industry
standard
servers

june 2003

technical
white paper

hp ProLiant BL e-class system overview and planning

abstract

This white paper provides an overview of the HP ProLiant BL e-Class server blades, infrastructure components, and management tools, as well as guidance for establishing a deployment infrastructure and power planning.

The ProLiant BL e-Class server blades are maximum density for scale-out solutions and are part of the ProLiant BL line. The ProLiant BL e-Class blade enclosure supports up to 20 ProLiant BL10e or ProLiant BL10e Generation 2 server blades and provides redundant, hot-plug power and cooling to all installed blades. Each blade enclosure contains the ProLiant BL e-Class Integrated Administrator for remote power control and remote console access to all installed server blades.

introduction

This white paper gives an overview of the ProLiant BL e-Class system: maximum density server blades for scale-out solutions. The paper is divided into two sections:

- Overview of the system components

- Planning the system environment

  NOTE: The ProLiant BL line also contains the ProLiant BL p-Class system architecture. This paper, however, focuses on the ProLiant BL e-Class system architecture only. For information regarding the ProLiant BL p-Class system architecture, refer to the *HP ProLiant BL p-Class System Overview and Planning* white paper.

The build-out of Internet infrastructure and the trend to scale out within the data center have created the need for businesses to deploy greater numbers of servers, particularly for Web and infrastructure applications. Adding servers, however, increases operating costs, requires more power and space, and makes system administration more complex.

HP has addressed these trends by developing a complete portfolio of modular, blade servers: the new ProLiant BL Line. The ProLiant BL Line is specifically designed to address the needs of enterprises and service providers for increased server density, rapid deployment and provisioning, and remote manageability.

ProLiant BL servers are optimized for use with the HP ProLiant Essentials Rapid Deployment Pack (RDP) enabling automatic configuration and installation of operating systems and applications on tens or hundreds of servers simultaneously. ProLiant BL server blades include HP industry-leading technologies such as tool-free mechanical designs, hot-plug redundant components, and integrated management functionality.

The ProLiant BL architecture is designed to protect customer investments in two important ways:

- Providing longevity of the ProLiant BL server blade and interconnect infrastructure

- Enabling installation of ProLiant BL server blades in standard racks along with legacy servers and storage

HP designed the ProLiant BL line specifically for customers operating in a multi-tiered environment requiring everything from ultra-dense, front-end to high-performance SMP server blades. HP ProLiant DL and ProLiant ML servers offer a wide range of industry-standard solutions to meet customer needs. ProLiant BL servers are not a replacement for ProLiant DL and ProLiant ML server solutions, but a complementary addition to the ProLiant product family, targeted at specific customer needs.

overview of the ProLiant BL e-class system components

figure 1: ProLiant BL e-class server blade enclosure (front view) with 20 ProLiant BL10e or ProLiant BL10e G2 server blades

ProLiant BL10e and BL10e G2 server blades (20)

ProLiant BL e-Class server blade enclosure

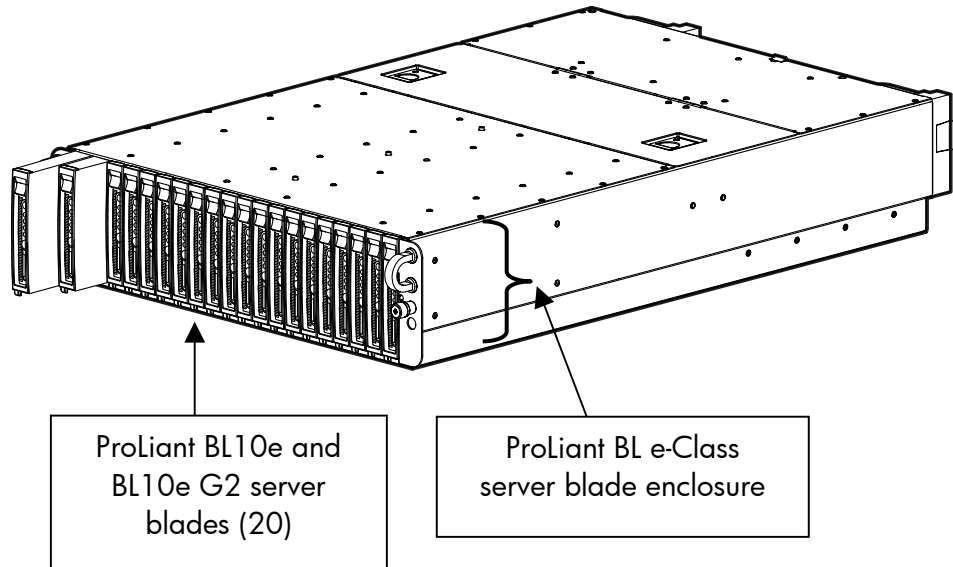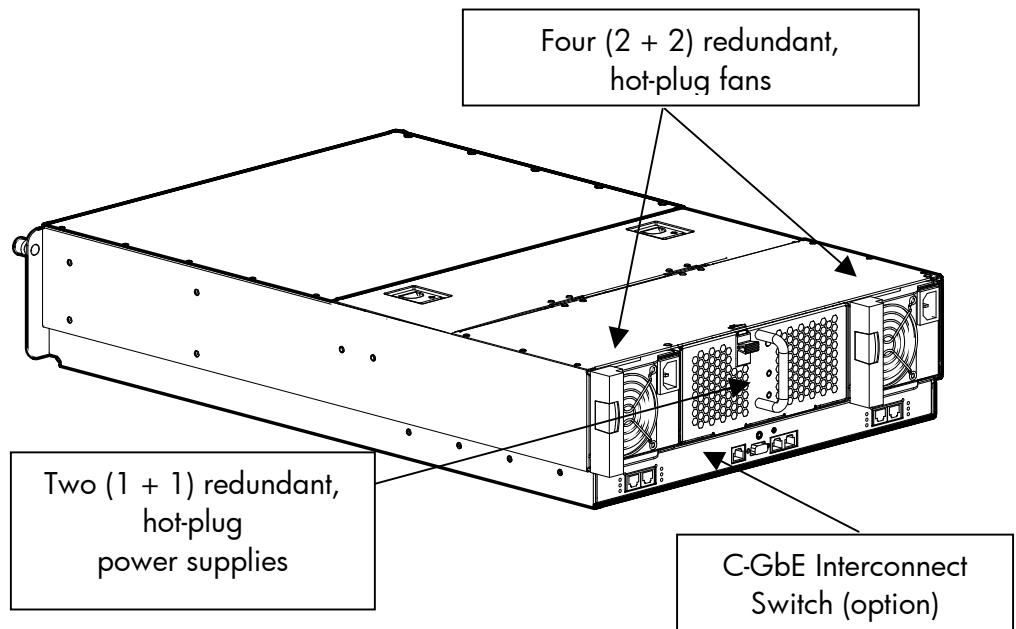figure 2: ProLiant BL e-class server blade enclosure (rear view) with two redundant, hot-plug power supplies, four redundant, hot-plug fans, and C-GbE interconnect switch option for network cable reduction

Four (2 + 2) redundant, hot-plug fans

Two (1 + 1) redundant, hot-plug power supplies

C-GbE Interconnect Switch (option)

The ProLiant BL e-Class system is comprised of several components (table 1).

