

ProLiant BL p-Class GbE2 Interconnect Switch Overview

white paper



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Abstract

This white paper provides an overview of the second generation Gigabit Ethernet (GbE2) Interconnect Kit options for the ProLiant BL p-Class system. Each GbE2 Interconnect Kit includes a pair of industry-standard Ethernet switches that dramatically reduce the number of Ethernet network cables attached to the rear of the ProLiant BL p-Class server blade enclosure. When the GbE2 Interconnect Kit is used with the optional GbE2 Storage Connectivity Kit, it also provides pass-through of Fibre Channel signals from the ProLiant BL20p G2 server blade.

The intended audience for this paper includes engineers and system administrators familiar with the overall network design of the ProLiant BL p-Class system. For readers not familiar with this overall network design, please see the [ProLiant BL p-Class Networking Overview](#)¹ white paper.

Introduction

The HP ProLiant BL p-Class system includes a portfolio of ProLiant BL p-Class server blades, the p-Class server blade enclosure, and four interconnect options.

The ProLiant BL p-Class server blade family includes the dual-processor ProLiant BL20p and BL20p G2 server blades for mid-tier applications and the quad-processor BL40p server blade for back-end applications.

The 6U (10.5 inch) p-Class server blade enclosure has eight server bays, and two outermost interconnect bays for collection of the network and storage signals. The signals are routed from the server blades, across the server blade enclosure backplane, and to the interconnect blades.

HP offers a family of interconnect options so that customers can choose how the Ethernet network signals exit the server blade enclosure. Interconnect options include two patch panel pass-through kits and two integrated Ethernet switch kits (the GbE Interconnect Kit and the GbE2 Interconnect Kit). The two patch panel options allow all Ethernet network signals to pass through to third-party LAN devices, thus giving customers flexibility in choosing their own switches. The GbE and GbE2 Interconnect Kit options include managed Ethernet switching technology that provides up to a 32-to-1 reduction in network cables at the back of the BL p-Class enclosure. This cable reduction significantly reduces the time required to deploy, manage, and service ProLiant BL p-Class systems.

Please see the *ProLiant BL p-Class Networking Overview* white paper for a summary of all four interconnect options along with an interconnect decision chart to assist in choosing the appropriate type of interconnect switch to use.

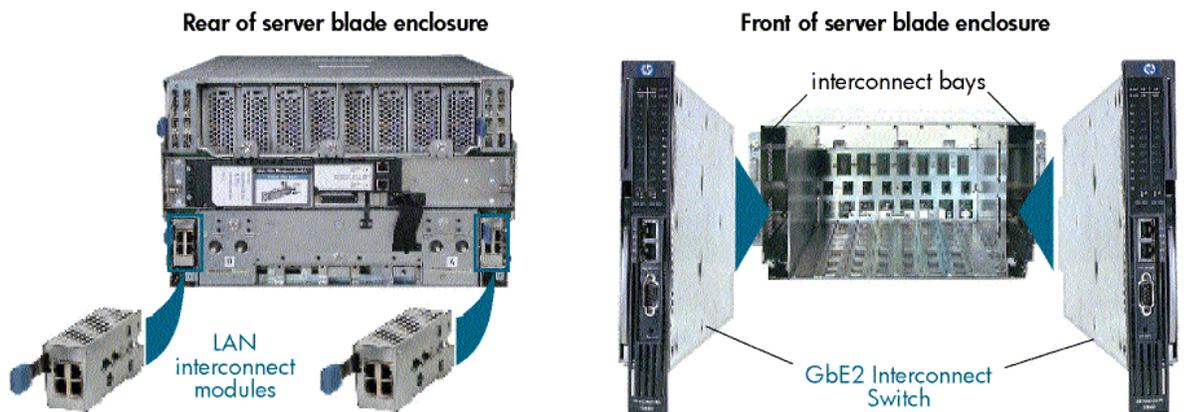
This white paper describes the GbE2 Interconnect Switch. The GbE2 Interconnect Switch is intended for applications that require up to 1000 megabits per second (Mb/s) Gigabit Ethernet network adapter (NIC) consolidation, advanced network feature support (including a future option for layer 7 switching), ProLiant BL20p G2 Fibre Channel pass-through, and future upgradeability for 10 Gigabit Ethernet bandwidth connectivity to the network.

