edition only runs when the system is not running and the server is not in production. Software information from the server is not available to the diagnostics in the offline mode.

The Insight Diagnostics Offline (SmartStart) Edition is a service tool that contributes to the serviceability and availability of ProLiant servers. Its main features help you to troubleshoot and isolate hardware issues. Access the features by clicking the tabs at the top of the Insight Diagnostics screen.

## Survey tab



Survey tab of Insight Diagnostics

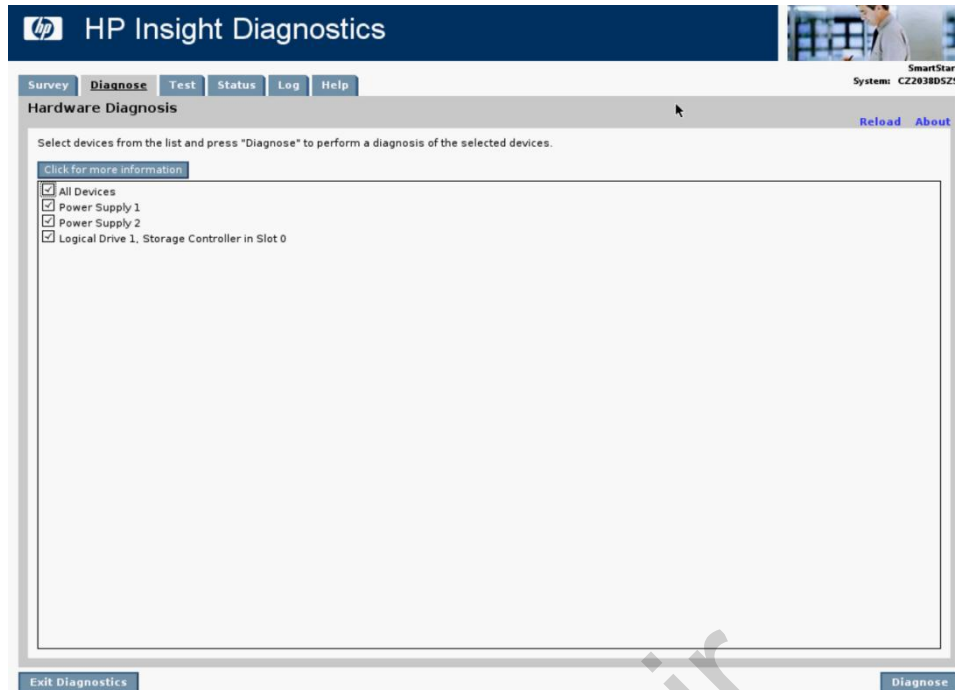
The Survey tab provides a comprehensive view of the server hardware. This system survey enables you to check for proper configuration and see other information such as firmware revision levels.

The Insight Diagnostics Survey feature captures system hardware configuration data. The survey collects the current system information each time Insight Diagnostics is loaded.

When troubleshooting an issue, use the Survey feature to check the firmware revisions and hardware configuration of the server. In general, all firmware in the server should be at the latest revision. The Survey feature can be used to look for devices that have firmware revisions with known issues, which can then be upgraded. The hardware configuration can be checked to ensure that all hardware is configured properly for its intended use.

Survey information can be saved in HTML format and viewed by any standard web browser.

## Diagnose tab



Diagnose tab of Insight Diagnostics

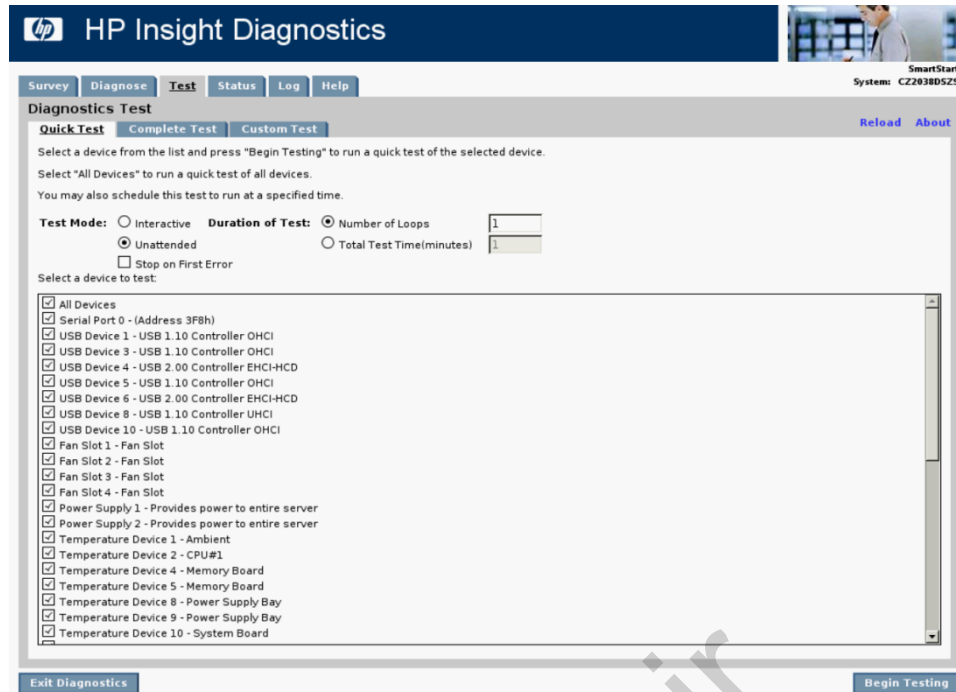
While the system is online and the operating system is operating, the HP Insight Diagnostics Diagnose feature performs diagnostic testing on the following devices:

- Hard drives attached to an HP Smart Array Controller
- Power supplies that are deemed diagnosable

If the computer does not have any logical volumes or power supplies that are diagnosable, the following message displays:

System does not have any diagnosable devices installed.