table 1: ProLiant BL e-class system required components

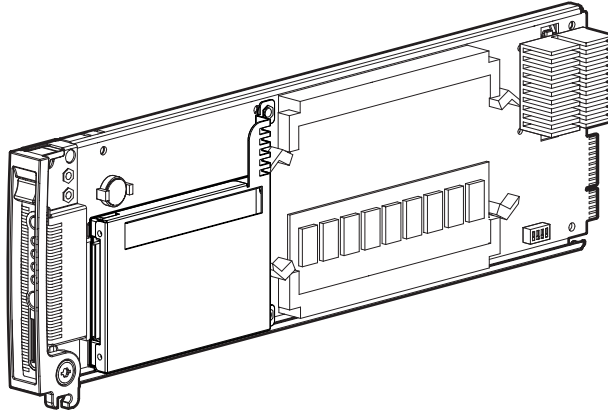| Required Component Categories	Function	Options
ProLiant BL10e server blade	Each ProLiant BL10e server blade features an Ultra-Low Voltage Intel Pentium III processor with 512-K cache, 2 DIMM slots for up to 1-GB max ECC memory, one 40-GB small form factor 2.5-inch ATA hard drive, and two integrated 10/100 PXE-enabled NICs.	Server blades are sold in single-packs and 10-packs.
ProLiant BL10e G2 server blade	Each ProLiant BL10e server blade features an Ultra-Low Voltage Intel® Pentium® M processor with 1-MB cache, 2 DIMM slots for up to 1-GB max DDR ECC memory, one 40-GB non-hot-plug 2.5-inch ATA hard drive, and two 10/100 PXE-enabled NICs.	Server blades are sold in single-packs and 10-packs.
ProLiant BL e-Class server blade enclosure	Each rack-mountable ProLiant BL e-Class server blade enclosure is 3U high and holds up to 20 ProLiant BL10e or ProLiant BL10e G2 server blades. The enclosure contains dual, 1 + 1 redundant 600-Watt hot-plug power supplies and four 2 + 2 redundant, hot-plug fans. Server blades plug into the server blade enclosures for network and power connections.	
Interconnect trays (three options)	Each ProLiant BL e-Class server blade enclosure requires an interconnect tray. The interconnect tray routes the network connections from the server blades out the back of the enclosure. Three different interconnect tray configurations are available for network cable management.	1. ProLiant BL e-Class C-GbE Interconnect Switch (with four Gigabit Ethernet uplink connectors): reduces network cables per enclosure from 40 to as few as one. 2. ProLiant BL e-Class RJ-45 Patch Panel (with 40 RJ-45 connectors) 3. ProLiant BL e-Class RJ-21 Patch Panel (with four RJ-21 connectors)

key benefits

- Rapid hardware deployment/redeployment to save valuable time
  - Takes only seconds to snap in server blades once the rack infrastructure is in place
  - Pluggable blades have no cables and are ideal for scale-out and load-balanced applications
- Rapid Deployment Pack software
  - Provision one or hundreds of server blades in minutes using a single console
  - User-defined deployment and configuration events enable unattended, headless installs
- Integrated Administrator for multi-server blade management
  - Local and remote access to 20 server blades from a single console using a serial or an Ethernet connection
  - Remote power control and console access to any server blade in the system
  - Health monitoring and alerts on-screen and delivered through SNMP and email
  - Customizable security features
- System-level redundancy
  - Dual, 1 + 1 redundant hot-plug power supplies for power redundancy across all server blades in an enclosure
  - Redundant network access on each server blade
  - Four 2 + 2 redundant hot-plug fans across all server blades in an enclosure
  - Server blade redundant ROM
- Relief of cabling problems
  - Access all 40 server blade NICs using as few as a single Gigabit Ethernet uplink on the ProLiant BL e-Class C-GbE Interconnect Switch option
  - Optimized for headless management—no keyboard, video, or mouse cables needed for power and console control
  - Shared power reduces power cables and PDUs
- Up to 20 ProLiant BL10e or ProLiant BL10e G2 server blades fit the 3U enclosure
- Designed to protect your investment
  - Fits into HP, Compaq branded, third-party, and telco racks
  - Mixes with traditional servers and storage—no need to dedicate a rack to server blades

**hardware
components**

ProLiant BL10e server
blade

figure 3. ProLiant BL10e server blade

description

The ProLiant BL10e server blade (figure 3) is ideal for use as an ultra-dense Web or infrastructure application server. Twenty ProLiant BL10e blades fit a 3U blade enclosure, making it the densest ProLiant server ever.

features

- Processor: Ultra-Low Voltage Intel Pentium III processor with 512K cache

- System Bus: 100 MHz

- Chipset: ServerWorks LELP 3.0

- Hard drive: One 40-GB small form factor ATA disk drive, 5400 rpm

- Memory: Two DIMM slots with a maximum capacity of 1-GB of 133-MHz, ECC SDRAM

- Management: Remote power control and console using the Integrated Administrator (refer to "Software Components")

- NICs: Each server blade has two Preboot eXecutable Environment (PXE) capable NC3163 Fast Ethernet NICs embedded 10/100 Wake-on LAN (WOL).

- LEDs on each Server Blade:

    – Unit Identification LED (UID) and button. The UID is a blue LED on the front of each server blade and enclosure and can be activated locally or remotely to help an onsite user find a specific server blade immediately in a densely loaded rack.

    – Health

    – NIC link and activity (2)

    – Disk drive activity

    – Power

- Local I/O: Keyboard, video, mouse, USB, and serial connections are available for each server blade by attaching the Diagnostic Adapter.

- Density: Twenty server blades fit into a 3U rack-mount enclosure.

- Supported Operating Systems: The ProLiant BL line supports the most current versions of these top-tier operating systems: Microsoft® Windows® 2000 Server, Microsoft Windows Server 2003, Red Hat Linux, SuSE Linux, and United Linux.

ProLiant BL10e G2 server blade

figure 4. ProLiant BL10e G2 server blade

description

The ProLiant BL10e G2 server blade (figure 4) is ideal for use as an ultra-dense Web and infrastructure server as well as compute node for Linux-based high performance compute clusters. The ProLiant BL10e G2 fits the same slot as the ProLiant BL10e.

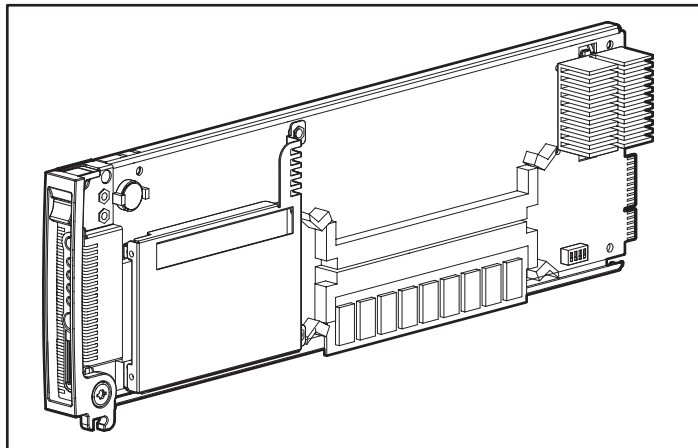**features**

- Processor: Ultra-Low Voltage Intel Pentium M processor with 1-MB cache

- System Bus: 400 MHz

- Chipset: ServerWorks GC-SL

- Hard drive: One 40-GB small form factor ATA disk drive, 5400 rpm

- Memory: Two DIMM slots with a maximum capacity of 1-GB of PC2100, ECC DDR SDRAM

- Management: Remote power control and console using the Integrated Administrator (refer to "Software Components")

- NICs: Each server blade has two PXE capable NC3163 Fast Ethernet NICs embedded 10/100 WOL.

- LEDs on each Server Blade:

  - UID LED and button. The UID is a blue LED on the front of each server blade and enclosure and can be activated locally or remotely to help an onsite user find a specific server blade immediately in a densely loaded rack.

  - Health

  - NIC link and activity (2)

  - Disk drive activity

  - Power

- Local I/O: Keyboard, video, mouse, USB, and serial connections are available for each server blade by attaching the Diagnostic Adapter.

- Density: Twenty server blades fit into a 3U rack-mount enclosure.

Supported Operating Systems: The ProLiant BL line supports the most current versions of these top-tier operating systems: Microsoft Windows 2000 Server, Microsoft Windows Server 2003, Red Hat Linux, SuSE Linux, and United Linux.

ProLiant BL e-class server blade enclosure

figure 5. ProLiant BL e-class server blade enclosure
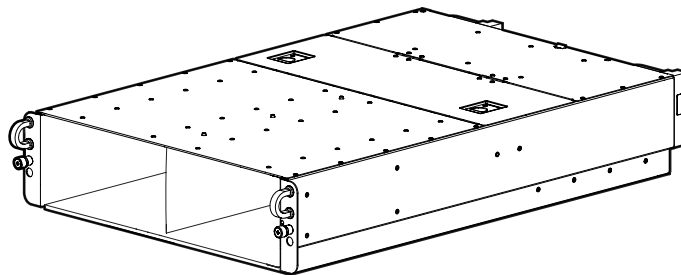
description

ProLiant BL10e and BL10e G2 server blades are housed in a 3U server blade enclosure (figure 5). The server blades plug into the enclosure for power and data connections.