¹ Available at <http://h18004.www1.hp.com/products/servers/proliant-bl/p-class/bl-p-interconnect-switch2.html>.

GbE2 Interconnect Kit

The GbE2 Interconnect Kit contains two redundant, hot-swappable GbE2 Interconnect Switches and two 4-port LAN interconnect modules. Users first insert the LAN interconnect modules into the bottom-left and bottom-right interconnect bays at the rear of the server blade enclosure and then install the interconnect switches into the interconnect bays from the front of the enclosure (Figure 1). The GbE2 Interconnect Switches consolidate the 32 Ethernet ports from the server blades into one to twelve external Gigabit Ethernet ports: eight ports on the two LAN interconnect modules and four additional ports on the front of the switches. If desired, users can configure the GbE2 Interconnect Kit to concentrate the 32 Ethernet signals into a single external Ethernet port (see the section titled "Maximizing network cable reduction").

Figure 1. Installation of LAN interconnect modules and GbE2 Interconnect Switches



Modular hot-swappable design

To enhance the system serviceability and simplify upgrades, both the GbE2 Interconnect Switch and the LAN interconnect modules are hot swappable. This modular design provides two key benefits:

- The GbE2 Interconnect Switches can be quickly and easily removed and replaced from the front of the rack without the need for re-cabling.
- Each GbE2 Interconnect Switch can support copper or fiber Ethernet network uplinks by using different LAN interconnect modules. This design also allows the uplinks to be easily upgraded to 10 Gigabit Ethernet.

Support for copper and fiber-based networks

Two interconnect kit options are available: the C-GbE2 Interconnect Kit for copper-based networks and the F-GbE2 Interconnect Kit for fiber-based networks. These kits are identical with exception of the interconnect modules, which are described in the "Interconnect switch architecture" section.

Interconnect switch architecture

Each GbE2 Interconnect Kit provides an end-to-end, fully redundant architecture that maximizes network availability (Figure 2). Redundant network adapters are routed from each server blade bay to each hot-swappable interconnect switch (four NICs total per server bay) creating a fully meshed topology to the external Ethernet network. The interconnect switches are cooled by on-board

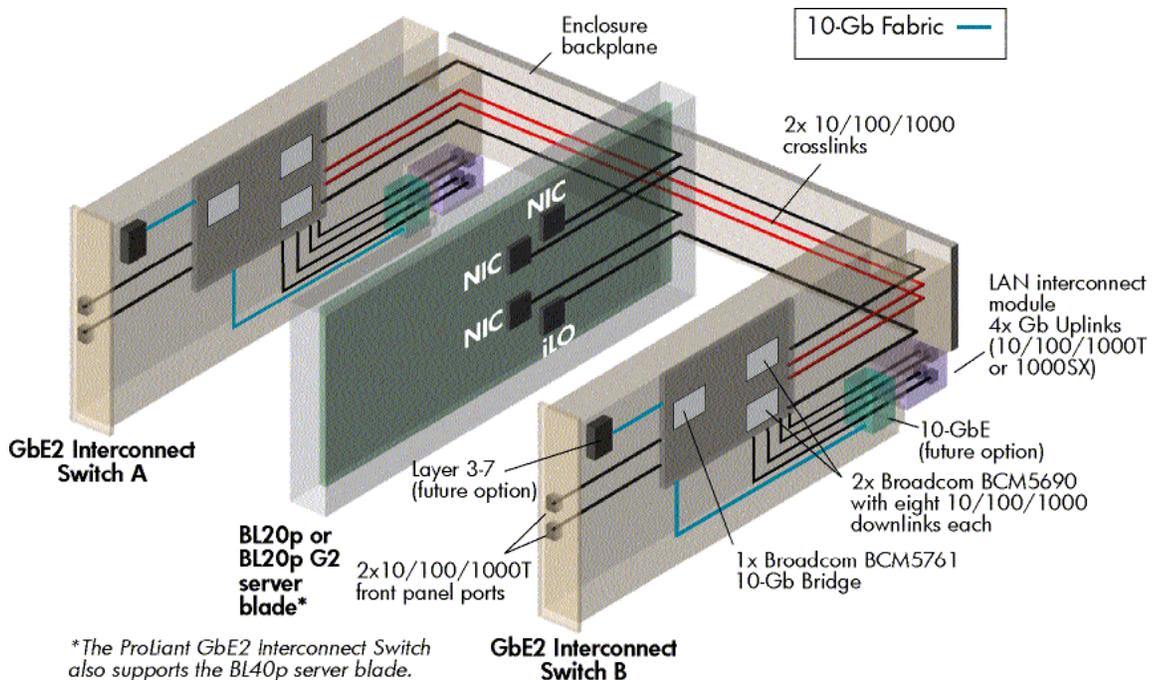
redundant fans and they are powered by two independent feeds via the redundant, N+N hot-plug ProLiant BL p-Class power enclosure.