## Test tab



Test tab of Insight Diagnostics

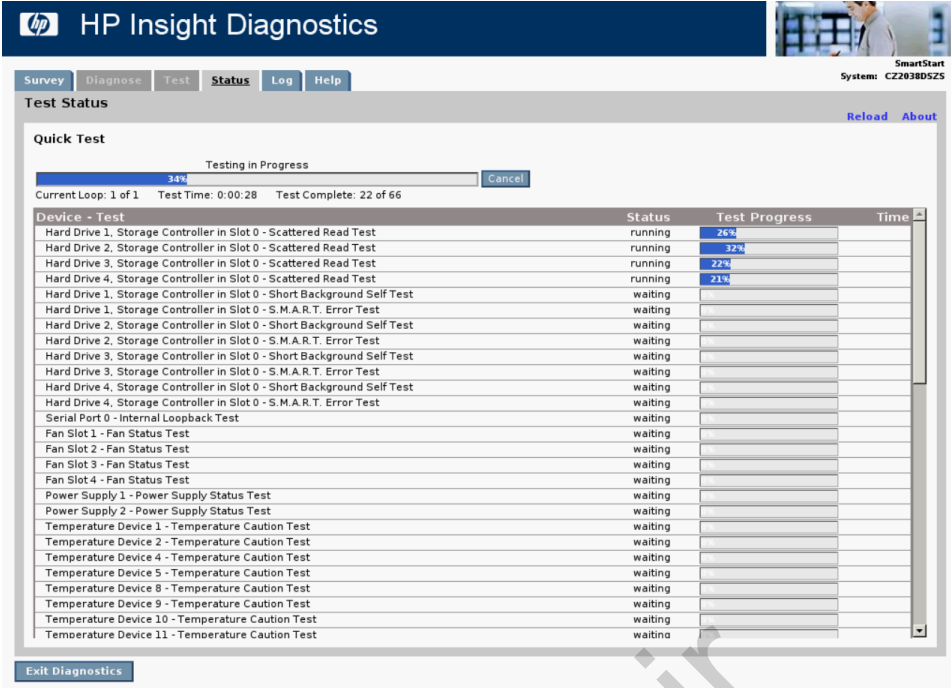
The Test tab provides a set of tests that can be run for the whole server or for individual components.

You can test the functionality of all the major hardware components in the system. The Test feature lets you customize test selections by providing the following modes and types of testing:

- **Quick Test**—Provides a predetermined script where a sample of each hardware component is exercised. This test requires no user intervention.
- **Complete Test**—Provides a predetermined script where each hardware component is fully tested.
- **Custom Test**—Provides the most flexibility in controlling the testing of the system. The Custom Test mode lets you select which devices, tests, and test parameters to run.
- **Interactive Mode**—Runs all tests, some of which require user responses.
- **Unattended Mode**—Requires no user action. Tests that require user action are not executed.



### Status tab

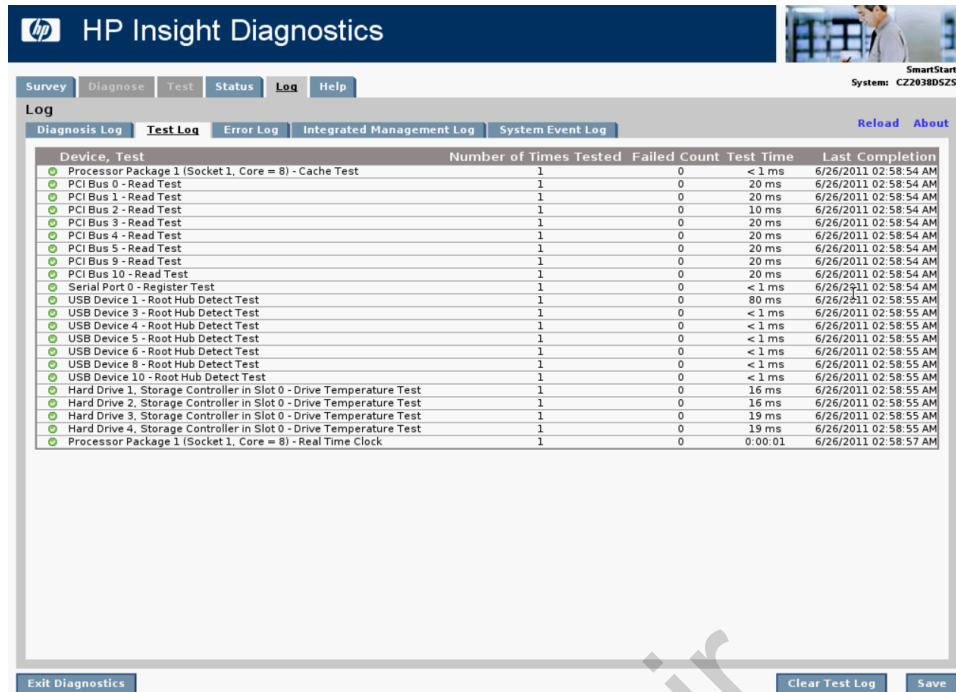


Status tab of Insight Diagnostics

The Status tab provides the ongoing progress and results of any tests. It also lets you cancel an ongoing test.

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## Log tab



Log tab of Insight Diagnostics

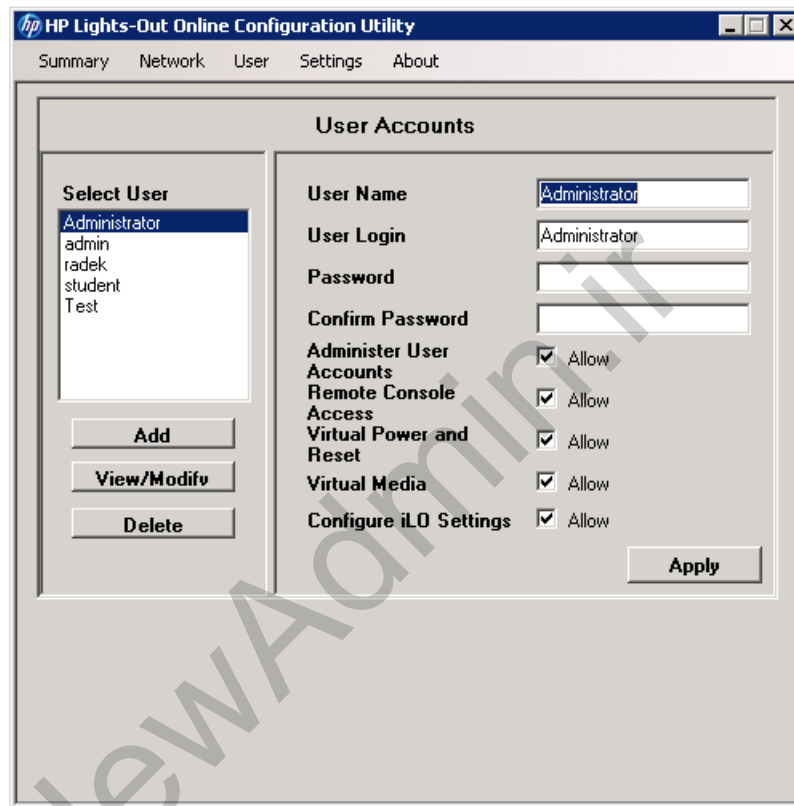
The Log tab contains detailed error information and repair actions to assist the troubleshooting process.

The Log tab provides five views:

- **Diagnosis Log**—Displays the following information: status indicator for each power supply or logical volume diagnosed, specific power supply or logical volume diagnosed, number of times the diagnostic test was run, number of times the diagnostic test failed, and the time required to complete the diagnostic test.
- **Test Log**—Displays all tests that have been executed, the number of times they were each executed, the number of times the test failed, and the amount of time it took to complete each test. You can also clear the contents of the Test Log or save it to an HTML file on a storage device such as a USB disk or diskette.
- **Error Log**—Displays the tests that failed during testing. Besides displaying the device and test, this section might also include error details. The description section describes the error that the diagnostic test found. The Recommended Repair section provides corrective actions. The error count is the number of times the test has failed. The contents of the Error Log can be cleared.