Each ProLiant BL e-Class server blade enclosure has 20 server blade bays that can hold both ProLiant BL10e and BL10e G2 blades and an interconnect tray bay in the back (for one of three interconnect tray options).

features

- Dimensions: 3U height, standard 48-cm (19-in) width, and 73.30-cm (28.86-in) depth

- Toolless installation: Server blade enclosures are easily installed with spring-loaded rack rails and thumbscrews.

- Management: Single console (both a browser-based interface and a command-line interface) for power control and remote console access to all installed server blades (refer to Integrated Administrator in "Software Components").

- Power redundancy: Dual 1 + 1 redundant 600-Watt, hot-plug power supplies

- Cooling redundancy: Four 2 + 2 redundant, hot-plug fans

- Rack requirements: The server blade enclosure fits in HP, Compaq branded, telco, and third-party standard racks.

  NOTE: An optional telco rack mounting hardware option kit is required for installing ProLiant BL e-Class systems in a telco (or 2-pole) rack.

ProLiant BL e-class interconnect trays

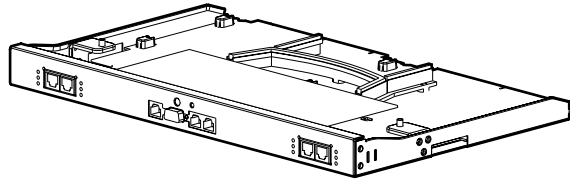**figure 6. ProLiant BL e-class C-GbE interconnect switch**

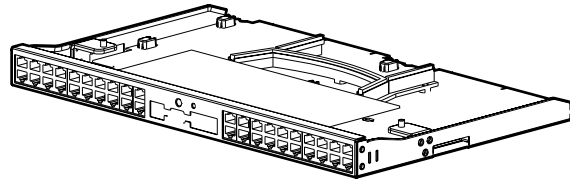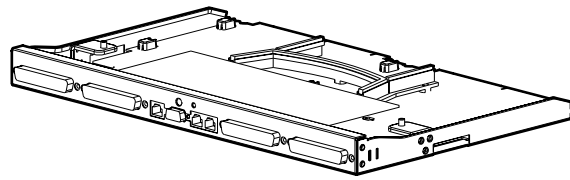**figure 7. ProLiant BL e-class RJ-45 patch panel**

figure 8. ProLiant BL e-class RJ-21 patch panel

description

Each ProLiant BL e-Class server blade enclosure requires an interconnect tray. The interconnect tray plugs into the rear of the server blade enclosure and is used to route Ethernet network connections from the server blades out the back of the enclosure. Each interconnect tray includes the Integrated Administrator module for centralized server blade and enclosure monitoring and management (refer to the "Software Components" section for more detail).

The three interconnect tray options are:

- ProLiant BL e-Class C-GbE Interconnect Switch (figure 6): The Interconnect Switch is designed to dramatically reduce the number of Ethernet network cables attached to the rear of the server blade enclosure and offers many enterprise-class Ethernet switching features. The interconnect switch reduces up to 40 server blade network connections to as few as a single Gigabit Ethernet uplink connector. For a complete overview of all available features, see the *HP ProLiant BL e-Class C-GbE Interconnect Switch* white paper located at

http://h18000.www1.hp.com/products/servers/proliant-bl/e-class/documentation.html

- HP ProLiant BL e-Class RJ-45 Patch Panel (figure 7): The RJ-45 patch panel functions as an Ethernet pass-through only and has 40 RJ-45 connectors. It brings all server blade NIC signals out as 40 separate RJ-45 connectors.

- HP ProLiant BL e-Class RJ-21 Patch Panel (figure 8): The RJ-21 patch panel functions as an Ethernet pass-through only, and brings all server blade NIC signals out using four separate RJ-21 connectors for significant cable consolidation.

features

- Reduced Cabling: The ProLiant BL e-Class C-GbE Interconnect Switch reduces 40 10/100 connectors to four 10/100/1000T uplink connectors. The customer is not required to use all uplink connectors and may use and configure one or more uplink connectors as desired, providing up to a 40-to-1 reduction in the number of Ethernet network cables for each server blade enclosure.

- Integrated high-availability features:

  – Two separate redundant Ethernet switch modules per enclosure

  – Redundant data paths to and from each Ethernet switch module to each server blade

  – Redundant data path cross connections between the two Ethernet switch modules

  – Two pairs of redundant Gigabit uplink connectors per each Ethernet switch module

  – IEEE 802.ID Spanning tree protocol support to provide loop-free path redundancy

- Pre-configured: The Interconnect Switch is completely pre-configured for immediate use with the ProLiant BL e-Class system. It plugs directly into the back of the ProLiant BL e-Class server blade enclosure and does not occupy a server blade bay or use any additional rack space.

- Industry-Standard design: The Interconnect Switch is industry-standard and does not use proprietary protocols. It is compatible with other industry-standard network components, such as those from Cisco, Nortel, and 3Com.

software components

ProLiant BL e-class integrated administrator

The ProLiant BL e-Class Integrated Administrator is a centralized management and monitoring system specifically designed for the ProLiant BL e-Class system. The Integrated Administrator acts as a combination terminal server and remote power controller, enabling out-of-band, secure, serial text console connections to all server blades in the enclosure, and offers the following:

- Full command line and web interfaces
    - Server blade privileges can be set on a per-user basis
    - Virtual power button remotely powers on or off server blades and the enclosure
    - Virtual NMI button generates non-maskable interrupt for crash debug and analysis
    - More than 100 scriptable commands enable automated management
- Remote administration
    - Enables access to any server blade serial console
    - Enables full control over server blade Power-On Self Test (POST) and boot process, including the ROM-Based Setup Utility (RBSU)
    - Enables future manageability enhancements with the Online Integrated Administrator Firmware Update feature
- Hardware health monitoring and Alerts
    - Monitors and controls the enclosure fans, temperature sensors, power supplies, and server blade status
    - AlertMail feature delivers email event and status alerts to user-specified email address
- Offline console buffering (when not connected) and event logging
    - Operating system console logging
    - Server blade and enclosure hardware events
- Security features
    - Secure Shell access
    - User administration for up to 25 users
    - Event generation for invalid login attempts
    - Logging of user actions in event log
    - Selective enabling of all protocols, such as Telnet
    - IP security allows user to specify IP addresses with access permission
    - Out-of-band management using Integrated Administrator RS-232 console
    - SSL (web interface)
    - Customer installable SSL certificates

- Increased availability
  - Self-contained embedded system with its own processor, memory, NIC, and Flash ROM
  - Intelligent and fault-tolerant, and continues to function independently of the Integrated Administrator
  - Enables online firmware update with code signing to ensure only certified software releases are installed
- Insight Manager 7 integration
  - Identifies the Integrated Administrator as a server blade "management processor"
  - A visualization of the enclosure and installed blades is presented in the Insight Manager 7 interface

    Users can launch the Integrated Administrator web interface from within the Insight Manager 7 or management agent interface. This enables users to monitor and access multiple Integrated Administrators from a single web-based interface

For more information about the ProLiant BL e-Class Integrated Administrator, go to

http://h18000.www1.hp.com/products/servers/proliant-bl/e-class/integrated-admin.html

HP ProLiant essentials rapid deployment pack

The Rapid Deployment Pack is a complete deployment solution for ProLiant servers running in a Windows or Linux environment. The Rapid Deployment Pack automates the process of deploying and provisioning server software, enabling companies to quickly and easily adapt to changing business demands. The Rapid Deployment Pack combines an off-the-shelf version of Altiris Deployment Solution for Windows or for Linux, and the ProLiant Integration Module. The ProLiant Integration Module consists of software optimizations for ProLiant Servers which include the SmartStart Scripting Toolkit, deployment and configuration events for industry standard leading operating systems, sample unattended files, and ProLiant Support Packs that include software drivers, management agents, and important documentation. The deployment console manages server deployment easily and consistently.