- **Integrated Management Log**—The diagnostic utility can add notes, clear, and mark for repair items in the IML (on supported systems). The IML records system events, critical errors, power-on messages, memory errors, and any catastrophic hardware or software errors that typically cause systems to fail. The errors and events might be discovered during POST or by the System Management driver during normal operations. IML records are dated and have severity levels and error counts that can be used to help isolate the problem.
- **System Event Log**—Display time and amount of occurrences of several system sensors, such as last finished boot process or last operating system critical stop.

## HP Lights-Out Online Configuration Utility

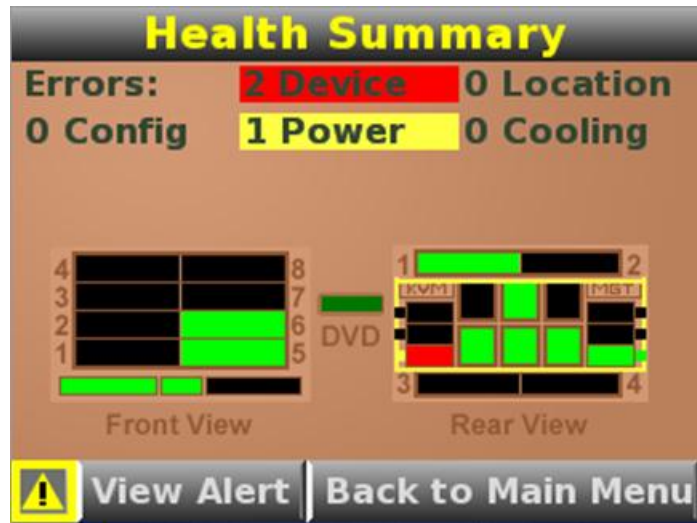


HP Lights-Out Online Configuration Utility

The HP Lights-Out Online Configuration Utility can be used to configure an iLO 2 or iLO 3 card while a Windows operating system is running. Use this tool to configure all aspects of integrated Lights-Out on the server, including networking, users, and security.

This tool is installed during standard ProLiant Support Pack (PSP) installation. When you are logged in to the operating system, you do not have to provide any passwords to use this tool.

## Systems Insight Display for c-Class BladeSystem



c-Class Insight Display

The Systems Insight Display on the front of the enclosure is a BladeSystem c-Class enclosure feature only. The display allows fast setup of the enclosure and displays enclosure and server status.

In its standard display mode, the Systems Insight Display has a green background, indicating that all systems are functional. When the background color changes to red, service for one or more components is required. The Systems Insight Display also helps to prevent misconfigurations (power supplies and fans in unsupported locations). All features of the Systems Insight Display are also accessible from within Onboard Administrator.

## BladeSystem Onboard Administrator

HP BladeSystem Onboard Administrator is the enclosure management processor, subsystem, and firmware base used to support the c-Class enclosure and all the managed devices contained within the enclosure.

Onboard Administrator provides a single point from which to perform basic management tasks on server blades or switches within the enclosure. Onboard Administrator performs configuration steps for the enclosure, enables run-time management and configuration of the enclosure components, and informs you of problems within the enclosure through email, SNMP, or the Insight Display.

Different user interfaces to the Onboard Administrator allow control and provide information about the enclosure and installed components. The most important interfaces are the web interface GUI and the scriptable command line interface.

The port mapping feature shows the relationship between server ports and ports on interconnected modules, so no documentation is required for LAN or SAN cabling and port assignment.

The uppermost uplink port can be used as an auxiliary port for servicing purposes. Before accessing the Onboard Administrator for the first time, an IP address must be set up using the Systems Insight Display or the Dynamic Host Configuration Protocol (DHCP). All functionality of the Onboard Administrator is available as standard; no licensing is involved.

New Administrator

## Diagnostic tools for ProLiant 100 series servers

Some diagnostic tools are specific to the ProLiant 100 series servers:

- Intelligent Platform Management Interface (IPMI) Event Log
- Watchdog Timer
- Server Board Management Controller (BMC)

### IPMI Event Log

The IPMI Event Log is a useful troubleshooting tool. It might also be called the Event Log, depending on the server.

You can access it from **BIOS Setup Utility** → **Advanced Menu** on ProLiant 100 series servers.

You can troubleshoot components, such as fans and temperature, by using the information recorded in this log. Depending on the server, it monitors and reports on the following events:

- Fan
- Memory—ECC
- Processor presence
- Voltage—VRM failure
- Temperature
- Firmware-suspected firmware errors, ATAPI device errors
- Watchdog Timer, which is similar to Automated Server Recovery (ASR)

### Watchdog Timer

In ProLiant 100 series servers, the Watchdog Timer is available instead of ASR. Use the Watchdog Timer to perform a power recycle and restart the server (similar to the ASR capability in the ProLiant 300, 500, and 700 series servers). This device can be set and enabled or disabled in the BIOS Setup Utility to monitor system events.

### Server Board Management Controller

The BMC provides server management monitoring capability by enabling communication over the IPMI interface. BMC resides on the motherboard and combines the following items into a single chip:

- Remote manageability
- Remote alerting
- Remote BIOS checking and switching functionality as defined by the IPMI specification

The BMC version displays during POST and logs events to the IPMI Event Log. (ProLiant DL140 servers provide the BMC Upgrade Utility, which enables you to upgrade the system firmware.)

The BMC on the server board provides management and monitoring capabilities. Flash memory holds the operational code, sensor data records, and system event log (SEL), also called the IPMI Event log, or Event Log. A serial EEPROM holds the BMC configuration defaults and field replaceable unit (FRU) information.

The BMC supports the following:

- Server board voltage monitoring
- Fan failure detection
- Fan speed control
- Processor voltage monitoring
- Processor presence detection
- Processor internal error (IERR) monitoring
- Fault resilient booting (FRB)
- Processor-disable control
- Watchdog Timer
- Periodic system management interrupt (SMI) timer
- I2C master controller for the Intelligent Platform Management Bus (IPMB)
- Three private I2C management bus interfaces
- Server management software (SMS) and server management mode (SMM) IPMB message receiver
- Event message receiver
- SEL management and access
- Sensor data record (SDR) repository management and access
- Processor nonmaskable interrupt (NMI) monitoring
- Processor SMI monitoring
- Time-stamp clock
- Secure mode, video blank, and floppy write protect
- Software front panel NMI generation

## Step 2—Evaluate the data to determine the subsystems causing the issue

After you collect data and identify the symptoms, evaluate all of these facts and symptoms to:

- Determine which components could cause what happened
- Isolate faults to a hardware or software subsystem
- Understand the mode of failure

### Processor issues

Processor performance is arguably the most misunderstood factor in system performance. When processor speed increases, other system component factors must be considered in addition to their overall integration. For these reasons, a 3GHz processor system is not exactly 10 times faster than a 300MHz processor system.

Further complicating the issue are multiprocessor systems. Two processors do not double the speed of the system because both the operating system and the application must be able to scale to the extra processor to leverage maximum performance from the system. As with processor speed, multiprocessor configurations do not increase system performance linearly.

Considering that processors are seldom used to their capacity, replacing a slower processor or adding a second one might not lead to the expected performance increase.

### Optimizing processor performance

Windows performance counters and other operating system tools can be used to analyze the performance data provided by applications, services, and drivers. You can then use this information to fine-tune system and application performance. For example, if the performance counters in the Windows System Monitor indicate 80% to 100% processor utilization, you must take steps to optimize processor performance.

Insight Control performance management can also be used to help optimize processor performance before and after modifications are implemented.

However, before proceeding further, you should check that high processor utilization is not caused by some other server subsystem failure or under-sizing (for example, lack of RAM).



Determining the best plan of action depends on whether tasks are being executed serially or in parallel. For optimal performance, you can:

- **Upgrade to faster processors**—Consider upgrading to faster processors if the processor executes each task serially until it is accomplished.
- **Add more processors**—Consider adding more processors if each processor executes tasks one at a time. More processors acting in parallel enable several tasks to execute concurrently.

## Memory issues

When the operating system loads, it allocates available memory to itself and other components such as device drivers. When applications load, they get clearance from the operating system to occupy memory.

Operating systems and applications also set aside memory for temporary usage, which can grow considerably under heavy load. At some point, lower priority transactions are cached in a temporary file on the hard disk to optimize remaining memory. Insufficient system memory can result in excessive temporary file access (called **paging**), which slows down the system because accessing the hard disk is slower than accessing RAM.



### Important

For optimal system performance, it is important to prevent paging.

---

## Optimizing memory performance

For the best memory performance, you must ensure that the applications running on the server have sufficient memory and memory cache. To optimize memory performance, you can:

- Add more RAM
- Reallocate the existing memory to minimize the file system cache and to maximize the available memory to the application cache
- Reallocate memory modules to use interleaving because current ProLiant server models use three-way interleaving.

## Storage issues

Many factors affect storage subsystem performance. If the bus is too narrow or controller bandwidth is too low, read/write requests will be delayed and the disk drives might be underutilized. If the drives themselves are too slow, read/write responses will be delayed.

If both bandwidth and the drives are experiencing excessive utilization, the overall system is approaching saturation. Excessive page file hits can reduce the I/O bandwidth needed for other transactions.

If an array controller is present, its read/write priority and stripe-size setting can also have an effect. The type and speed of the drive are also factors.

## Optimizing storage performance

To optimize storage performance, you must consider all the factors affecting performance. The following concepts apply in most situations:

- **Capacity**—In random I/O environments, more spindles might be necessary. In a sequential I/O profile, you might need to add more controllers.
- **Transfer rate (MB/s)**—In a sequential I/O environment, add more controllers.
- **I/O per second**—In a random I/O environment, add more spindles and use disks with faster rotational speed.

The factors that determine the overall performance of the disk subsystem include:

- **Seek time**—The time required to position read/write heads over the correct track and cylinder. Seek time is insignificant in sequential I/O environments but important in random I/O environments. It increases with the fill factor (percentage of the disk drive capacity being used) of the disk drives.  
Performance enhancements, such as elevator seeks (also called **elevator sorts**) decrease the seek time by servicing I/O requests along the current read/write head path.
- **Rotational latency**—The time required to position the target sector within the track under the read/write heads. Like seek time, rotational latency is insignificant in sequential I/O environments but important in random I/O environments.
- **Queue time**—The time each I/O request spends in the queue waiting to be processed. When the queue is long, the disk subsystem is saturated with requests and takes longer to process each I/O request. Queue time is an important consideration for both random and sequential I/O profiles because when a request is waiting in the queue, it is not performing any useful work.

- **Transfer time**—The time required to transfer a specific amount of information from the disk drives to the application. Random I/O environments transfer small amounts of data, and the transfer time typically does not impact performance. Sequential I/O environments transfer large amounts of data, and the transfer time is an important factor.
- **Performance capabilities of disk drives and array controllers**—Refer to the maximum performance limit of each type of disk drive and array controller. This limit is either a specific number of random I/O requests per second (random I/O profile) or a specific number of MB/s (sequential I/O profile). Any work beyond this limit waits in the queue and results in significantly increased latencies.
- **RAID level and overhead**—Specific overhead associated with each RAID level. For example, RAID 5 must perform an average of four physical I/O transactions for every logical write it receives. This overhead affects the performance levels of both the disk drives and the array controller.

## Physical and logical I/O

When considering the storage subsystem, it is important to understand the difference between physical and logical I/O.

- **Physical I/O**—Refers to the number of I/O requests that the array controller sends to the disk drives, using the array controller as the reference point. This calculation includes RAID overhead when applicable.
- **Logical I/O**—Refers to the number of I/O requests that the operating system or the application sends to the array controller for processing. It does not include RAID overhead because hardware RAID is transparent to the operating system and application.

### Example

If the application sends 1,000 logical requests per second to the array controller with RAID 5, and 750 are reads and 250 are writes, the resulting physical I/O is as follows:

- 750 physical reads resulting from 750 logical reads
- 250 x 4 physical I/O transactions resulting from 250 logical writes
- Total of 1,750 physical I/Os

Each physical disk drive should not be servicing more than 150 physical random I/O requests per second. Therefore, in this example, 10 drives would be saturated by this I/O profile (1,750 physical I/Os ÷ 10 drives = 175 I/Os per second per disk drive), but 15 drives would not be saturated.

Write performance is impacted more by RAID level than read performance. RAID 0 has the least impact on write performance, and RAID 6 (ADG) has the most impact. The impact on write performance is caused by the data redundancy overhead associated with a RAID level:

- **RAID 0**—Provides no data redundancy, and, therefore, has no impact on performance
- **RAID 1+0**—Generates two physical writes for every logical write
- **RAID 5**—Generates four physical I/O requests (two reads and two writes) for every logical write
- **RAID 6 (ADG)**—Generates six physical I/O requests for every logical write

Therefore, the RAID level of the storage subsystem impacts performance and should be considered. Other factors that impact storage subsystem performance include:

- Application environment and the associated I/O profile
- Amount of memory and memory configuration
- Amount of array controller cache and its configuration

## Designing storage environments

When designing storage subsystems, consider the following HP recommendations, based on the predominant application environments:

- **High I/O capacity environments**—Measured in I/O requests per second, these environments should be designed with a high drive-to-controller ratio to ensure maximum requests per second. For example, an online transaction-processing database requires several disk drives connected to a few high-performance array controllers.
- **High-bandwidth environments**—Measured in MB/s, these environments should have the lowest drive-to-controller ratio, which effectively spreads the required capacity over more controllers to maximize bandwidth. For example, a file or video streaming server requires a few wide-bus array controllers and drives.
- **General business environments**—Designed to accommodate low-volume transaction processing, these environments should have a low drive-to-controller ratio to effectively spread the required capacity over more controllers and maximize bandwidth. Additionally, their balanced design should accommodate transaction-processing requests and have the flexibility to add disk drives.