The deployment console graphical interface provides intuitive drag-and-drop events, such as scripts and images, to deploy the operating systems and applications on any combination of server blades, and then simultaneously deploy multiple server blades. Rapid Deployment Pack also has advanced features that can detect and display server blades based on their physical rack, enclosure, and bay locations. You can set the deployment console to automatically install pre-defined configurations on newly installed server blades.

Use of Rapid Deployment Pack maximizes your IT resources by providing a full server build from a central console for initial power on, automated server configuration on the fly, and installation of standard software sets across systems. The intuitive interface reduces the level of IT skill sets needed to deploy and re-deploy ProLiant BL server blades, as well as ProLiant ML and DL servers, in the data center and throughout the enterprise.

Refer to the "Planning the System Environment" section for information about setting up a deployment infrastructure using Rapid Deployment Pack. For information on Rapid Deployment Pack, refer to the *HP ProLiant Essentials Rapid Deployment Pack User Guide* or the *HP ProLiant Essentials Rapid Deployment Pack Linux Edition User Guide* on either the Rapid Deployment Pack CD or

http://h18000.www1.hp.com/products/servers/management/rdp/documentation.html

insight manager 7

Insight Manager 7 is delivered as a key component of the ProLiant Essentials Foundation Pack that ships standard with all ProLiant servers. Insight Manager 7 maximizes system update, simplifies system software maintenance, and provides powerful monitoring and control of an adaptive infrastructure based on ProLiant servers, including ProLiant BL e-class blades, so you can use the same management tool regardless of the form factor of your servers. For blade servers, Insight Manager 7 includes a visual representation of the status of blades within a rack or enclosure to facilitate navigation. Insight Manager 7 delivers pre-failure alerts for all ProLiant servers ensuring that potential failures are detected before they result in unplanned downtime. Extensive inventory reporting dramatically reduces the time to track assets and prepare for upgrades. The version control capabilities within Insight Manager 7 enable you to define one or more system software standards for the ProLiant servers and then track any changes relative to those standards across your environment. Detailed information is provided to assist you in deciding whether the system software should be updated. If you decide that an update is required, you can use Insight Manager 7 to remotely update BIOS, drivers, and agents across groups of servers. And Insight Manager is an effective tool for monitoring your HP desktops and notebooks in addition to third-party devices instrumented to SNMP or DMI.

For more information about the Insight Manager 7, go to

http://h18013.www1.hp.com/products/servers/management/cim7-overview.html

planning the system environment

software deployment

ProLiant BL e-Class server blades are designed for headless management and deployment. While many possibilities are available for deploying the operating system of choice on ProLiant BL e-Class server blades, the following methods have been tested and are supported by HP:

- HP ProLiant Essentials Rapid Deployment Pack (including the Linux Edition)

- SmartStart Scripting Toolkit

- OS installation using devices connected to the diagnostic adapter

  IMPORTANT: When you install the ProLiant BL e-Class system to your network, the server blades automatically boot to the network using PXE.

  Before you install server blades in the ProLiant BL e-Class server blade enclosure, be sure a PXE server is installed and running on your network, such as the HP ProLiant Essentials Rapid Deployment Pack, which contains a PXE server.

rapid deployment pack

The HP ProLiant Essentials Rapid Deployment Pack (including the Linux Edition) is the recommended solution for deployment of HP server blades. RDP includes the Altiris eXpress Deployment Server software as well as the ProLiant Integration Module. The ProLiant Integration Module includes the pre-configured scripts to install supported Windows and Linux operating systems, as well as HP value-add software, such as ProLiant Support Packs (PSPs) and agents.

  NOTE: If using PXE to do remote deployments with RDP, a DHCP server is required.

Licensing for the RDP and RDP Linux Edition is on a per-server basis; however, RDP can also be obtained at a discounted price bundled with a ProLiant BL e-Class server blade enclosure.

For information on RDP, refer to the *HP ProLiant Essentials Rapid Deployment Pack User Guide* on either the Rapid Deployment Pack CD or go to
http://h18000.www1.hp.com/products/servers/management/rdp/documentation.html

smartstart scripting toolkit

The latest versions of the SmartStart Scripting Toolkit are packaged with the HP ProLiant Essentials Rapid Deployment Pack (RDP). RDP provides the necessary scripts for ProLiant BL server configuration and OS deployment in a ready-to-run format. RDP provides a turn-key solution for customers that prefer an out-of-the box solution for server deployment. Use of the SmartStart Scripting Toolkit to deploy blades independent of RDP, is targeted to customers that desire to integrate ProLiant BL deployments into a customized server deployment process.

The SmartStart Scripting Toolkit is a server deployment product that delivers a hands-off, unattended installation for high-volume ProLiant server deployments. The Scripting Toolkit provides a flexible method for creating standard server configuration scripts that are used to automate the server configuration process. The Scripting Toolkit saves time from each server deployed, making it possible to scale server deployments to high volumes in rapid fashion.

The SmartStart Scripting Toolkit contains customizable pre-configured scripts for unattended OS deployment. The Scripting Toolkit requires the user to create a custom boot CD or boot diskette to start the OS installation on ProLiant BL e-Class server blades. Booting from local CD or diskette requires connecting a USB device to the diagnostic adapter (refer to ProLiant BL e-Class system documentation). To obtain additional information about the Scripting Toolkit (including sample scripts), download the *utility* and *readme* files from

http://h18000.www1.hp.com/products/servers/management/smartstart/documentation.html

> **Note:** This method can be used to deploy any Linux OS distribution that supports an unattended installation, but HP only supports and provides sample scripts for Linux versions supported by the ProLiant BL line of server blades.

The diagnostic adapter, which connects to the front of the server blade, contains PS/2, USB, serial, and video connections. These ports enable connecting a PS/2 keyboard, PS/2 mouse, USB diskette, and USB CD-ROM. A USB diskette or USB CD-ROM can be connected to the diagnostic adapter for OS installation, but depends on USB support by the OS vendor. A USB diskette drive can be used to complete a network installation booting from a USB diskette, or you can use the SmartStart Scripting Toolkit (previously described). For specific information on USB supported on ProLiant servers, go to

www.compaq.com/products/servers/platforms/usb-support.html

Additionally, review the product QuickSpecs for a full list of USB devices HP has tested and supports.

Microsoft Windows 2000 deployment

Install the Microsoft Windows 2000 operating system using a USB. Use of F6 drivers through USB has been expanded with HP SP21828, found at

http://h18023.www1.hp.com/support/files/server/us/download/17581.html.

Windows 2000 can support a large number of USB devices after it is completely installed, but only supports a small subset during installation. The softpaq mentioned expands the list of supported devices at installation time to the full set of devices supported after installation. If, for example, a server with Windows 2000 installed recognizes a USB diskette/CD, then this softpaq will allow you to install Windows 2000 to recognize that device during setup.