## Networking issues

Poor network server or workstation performance is often associated with physical network problems. In an overly congested or poorly designed network, the performance level of a server or workstation can do little to improve overall network performance.

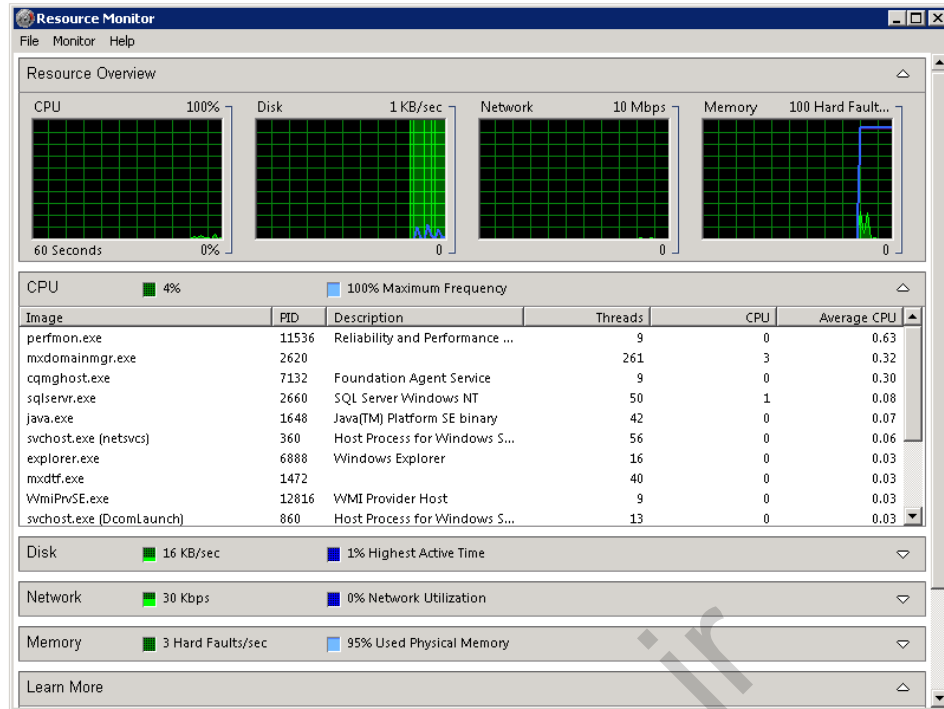
In a resource-sharing environment, the network communications subsystem, because of its heavy use in this environment, is one of the most likely places for network performance problems. The resolution can involve adding more NICs and rebalancing the network load or adding more network bandwidth.

When modifying any network, document all modifications to ensure that accurate records are available if a similar network problem occurs at a later date.

NIC performance problems limit the amount of data that can be handled by the server. Monitoring this subsystem involves:

- Eliminating NIC queuing
- Identifying bandwidth deficiencies
- Controlling processor and I/O bus overhead attributed to the NIC
- Optimizing NIC-related configuration parameters
- Properly configuring the network infrastructure

## Evaluating performance in a Windows environment



Windows Resource Monitor in Windows Server 2008

Before any changes are made to a system, gather information to understand the perceived performance problems and to establish a performance baseline. Interpreting the data comes next, followed by a decision to change one variable of the potential problem.

You can use the System Monitor for real-time monitoring and logging for a baseline. Over time, this data can help identify system bottlenecks. In Windows Server 2003 and earlier versions, the System Monitor is located under the Administrative Tools icon in the Control Panel.

After the tool is started, you can add various counters to the System Monitor feature to track performance of a local or remote computer. You can choose related counters and specific instances from several performance object categories. Specific instances refer to the ability to choose a specific processor or page file, or all. Not all counters have multiple instances to choose from.

Although some of the counters represent averages for read/write requests, separate counters for read and write operations can be used to gain a more specific view of activity.

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### Note

To see an explanation of each counter, click **Explain** in the Add Counters window after clicking the + icon in System Monitor.

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Some counters have different scales, so it is important that the scale of one counter does not affect the readability of the other counters. Counter scales can be adjusted by right-clicking the counter in the legend area at the bottom of the Performance window and selecting **Properties** → **Data**. This tab in the System Monitor Properties window enables you to adjust the color, scale, width, and style of each counter. Other tabs allow you to adjust the General, Source, Graphs, Colors, and Fonts properties.

You can monitor these counters through a browser. After you select the counters and optimize them for readability, you can save them as an .htm file by right-clicking the graph. You can open them in a browser on any computer.

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**Note**

You can also save the counters in a .tsv (Tab Separated Value) file.

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## Evaluating the processor subsystem

Two useful counters in the Processor category of System Monitor performance objects are:

- **% Interrupt Time**—Displays the percentage of time that the processor spends receiving and servicing hardware interrupts during the sample interval. This value is an indirect indicator of the activity of devices that generate interrupts, such as the system clock, the mouse, disk drivers, data communication lines, NICs, and other peripheral devices. This counter displays the average busy time as a percentage of the sample time.
- **% Processor Time**—Displays the percentage of time that the processor spends executing a non-idle thread. This counter was designed as a primary indicator of processor activity and displays the average percentage of busy time observed during the sample interval. It is calculated by measuring the time that the processor spends executing the thread of the idle process in each sample interval, and subtracting that value from 100%. (Each processor has an idle thread that consumes cycles when no other threads are ready to run.)

This counter can be viewed as the percentage of the sample interval spent doing useful work. If the processor time reaches 80%, you must replace the existing processor with a faster processor or add an additional processor.

## Evaluating the memory subsystem

Two useful counters in the Memory category of the System Monitor performance objects are:

- **Available Bytes (kilobytes or megabytes)**—Displays the amount of physical memory available to processes running on the computer, in bytes. This value is calculated by summing the space on the Zeroed, Free, and Standby memory lists.
  - **Zeroed memory**—Monitors pages of memory filled with zeros to prevent later processes from seeing data used by a previous process.
  - **Free memory**—Monitors memory ready for use.
  - **Standby memory**—Monitors memory that was removed from the working set of a process (its physical memory) while en route to disk, but is still available to be recalled. This counter displays the last observed value only; it is not an average.