linux deployment	Red Hat Linux 7.2, United Linux, and SuSE Linux support installation using a USB CD-ROM, but only for OS vendor-supported USB devices. Contact Red Hat (or the OS vendor) for a listing of supported devices. Review the product QuickSpecs to review the USB devices HP has tested and supports. For details on how to install the Linux operating system using the diagnostic adapter on ProLiant BL e-Class server blades, go to **www.compaq.com/products/servers/Linux/compaq-howto.html**
Preboot eXecution Environment (PXE)	PXE can be used to deploy the operating system on any server. For information on PXE requirements and how to setup a PXE server, view the white paper at **www.compaq.com/products/servers/linux/redhat-whitepapers.html**
Microsoft Windows 2000 deployment	Microsoft Windows 2000 has an additional component called Remote Installation Services (RIS), which can be used to setup images of Windows 2000 Professional for deployment. However, Microsoft does not provide a method for installing Windows 2000 Server-based OS editions. To install Windows 2000 Server Edition on ProLiant BL e-Class server blades, a PXE deployment server (such as Altiris eXpress Deployment Server) is required.
red hat linux deployment	Red Hat Linux, as well as other distributions, supports the installation of a PXE deployment server to install the OS on a ProLiant BL e-Class server blade. For detailed instructions on how to set up a PXE deployment server and deploy Red Hat Linux, go to **www.compaq.com/products/servers/linux/redhat-whitepapers.html**
troubleshooting	• For troubleshooting information regarding the Rapid Deployment Pack, download the user guide at **www.hp.com/servers/rdp** • Although USB devices are supported, the SmartStart CD does not support booting using a USB CD-ROM for operating system installation. • The Microsoft Windows 2000 OS CD has an option to create boot diskettes to start the OS installation. These diskettes can be booted using a USB diskette drive connected to the diagnostic adapter, but the OS installation fails when it tries to connect to the CD if a USB CD-ROM device is used. The installation path from boot diskettes is therefore not supported. • A USB diskette cannot be connected to the diagnostic adapter to provide an updated storage driver during the F6 prompt of the Windows 2000 installation. • For troubleshooting information regarding HP-specific problems installing Linux, go to **www.compaq.com/products/servers/Linux/compaq-howto.html** • For general questions regarding Linux support on ProLiant servers, go to **www.compaq.com/products/servers/linux/redhat-whitepapers.html** • Linux whitepapers can be found at **www.compaq.com/products/servers/linux/redhat-whitepapers.html**

power planning

The following general guidelines should be followed when planning and installing a ProLiant BL e-Class system:

- High-voltage deployment is highly recommended (200-240 VAC) because of lower current requirements.

- Both power supplies provided with the ProLiant BL e-Class server blade enclosure should be plugged into an AC power source to assure full power supply redundancy.

- Avoid single points of failure:

  - Do not cable both enclosure power supplies to the same PDU (or power strip) to prevent a single PDU failure causing loss of the enclosure.

  - Do not cable multiple enclosures or PDUs to the same AC wall outlet (or AC breaker) to prevent a single AC source failure causing loss of all enclosures.

  - Each power supply should be supplied by different AC sources—ideally, different municipal AC power networks

- The ProLiant BL e-Class server blade enclosure has two power supplies that share the load approximately 50/50%, but this can vary by ± 12% up to 44/56%. For example, a 1000 W load could be shared 440/560 W.

- Determine how many PDUs you need. For instance, a 16-A, low-voltage PDU can only meet the requirements of one fully loaded, non-AC-redundant enclosure at 10 A. A 24-A high-voltage PDU can support up to 4 fully loaded, non-AC-redundant enclosures at 4*5 = 20 A.

- Decide what level of redundancy your environment needs (described in section "Redundancy and Single Sources of Failure"). This requires a significantly different PDU configuration.

  - Power supply redundancy (standard on ProLiant BL e-Class server blade enclosures)

  - PDU redundancy

  - AC source redundancy

- Carefully review PDU or power strip current limitations to avoid the "domino effect" (described following). If a power supply or AC source fails (or is unplugged), the remaining components must have enough capacity to support the new power distribution.

- The ProLiant BL e-Class server blade enclosure should always have two power supplies installed to ensure proper airflow and adequate cooling. This is true even if only one power supply has AC power.

ProLiant BL e-class enclosure power specification summary

- 1000-W AC input for a fully loaded ProLiant BL e-Class server blade enclosure.

- 10-A maximum current draw at low voltage (100 V).

- 5-A maximum current draw at high voltage (200 V).

- The enclosure supports power supply redundancy with 2 power supplies in a 1 + 1 configuration.

definitions and
theory

single sources of failure (SSOF)

A server blade enclosure (or rack) can fail if it is dependent on a critical component or resource that is itself vulnerable to failure. This dependence is deemed a single source of failure (SSOF).

Redundancy is based on the types of failures a configuration can tolerate and is characterized by removal of as many SSOFs as possible. This section describes typical SSOFs and the redundancy features needed to survive their failure. These SSOFs include power supplies, power cords, PDUs, and AC sources.

power supply failure

The power supply may have an internal failure. This term also loosely applies when the power cord is unplugged, the supply has an AC source failure, and when the power supply is not fully inserted into the server blade enclosure.

power supply redundancy

Power supply redundancy is a feature enabling an enclosure to survive the failure of a power supply. A 1 + 1 redundant enclosure can tolerate a single power supply failure by re-distributing 100% of the load to the remaining power supply.

figure 9: power supply redundancy, SSOF = PDU and AC source
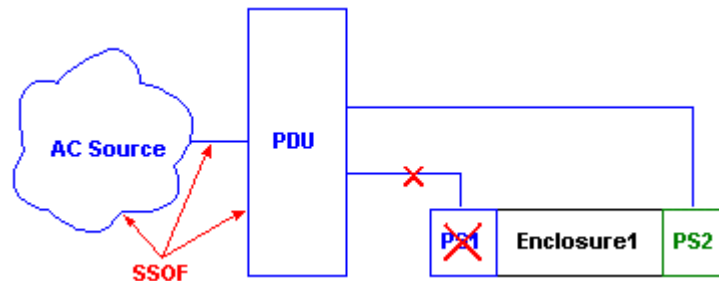
The ProLiant BL e-Class server blade enclosure has power supply redundancy built in, provided you have two working power supplies, two attached power cords, and stable AC source(s). In that configuration, the enclosure can survive a power supply failure or unplugged power cord (figure 9).

NOTE: The Power Distribution Unit (PDU), PDU power cord, and AC source are each an SSOF. Power supply redundancy implies the AC source or PDU supporting the remaining power supply has sufficient capacity to handle the re-distributed load.

PDU

A PDU has one or two AC power inlets and multiple power outlets (12) to simplify power cord management.

- PDU Failure—The PDU may have an internal failure or its input circuit breaker may be tripped due to over-current. A PDU SSOF can also loosely be described as a situation when the PDUs have tripped due to over-current. This term also loosely describes when the PDU power cord is removed or the AC source supplying power to the PDU fails.

- PDU Redundancy—A PDU configuration that enables a server blade enclosure (or rack of enclosures) to survive a PDU failure by re-distributing the load to other PDUs provides PDU redundancy.

figure 10: PDU redundancy, SSOF = AC source
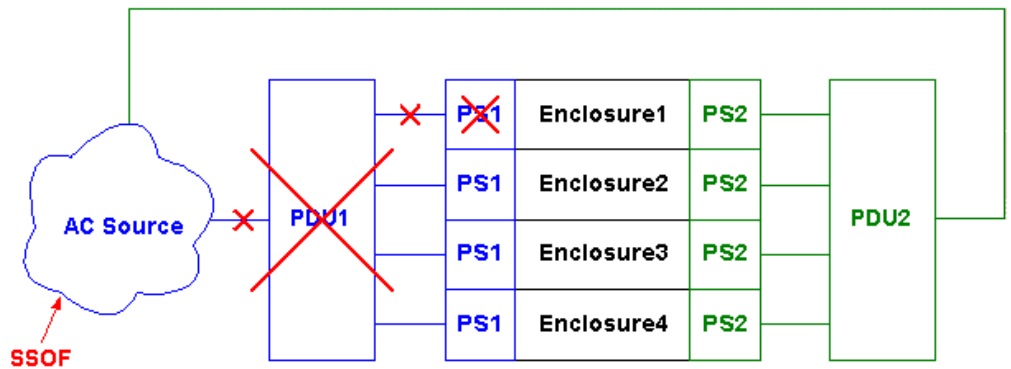
This configuration (figure 10) can survive a power supply failure, PDU failure, or unplugged PDU power cord.
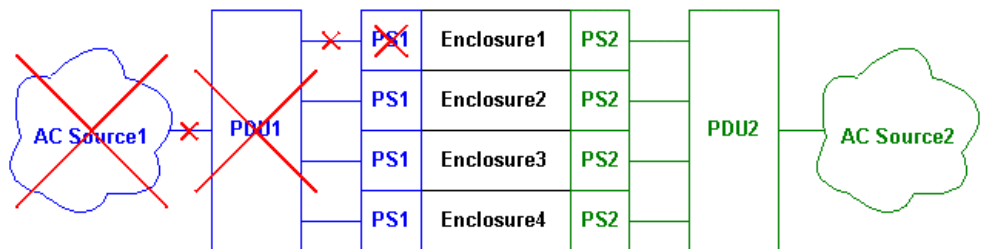
> **NOTE:** The AC source is an SSOF.

PDU redundancy implies the remaining PDU(s) and AC sources have sufficient capacity to safely handle the re-distributed load.

AC source

An AC source is AC power delivered using an AC wall outlet, main circuit breaker, or a power infrastructure in a building. This term also loosely describes AC power delivered to a power supply or PDU.

- AC Source Failure—The AC source supplying power to a component has failed.

- AC Source Redundancy—An AC source redundancy is a power configuration that enables an enclosure (or rack of enclosures) to survive the failure of an AC source by re-distributing the load to an alternate AC source.
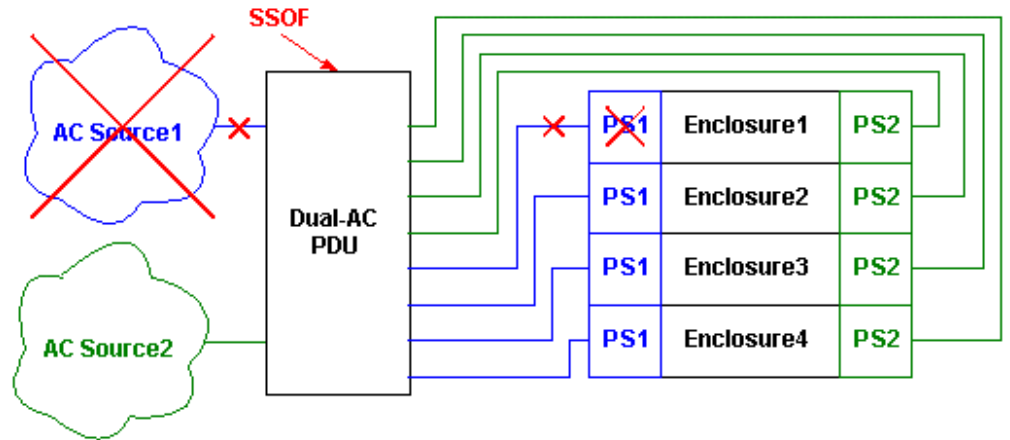
figure 11: AC source full redundancy

This configuration (figure 11) can survive a power supply failure, PDU failure, and even a single AC source failure.

Note: AC source redundancy implies the remaining AC source and PDU(s) have sufficient capacity to safely handle the re-distributed power load.

figure 12: dual AC PDU and power supply redundancy, SSOF = PDU

This configuration (figure 12) shows a dual-AC PDU configuration that can survive a power supply failure and even a single AC source failure.

**NOTE:** The dual-AC PDU is still a potential SSOF.

the domino effect

If a power supply, PDU, or AC source fails or is unplugged, the power load is automatically re-distributed. The remaining AC source and PDUs must support 100% of enclosure power requirements. If the resulting load exceeds the capacity of the remaining PDU, that PDU circuit breaker may trip, resulting in a potential "domino effect."

Similarly, if the resulting load exceeds the capacity of the remaining AC source, that AC source may also fail.

example

The following configuration (figure 13) shows four fully loaded enclosures using two low-line voltage (100-120VAC) PDUs (P/N 207590-D71). The configuration is not PDU redundant, but it appears to be power-supply redundant. In reality, this configuration is susceptible to the domino effect if even a single power supply fails.

**figure 13: domino effect caused by low-line current overload**
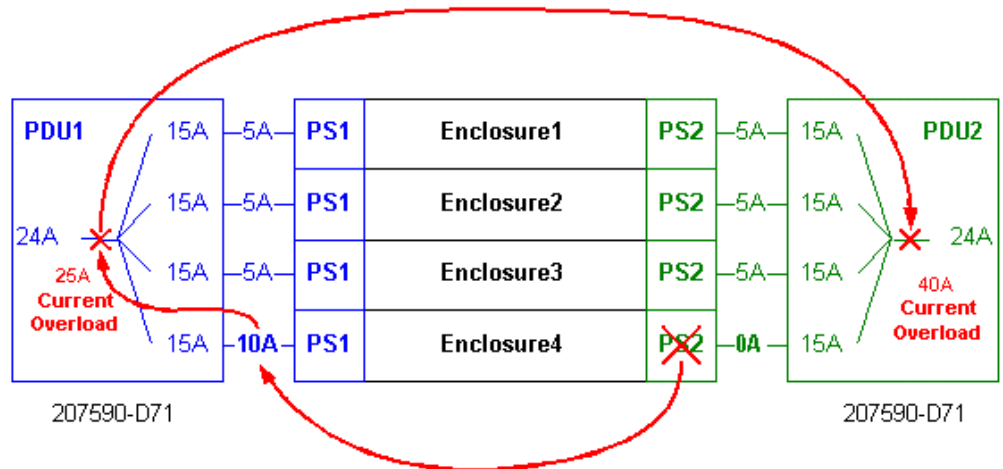
normal operation

At low-line, each fully loaded enclosure draws 10 A that are shared approximately 50/50% between the two power supplies. The output circuit breaker on each PDU supports 5A, which is within 15 A limit of the breakers. The PDU supports 4*5 = 20 A total which is also within the 24 A input limit of the breakers.

- Failure scenario 1—If a single power supply fails or is unplugged (for example, power supply 2 in enclosure 4), PDU 1 trips, followed quickly by PDU 2. This chain reaction occurs after power supply 1 fails because PDU 1 must now support the full 10-A load of enclosure 4. This is within the output circuit breaker limit for PDU 1 of 15 A. However, the total output current of PDU 1 becomes 5 + 5 + 5 + 10 = 25 A, which exceeds its input rating of 24 A. By exceeding the input rating for the PDU, its input circuit breaker may potentially trip. If the AC source is designed for 24 A, it is also at risk for tripping. If PDU 1 trips or its AC source fails, the entire 40-A load of 4 enclosures falls on PDU 2 and its AC source, which are likely to fail, resulting in power loss to all enclosures.

- Failure scenario 2—If the AC source for PDU 1 fails (or the power cord for PDU 1 is unplugged), PDU 2 must now support the full current load of all enclosures. The output circuit breakers for PCU 2 each support a 10-A enclosure, which is within the rated specifications for the breakers. However, this combined 10 + 10 + 10 + 10 = 40. A load exceeds the 24 A input rating for PDU 2. This may cause the input breaker for PDU 2 to trip or for the AC source of PDU 2 to fail, resulting in power loss to all enclosures.

- Remedy—Use two high-line voltage PDUs (such as P/N 207590-D72) instead of low-line PDUs. At high-line, each enclosure only requires 5 A, so power re-distribution after a power supply failure is still within limits (refer to figure 14).

figure 14: redundant PDU configuration with four enclosures (high-line)
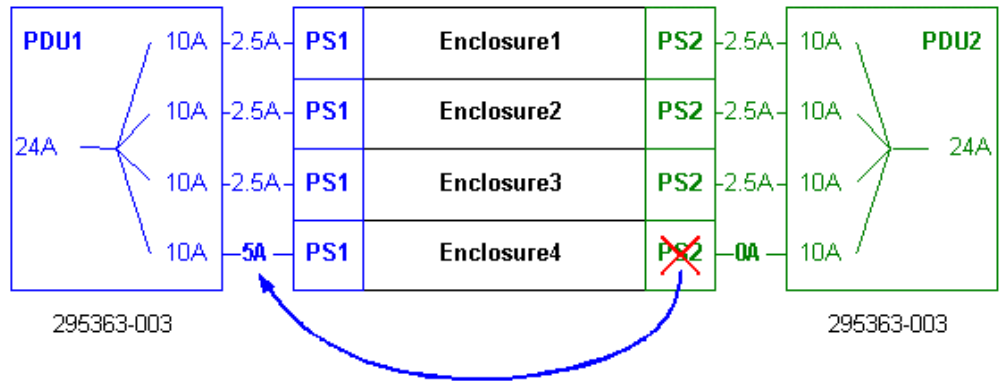
choosing a power solution

HP offers several PDUs designed for use in high-volume rack deployments. HP PDUs are equipped with circuit breakers that provide over current and surge protection for connected devices to help prevent electrical surges and external equipment malfunction. HP offers a variety of PDUs that support both high- and low-voltage applications. HP PDU options can be found at

www.compaq.com/products/servers/proliantstorage/power-protection/power-distribution

determining type and number of PDUs: redundant PDU configuration

Use the following guidelines if using a redundant PDU configuration to survive a PDU failure or PDU power cord unplug event. In this configuration, each power supply is connected to a different PDU to eliminate the PDU as an SSOF for that enclosure.