If this value stays at less than 20% of installed RAM, it is an indication that you do not have enough memory. If this counter is consistently low after running an application, it indicates a memory leak.

- **Pages/Sec**—Displays the number of pages read from or written to disk to resolve hard page faults. Hard page faults occur when a process requires code or data that is not in its working set or elsewhere in physical memory, and must be retrieved from disk.

This counter was designed as a primary indicator of the kinds of faults that cause systemwide delays. It is the sum of Memory: Pages Input/sec and Memory: Pages Output/sec. It is counted in numbers of pages, so it can be compared to other counts of pages, such as Memory: Page Faults/sec, without conversion.

The counter includes pages retrieved to satisfy faults in the file system cache (usually requested by applications) and non-cached mapped memory files. This counter displays the difference between the values observed in the last two samples, divided by the duration of the sample interval.

On most servers, if this value is consistently greater than 5, it indicates an excessive amount of paging. Try to identify the application that is creating the paging condition. If this is not normal behavior for the application, adding memory might increase system performance.



## Evaluating the storage subsystem

Two useful counters in the Physical Disk category of performance objects are:

- **% Disk Time**—Displays the percentage of elapsed time that the selected disk drive is busy servicing read or write requests.
- **Avg. Disk Queue Length**—Displays the average number of read and write requests that were queued for the selected disk during the sample interval.

## Evaluating the network subsystem

When evaluating the network subsystem, you should start by making an inventory of the existing network and identifying any existing bottlenecks. The System Monitor can help you isolate performance bottlenecks.

The main concerns when searching for bottlenecks are how the network subsystem interacts with the memory, processor, and disk subsystems. Performance data for the network subsystem is collected from the network interface performance object.

### Network interface counters

The network interface performance object allows independent observation of each NIC. You must install the Network Monitor Driver from the Add/Remove Windows Components option in the Control Panel to monitor the network interface performance object.

Network interface counters include:

- **Output Queue Length**—Reports the length of the output packet queue (in packets). If the length is 2 or longer, delays are being experienced and the bottleneck should be found and eliminated, if possible. Because the requests are queued by the Network Driver Interface Specification (NDIS) in this implementation, this counter should always be zero.
- **Current Bandwidth**—Shows an estimate of the current bandwidth of the interface in bits per second. For interfaces that do not vary in bandwidth or for those where no accurate estimation can be made, this value is the nominal bandwidth.
- **Bytes Total/s**—Reports the rate at which bytes are sent and received on the interface, including framing characters (overhead associated with each bound protocol).

## Network segment counters

The Microsoft Network Monitor Agent is required to monitor the network segment object. With the Network Monitor Agent installed from the PSP, you can gather performance data using the System Monitor on the network segment object. Data is sourced through the agent and passed to the System Monitor.

The network segment counters include:

- **Network Segment: % Network Utilization**—Displays a percentage of the network bandwidth being used. It confirms data provided by the queuing counter and measures the degree of the bottleneck. Segmenting and upgrading the network infrastructure yields measurable improvements in latency and bandwidth when sustained usage is greater than 60%.
- **Network Segment: Frames/s**—Counts the number of frames transmitted on the network per second.
- **Network Segment: Bytes/s**—Displays the number of bytes transmitted on the network per second. This counter indicates segment saturation.

---

**Note**

To convert bytes/s to Mb/s, use the following formula:

$$\text{Mb/s} = [(\text{bytes/s} \times 8) \div 1024] \div 1024$$

If the Mb/s calculation approaches 60% of the network capacity, the segment has surpassed maximum efficiency and might need to be segmented.

---

- **Network Segment: Broadcasts/s**—Displays the number of broadcast frames on the network.
- **Network Segment: Multicasts/s**—Displays the number of multicast frames on the network.

---

**Note**

The Network Segment object can negatively impact system performance. The data collection for this performance object places the NIC in a promiscuous mode. When a network card is in a promiscuous mode, it reads all the network packets.

---

Additional NICs do not improve server performance if the current NIC is not close to saturation.

## Evaluating other subsystems

Other useful counters include:

- **Paging File: % Usage Peak**—Reports the amount of the page file instance in use.
- **System: Processor Queue Length**—Reports the number of threads in the processor queue. There is a single queue for processor time, even on computers with multiple processors.

Unlike the disk counters, this counter counts ready threads only, not threads that are running. A sustained processor queue of greater than two threads generally indicates processor congestion. This counter displays the last observed value only; it is not an average.

The preceding counters are useful for their ability to monitor the typical aspects of a system. Deeper inquiry requires more specific counters within a performance object category.

## Determining acceptable values for counters

Deciding whether performance is acceptable is a subjective judgment that varies significantly across user environments. The values established as the baselines for the organization provide the best basis for comparison.

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## Evaluating performance in a Linux environment

Red Hat and SUSE Linux include a variety of resource monitoring tools including:

- Commands: `free`, `watch`, and `top`
- GNOME System Monitor (a more graphically oriented version of `top`)
- `vmstat`
- Sysstat suite of resource monitoring tools

### **free**

The `free` command displays system memory utilization, for example:

```

           total      used      free   shared  buffers   cached
Mem:      255508      240268      15240        0         .7592      86188
-/+ buffers/cache: 146488      109020
Swap:      530136       26268      503868
```

The `Mem:` row displays physical memory utilization, the `-/+ buffers/cache:` row displays the amount of physical memory currently devoted to system buffers, and the `Swap:` row displays the utilization of the system swap space.

Because the `free` command, by default, only displays memory utilization information once, it is only useful for short-term monitoring or for quickly determining whether a memory-related problem is in progress. Although the `free` command can repetitively display memory utilization figures by means of its `-s` option, the output scrolls, making it difficult to see changes in memory utilization.

### **watch**

A better solution than using the `free -s` command would be to run the `free` command using the `watch` command. For example, to display memory utilization every 2 seconds (the default display interval), use this command:

```
watch free
```

The `watch` command issues the `free` command every 2 seconds, after first clearing the screen. This refresh makes it easier to see how memory utilization changes over time.