The input current rating for a fully-configured ProLiant BL e-Class server blade enclosure is 5 A (200 to 240 VAC) or 10 A (100 to 120 VAC). This is the total current drawn by both enclosure power supplies. To determine the number of server blade enclosures supported by a PDU, the more restrictive of the following rules must be observed.

To ensure power supply 1 + 1 redundancy (only):

- The total number of Amps drawn from the PDU should not exceed the input rating of the PDU.

- The number of Amps drawn from any branch of the PDU should not exceed the output breaker limit of that branch.

To ensure PDU redundancy:

- If an enclosure has a power supply failure, the entire load (100%) for that enclosure shifts to the PDU supporting the remaining supply. This additional 50% load must not exceed that branch output breaker limit of the affected PDU.

- Similar to the previous restriction, if a power supply fails, the re-distributed 50% load must not exceed the input rating of the affected PDU.

To ensure AC source redundancy:

- Each AC source (example, wall outlet) has a specified current rating and associated circuit breaker specified by the facility owner. If an enclosure power supply failure or PDU failure occurs, the total current requirement for the re-distributed load must not exceed the facility rating for either redundant AC source.

- Each AC source must be able to support 100% of the load of all equipment requiring AC source redundancy. In the event of a total AC source failure, the total current requirement for all enclosures, PDUs, and supporting equipment and monitors re-directs to the remaining AC source and must not exceed the facility rating for that AC source.

IMPORTANT: Violation of any restriction could result in a "domino effect" that may disrupt power to the enclosure, multiple enclosures, or the entire rack.

redundant PDU high-line example no. 1

This example (figure 15) presents a high-line configuration for PDU redundancy supporting one to three enclosures, and is valid for high-line PDUs with inputs rated 16 A. It does not support four enclosures at high-line voltage because the total current load of 4*5 A = 20 exceeds the input rating of 16 A. Refer to the previous restrictions.
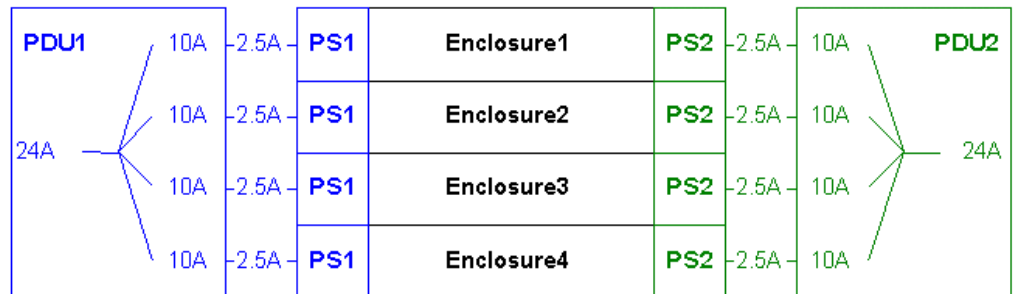
figure 15: high-line redundant PDU configuration supporting one to three enclosures
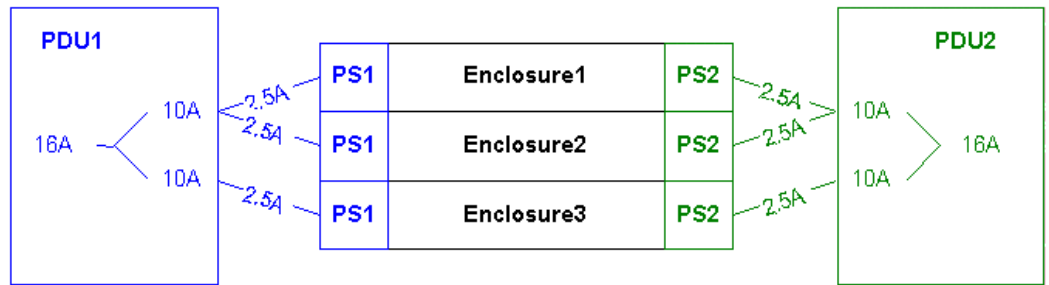
redundant PDU high-line example no. 2

This example (figure 16) presents a high-line configuration for PDU redundancy supporting one to four enclosures, and is valid for high-line PDUs with inputs rated 24/30/32 A. It does not support five enclosures at high-line voltage because the total current load of 5*5 A = 25 exceeds the input rating of 24 A. Refer to the previous restrictions.

figure 16: high-line redundant PDU configuration supporting one to four enclosures

redundant PDU low-line example

This example (figure 17) presents a low-line configuration for PDU redundancy supporting one to two enclosures, and is valid for low-line PDUs with inputs rated >20 A. It does not support three enclosures at low-line voltage because the total current load of 3*10 A = 25 exceeds the input rating of 24 A.

> **NOTE:** You cannot connect both enclosures to a single 15A output breaker because the total current load of 2*10A exceeds the output rating of 12A (after 20% UL derating factor).

figure 17: low-line redundant PDU configuration supporting one to two enclosures
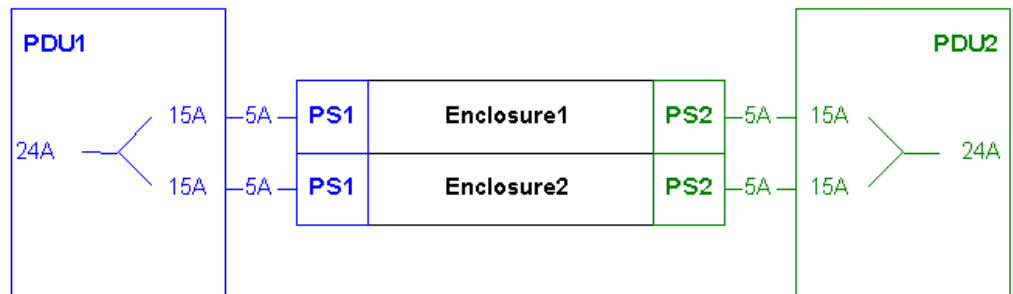
determining type and number of PDUs: non-redundant PDU configuration

Use this procedure if using a non-redundant PDU configuration in which both power supplies are connected to the same PDU. This ensures the enclosure's built-in 1 + 1 power supply redundancy works as intended, but does not provide PDU redundancy nor AC source redundancy.

The input current rating for a fully configured ProLiant BL e-Class server blade enclosure is 5 A (200 to 240 VAC) or 10 A (100 to 120 VAC). This is the total current drawn by both enclosure power supplies. To determine the number of server blade enclosures supported by a PDU, the more restrictive of the following two rules must be observed.

- The total number of Amps drawn from the PDU should not exceed the input rating of the PDU.

- The number of Amps drawn from any branch of the PDU should not exceed the output breaker limit of that branch.

> **IMPORTANT:** Violation of either restriction could result in a "domino effect" that may disrupt power to the enclosure, multiple enclosures, or the entire rack.

non-redundant PDU example no. 1 (PDU P/N 207590-D72)

- PDU (P/N 207590-D72) is a high-voltage PDU with a current rating of 24 A. The enclosure has a maximum input current requirement of 5 A at 200 volts.

- 24 A (PDU current rating)/5 A (enclosure total input current rating) = 4 enclosures per PDU

- This PDU can support a maximum of four fully configured ProLiant BL e-Class enclosures in a non-redundant configuration.

- The selected PDU has four branch circuit breakers rated at 10 A each.

- 10 A (PDU branch current rating)/5 A (enclosure total input current rating) = 2 per branch

- 2 enclosures per branch x 4 branches = 8 enclosures per PDU

- This branch of the PDU can support a maximum of two fully configured enclosures in a non-redundant configuration. This would suggest that eight enclosures (4 branches x 2 enclosures per branch) could be supported. However, in this case, the more restricted rule is the first, which allows only four enclosures per PDU.

non-redundant PDU example no. 2 (PDU P/N 207590-D71)

- PDU (PN 207590-D71) is a low-voltage PDU with a current rating of 24 A. The server has a total input current rating of 10A at 100 V.

- 24 A (PDU current rating)/10 A (enclosure total input current rating) = 2 enclosures per PDU

- This PDU can support a maximum of two enclosures at full server input current ratings in a non-redundant configuration.

- The PDU has with two branch circuit breakers rated at 15 A each.

- 15 A (PDU branch current rating)/10 A (enclosure total input current rating) = 1 enclosure per branch

- One enclosure per branch x 2 branches = 2 enclosures per PDU

The PDU can support only one enclosure per branch. Since two branches exist, the PDU can support a maximum of two enclosures. In this case, both restrictions allow a maximum of two enclosures per PDU in a non-redundant configuration.

PDU installation

installing PDUs

PDU installation varies depending on the rack configuration, the number of ProLiant BL e-Class server blade enclosures deployed in the rack, the selected type of PDU, the voltage, and current rating for each PDU.

positioning PDUs in 22U, 36U, and 42U racks

The position of the PDUs in the rack side panels depends on the rack size, the number of ProLiant BL e-Class server blade enclosures deployed in the rack, and the cable management solution. As a general rule, install PDUs from the bottom to the top of the rack.

cabling guidelines

- Do not block airflow of center fans or power supplies with large cable bundles.

- Do not block access to power supply handles. Leave enough cable slack so the power supplies can be removed without having to disconnect cables.

- Do not block access to the fan cage. Leave enough cable slack so the fan cage can be extended without having to disconnect cables. All fans should be physically accessible for service.

- Shorter cables help reduce cable clutter. For power cables, IEC C14 to IEC C13 (10A) cables are available in various lengths as follows:

    - 142257-001—(x1) IECC13-C14, 2m WW

    - 142257-002—(x1) IECC13-C14, 2.5m WW

    - 142257-003—(x1) IECC13-C14, 3m WW

    - 142257-004—(x1) IECC13-C14, 3.6m WW

    - 142257-005—(x1) IECC13-C14 Right Angled, 3.6m WW

    - 142257-006—(x1) IECC13-C14, 1.4m WW

    - 142257-007—(x15) IECC13-C14, 1.4m WW

appendix A: input current and thermal dissipation calculations

The input power is necessary for determining the input current and thermal dissipation. For a given input power, the input current varies depending on the input voltage level.

The relationship among the current, the voltage and the power for the power supply input is as follows:

Input Current = Input Power/Input Voltage

For example:
Input Current = 1000 W/110 V = 09.1 A
Input Current = 1000 W/208 V = 04.8 A

The thermal dissipation can be calculated from the input power as follows:

Thermal Dissipation = Input Power x 3.41

For example:
Thermal Dissipation = 1000 W (input power) $\times$ 3.41 = 3410 BTUs/hour

The easiest way to calculate the thermal dissipation for the entire rack is to add the input power requirements for all the ProLiant BL e-Class server blade enclosures and other units populated in the rack and multiply the total input power by 3.41. The total thermal dissipation helps you determine cooling and environmental requirements for the populated rack. Refer to the list of the input power of each subsystem component (table 2).

table 2: measured input power for subsystem components

Subsystem Components	Power Input
ProLiant BL e-Class server blade enclosure (without interconnect tray): Base configuration	50 W
a. RJ-45 Patch Panel (with Integrated Administrator module)	25 W
b. RJ-21 Patch Panel (with Integrated Administrator module)	25 W
c. C-GbE Interconnect Switch (with Integrated Administrator module)	95 W
1-GHz ProLiant BL10e G2 server blade with 128-MB memory[1]	42 W
1-GHz ProLiant BL10e G2 server blade with 256-MB memory[1]	42 W
1-GHz ProLiant BL10e G2 server blade with 512-MB memory[1,2]	42 W
1-GHz ProLiant BL10e G2 server blade with 1-GB memory[1]	43 W
[1] DIMM input power may vary depending on the component manufacturer. Follow HP guidelines for selecting low-power DIMMS. [2] Server blades ship standard with 512-MB memory.	

appendix B: input power budget de-rating

All power requirements for the ProLiant BL e-Class server blade enclosures discussed in this document are based on the input power of the enclosure. **HP recommends using the maximum rated power supply input of 1000 Watts when planning power distribution**. De-rate the input power for any of the following reasons:

– To minimize the number of PDUs required for each rack

– To match the rack current requirements with the existing circuit breaker capacity

– To match the rack cooling requirements with the existing facility cooling capability

NOTE: In this document, de-rating the input power budget means not using the maximum rated input power values for the power supply. HP strongly recommends that you verify that the de-rated power budget will satisfy all the installation requirements including future upgrade plans.

IMPORTANT: De-rating may cause your configuration to lose redundancy. Verify the output circuit breaker for each PDU can support the de-rated load, including load re-distribution caused by a power-supply failure, PDU failure, or AC source failure.

IMPORTANT: Violation of any restriction could result in a "domino effect" that may disrupt power to the enclosure, multiple enclosures, or the entire rack.

Calculate the de-rated value by using the supplied worksheet at the end of this appendix.

To de-rate the input power, start with the base configuration from the table in Appendix A. Add the peak power of the components included in the desired system configuration to calculate the de-rated power budget.

Assume the desired enclosure configuration is as follows:

– 1 x ProLiant BL e-Class Server Blade Enclosure; plus

– 1 x RJ-45 Patch Panel; plus

– 10 x ProLiant BL e-Class Server Blades (each with 512-MB memory)

Use the example de-rating worksheet (table 3) to calculate the de-rated power budget using the peak power from the previous configuration.

table 3: example de-rating worksheet

Maximum Rated Input Power (in Watts) for the Base Configuration	Peak Power
ProLiant BL e-Class server blade enclosure	50 W
Add: RJ-45 Patch Panel power	25 W
Add: ProLiant BL10e or ProLiant BL10e G2 server blade power: Single server blade with 512-MB memory x number of server blades	43 W <u>x 10 Server Blades</u> 430 W 430 W
Total ProLiant BL e-Class system input power	505 W
Calculate the thermal dissipation	x 3.41
Thermal dissipation for the desired configuration (in BTUs)	1722 BTUs

Therefore, the new power budget for this configuration is 505 W (compared to the rated 1000 W), and the thermal dissipation is approximately (505 × 3.41 =) 1722 BTUs/hour (compared to the rated 3410 BTUs/hour).

This de-rated input power budget significantly reduces the power and thermal requirements for highly populated racks, which reduces the number of PDUs for certain configurations. Fewer PDUs increases deployment time and lowers costs. Costs for the facility electrical plumbing, data center floor ventilation, and facility air conditioning installation can also be reduced.

Add together the input powers of the components that are included in your desired configuration. The peak and typical input powers are listed in the table in Appendix A. Use the de-rating worksheet (table 4) to calculate the de-rated input power.

table 4: de-rating worksheet

Maximum Rated Input Power (in Watts) for the Base Configuration	Peak Power
ProLiant BL e-Class Server Blade Enclosure	50 W
Add: Interconnect Tray option power (RJ-45 Patch Panel, RJ-21 Patch Panel or Interconnect Switch)	
Add: ProLiant BL10e or ProLiant BL10e G2 Server Blade power: Single Server Blade (with XXX-MB) x number of Server Blades	x_____
Total enclosure input power	
Calculate the thermal dissipation	x 3.41
Thermal dissipation for the desired configuration (in BTUs)	

for more information

For more information on the HP ProLiant BL e-Class System, refer to the product page at

www.hp.com