You can control the delay between updates by using the `-n` option, and can cause any changes between updates to be highlighted by using the `-d` option, as in the following command:

```
watch -n 1 -d free
```

The `watch` command runs until it is interrupted with **Ctrl+C**. For more information about the `watch` command, enter:

```
man watch
```

**top**

```

top - 10:00:48 up 1:55, 1 user, load average: 2.03, 1.51, 0.65
Tasks: 105 total, 1 running, 104 sleeping, 0 stopped, 0 zombie
Cpu(s): 0.8%us, 0.6%sy, 0.0%ni, 92.1%id, 6.4%wa, 0.0%hi, 0.0%si, 0.0%st
Mem: 256400k total, 238008k used, 18392k free, 6500k buffers
Swap: 585720k total, 18168k used, 567552k free, 138944k cached
Change delay from 3.0 to:

```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
1	root	20	0	2104	688	592	S	0.0	0.3	0:03.16	init
2	root	15	-5	0	0	0	S	0.0	0.0	0:00.00	kthreadd
3	root	RT	-5	0	0	0	S	0.0	0.0	0:00.00	migration/0
4	root	15	-5	0	0	0	S	0.0	0.0	0:00.12	ksoftirqd/0
5	root	RT	-5	0	0	0	S	0.0	0.0	0:00.00	watchdog/0
6	root	15	-5	0	0	0	S	0.0	0.0	0:00.22	events/0
7	root	15	-5	0	0	0	S	0.0	0.0	0:00.02	khelper
39	root	15	-5	0	0	0	S	0.0	0.0	0:00.10	kblockd/0
41	root	15	-5	0	0	0	S	0.0	0.0	0:00.00	kacpid
42	root	15	-5	0	0	0	S	0.0	0.0	0:00.00	kacpi_notify
173	root	15	-5	0	0	0	S	0.0	0.0	0:00.00	kseriod
212	root	20	0	0	0	0	S	0.0	0.0	0:00.10	pdflush
213	root	15	-5	0	0	0	S	0.0	0.0	0:00.18	kswapd0
214	root	15	-5	0	0	0	S	0.0	0.0	0:00.00	aio/0
763	root	15	-5	0	0	0	S	0.0	0.0	0:00.00	ata/0

Sample display of the `top` command output

The `top` command provides information on processor utilization, process statistics, and memory utilization. Unlike the `free` command, the `top` command runs continuously; you do not need to use the `watch` command.

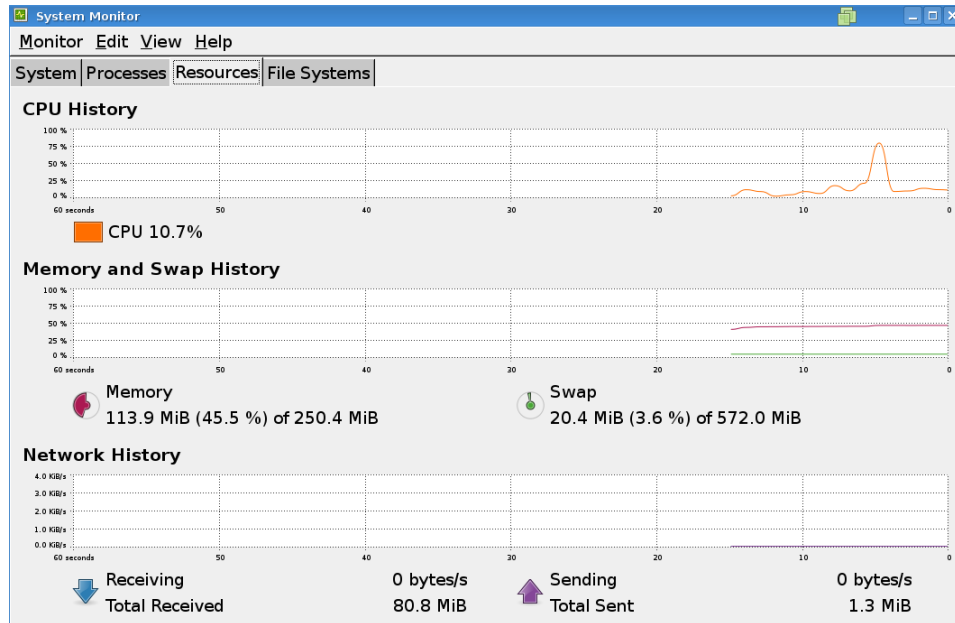
The display is divided into two sections:

- The top section contains information related to overall system status—Uptime, load average, process counts, processor status, and utilization statistics for memory and swap space.
- The lower section displays process-level statistics, the exact nature of which can be controlled while the `top` command is running.

**Caution**

Although the `top` command looks like a simple, display-only program, this is not the case. The `top` command uses single-character commands to perform various operations; if you are logged in as root, you can change the priority and stop any process on your system. Therefore, until you have reviewed the help screen (enter a question mark to display it), it is safest to enter only `q`, which exits the `top` process.

## GNOME System Monitor



GNOME System Monitor display

The GNOME System Monitor displays information related to overall system status, process counts, memory and swap utilization, and process-level statistics.

The GNOME System Monitor also includes graphical representations of processor, memory, and swap utilization, along with a tabular disk space utilization listing.

You can display additional information for a specific process by clicking the desired process and then clicking the **More Info** button.

To view the processor, memory, and disk usage statistics, click the **System Monitor** tab.

**vmstat**

```
procs -----memory----- --swap-- -----io----- -system-- ----cpu----
r  b  swpd  free  buff  cache  si  so  bi  bo  in  cs  us  sy  id  wa
1  0  20860 14680 8932 121836  1  4  82  78  19 149  1  1 92  6
```

One-line output example

The `vmstat` tool provides a concise view of system performance. Using this resource monitor enables you to display an overview of process, memory, swap, I/O, system, and processor activity in one line of numbers.

Field	Description
<b>Process-related fields</b>	
r	Number of runnable processes waiting for access to the processor
b	Number of processes in an uninterruptible sleep state
w	Number of processes swapped out but runnable
<b>Memory-related fields</b>	
swpd	Amount of virtual memory used
free	Amount of free memory
buff	Amount of memory used for buffers
cache	Amount of memory used as page cache
inact	Amount of inactive memory (requires the <code>-a</code> option)
active	Amount of active memory (requires the <code>-a</code> option)
<b>Swap-related fields</b>	
si	Amount of memory swapped in from disk
so	Amount of memory swapped out to disk
<b>I/O-related fields</b>	
bi	Blocks sent to a block device
bo	Blocks received from a block device
<b>System-related fields</b>	
in	Number of interrupts per second
cs	Number of context switches per second
<b>Processor-related fields</b>	
us	Percentage of the time the processor ran user-level code
sy	Percentage of the time the processor ran system-level code
id	Percentage of the time the processor was idle
wa	Percentage of the time the processor is waiting for I/O
st	Percentage of the time stolen from a virtual machine

When the `vmstat` command is run without any options, only one line is displayed. This line contains averages that are calculated from the time the system was last started.

However, most system administrators do not rely on the data in this line because the time over which it was collected varies. Instead, the `vmstat` command repetitively displays resource utilization data at set intervals.

**Example**

The `vmstat 1` command displays one new line of utilization data every second, and the `vmstat 1 10` command displays one new line per second, but only for the next 10 seconds.

**Sysstat suite of resource monitoring tools**

Sysstat contains the following tools related to collecting I/O and processor statistics:

- **iostat**—Displays an overview of processor utilization, along with I/O statistics for one or more disk drives.

```
Linux 2.6.26-2-686 (lenny)      06/26/2011      _i686_
avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           1.02    0.00   0.74   6.95    0.00   91.29

Device:            tps    Blk_read/s    Blk_wrtn/s    Blk_read    Blk_wrtn
sda                 7.68        168.15         162.06    1247451    1202280
sda1                 0.05          0.62           2.81       4590      20864
sda2                 7.62        167.41         159.25    1241981    1181416
dm-0                 24.72        165.08         151.17    1224666    1121528
dm-1                 1.22          1.70           8.07      12624     59888
```

iostat display

- **mpstat**—Displays more in-depth processor statistics.

```
Linux 2.6.26-2-686 (lenny)      06/26/2011      _i686_
10:10:23 AM CPU   %user   %nice   %sys %iowait  %irq   %soft  %steal  %idle  intr/s
10:10:23 AM all   1.01    0.00    0.70  6.92    0.02   0.01   0.00   91.33  19.52
```

mpstat display



Sysstat also contains tools that collect system resource utilization data and create daily reports based on that data. These tools are:

- **sadc**—Known as the system activity data collector, `sadc` collects system resource utilization information and writes it to a file.
- **sar**—`sar` reports are based on `sadc` data and can be generated interactively or written to a file for more intensive analysis.

```
Linux 2.6.18-4-686 (bender)    06/26/2011
12:00:01 AM      CPU    %user   %nice   %system %iowait  %steal   %idle
12:05:01 AM      all    0.42    0.44    0.21    0.15    0.00    98.78
12:15:01 AM      all    0.31    0.51    0.16    0.11    0.00    98.92
12:25:01 AM      all    0.29    0.36    0.15    0.07    0.00    99.13
12:35:01 AM      all    0.28    0.40    0.14    0.05    0.00    99.12
12:45:01 AM      all    0.39    0.40    0.15    0.04    0.00    99.02
12:55:01 AM      all    0.27    0.34    0.12    0.04    0.00    99.23
01:05:01 AM      all    9.64    1.53    4.38    10.12   0.00    74.33
01:15:02 AM      all    91.21   0.59    8.18    0.02    0.00    0.00
01:25:01 AM      all    90.92   0.70    8.38    0.00    0.00    0.00
01:35:02 AM      all    91.72   0.61    7.63    0.04    0.00    0.00
01:45:01 AM      all    92.57   0.29    7.13    0.01    0.00    0.00
01:55:01 AM      all    92.56   0.30    7.13    0.01    0.00    0.00
```

sar report example

## Step 3—Develop an optimized action plan

After collecting the facts and isolating the specific mode of failure, perform these actions to develop an optimized action plan:

- Identify specific root causes for the specified mode of failure.
- Identify possible solutions for each root cause.
- List the solutions in order by balancing the time and cost it will take to implement each solution against the likelihood that the solution will fix the issue or by the potential value of the information gained if the solution is inadequate.
- Identify the steps necessary to implement each solution.
- Compile all the steps into an optimized action plan by eliminating redundancy and ensuring that only one variable is being manipulated at a time.
- Inform and update your customer about your action plan.
- Incorporate an elevation plan into the master action plan:
  - Be prepared to escalate for technical assistance.
  - List the order of people or groups to contact and the information needed by each.

---

**Note**

Elevation is the process of engaging higher level technical resources. This can be from Level 1 to Level 2, or a Level 2 to a Level 3 engineer.

If the current plan does not meet the expectations of the customer, additional management of the customer is required. This process is called **escalation**.

---

## Step 4—Execute the action plan

Implement the written optimized action plan by following these steps:

1. Execute each step completely, as agreed to by your customer.
2. Apply only one solution or change only one variable at a time.
3. Carefully observe and record the results of each step, including any error messages or changes in functionality.

If your action plan did not solve the problem, it might:

- Provide more clues to solve it
- Enable you to collect enough pertinent information to go back to “Step 2—Evaluate the data”

With a newly created action plan, you might be able to find the root cause of the problem and come to a satisfying solution.

**Important**

To keep your customers involved, you must ensure that they are informed of the steps taken and the actions planned.

---

## Step 5—Determine whether the problem has been solved

Observe the results of each step in each solution, and evaluate the results of each step until the problem has been isolated and resolved. If the problem is not resolved:

1. Collect more data.
2. Evaluate the information gathered from the implementation of the action plan.
3. Develop another optimized action plan.
4. Implement the new optimized action plan.

Repeat these steps as additional information is gathered and new action plans are optimized, executed, and evaluated, until you resolve the problem.

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## Step 6—Implement preventive measures

As soon as the problem has been resolved, look at opportunities to implement preventive measures to stop the problem from recurring and look for other ways to improve or increase availability.

To implement preventive measures:

1. Determine the root cause of the problem.
2. Determine proactive steps that can prevent the problem from recurring.
3. Devise a system test to verify changes and procedures before implementing them.
4. Implement a new set of procedures, software, and administrative maintenance to attain a higher level of availability.
5. Perform preventive maintenance, including checking for loose cables, reseating boards, and checking for proper airflow.
6. Add fault-tolerant elements to critical subsystems, where applicable.

A carefully planned system software maintenance strategy maximizes server stability and availability. By developing well-regulated system software baselines for business servers, you can reduce the time required to update or troubleshoot existing servers and ensure that new servers are set up with tested and stable software configurations. Also, an appropriate service agreement for hardware and software can minimize downtime.

## Updating software and drivers

In a computing environment, performance issues can be a combination of older components and heavy usage, reaching a point where degradation begins to occur. You might need to assess the IT infrastructure of the organization to establish a software version control baseline.

HP has several ways to manage the download and application of new drivers and control software. For simple environments, using the HP Software and Drivers website for downloading an individual update for a single computer is the most efficient method. The SmartStart CD is another resource for updating drivers and software.

In a large or complex environment, a combination of HP SIM, Version Control Agents, and the Version Control Repository Manager might be needed to manage a centralized repository that distributes HP system software.

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### Note

The HP Software and Drivers website can be accessed at:

**<http://www.hp.com/go/support>**

The Subscriber's Choice website can be accessed at:

**<http://www.hp.com/go/subscriberschoice>**

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# Learning check

1. What are the six steps of the HP troubleshooting methodology?

.....  
.....  
.....  
.....  
.....  
.....

2. When running the HP Insight Diagnostics Offline Edition, the server software information is available to the diagnostics.

- True
- False

3. List at least three actions you should perform when optimizing an action plan.

.....  
.....  
.....  
.....

4. If executing the entire action plan did not solve the problem, what steps should you perform?

.....  
.....

5. List at least three things you should do after the problem has been resolved.

.....  
.....  
.....  
.....

6. What are the steps for activating an action plan?

.....  
.....

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