Users can independently disable or enable the switch ports as desired. Auto-MDI/MDIX with auto-negotiation of speed and duplex mode is supported. Each GbE2 Interconnect Switch includes the following Ethernet ports:

- Sixteen dedicated internal 10/100/1000 Mb/s Ethernet downlink ports connecting the server NICs to the switch.
- Six external Ethernet ports for data, interconnect switch A and B management, Integrated Lights-out (iLO) management, and/or pre-boot execution environment (PXE) remote configuration.
 - Four 10/100/1000T uplink ports (C-GbE2) or four 1000SX uplink ports (F-GbE2) on the rear-mounted LAN interconnect module.
 - Two 10/100/1000T ports on the switch front panel.
- A 10-gigabit (10-Gb) internal fabric that supports future planned GbE2 switch upgrades, including layer 3-7 switching and 10 Gigabit Ethernet uplinks.
- Two dedicated internal 10/100/1000 Mb/s Ethernet crosslink ports bundled as a multi-port trunk for switch-to-switch communication and failover, if desired.

These Ethernet ports are described in the following subsections.

Figure 2. ProLiant BL p-Class GbE2 Interconnect Kit architecture



Downlink ports

Each GbE2 Interconnect Switch includes sixteen pre-assigned, internal 10/100/1000 Mb/s Ethernet downlink ports connecting the server blade network adapters signals to the switch. The signals are routed as Ethernet from the server blades, across individual category 5e (CAT5e) specified signal traces on the passive backplane assembly of the server blade enclosure, and then to the switches.

LAN interconnect module uplink ports

The LAN interconnect module uplink ports are typically used to connect the interconnect switches to the network infrastructure; however, they are standard Ethernet switch ports and may be used as desired. The GbE2 interconnect kits are identical with exception of the LAN interconnect modules. The C-GbE2 Interconnect kit includes two QuadT2 interconnect modules, each with four 10/100/1000T Ethernet ports with RJ-45 connectors. The F-GbE2 Interconnect Kit includes two QuadSX interconnect modules, each with four 1000SX Ethernet ports with LC connectors. Each interconnect module has an independent guide pin to ensure insertion alignment and a robust connector assembly to prevent it from being used with incompatible devices.

Table 1. Interconnect modules used with the C-GbE2 and F-GbE2 Interconnect Kits

Components	C-GbE2 Interconnect Kit	F-GbE2 Interconnect Kit
Interconnect switches	Two GbE2 Interconnect Switches	Two GbE2 Interconnect Switches
Interconnect modules	Two QuadT2 interconnect modules with: <ul style="list-style-type: none"> • Four 10/100/1000 BASE-T/TX/T ports • Four RJ-45 connectors with link speed and activity LEDs. 	Two QuadSX interconnect modules with: <ul style="list-style-type: none"> • Four 1000 BASE-SX ports • Four LC connectors with link speed and activity LEDs 

Front panel ports

Two 10/100/1000T external ports are conveniently located on the front panel. These front panel ports allow users to perform local management and diagnostic tasks without unplugging a dedicated uplink. This prevents disruption the production network to perform these tasks. See the “Serviceability and diagnostics” section for more details on the switch front panel.

When the front panel ports are not used for local management, one or both ports may be used as additional uplinks. A channel is provided at bottom of each interconnect switch to allow network cables to be routed from the front to the rear of the rack, or vice versa.

10-Gb fabric

The GbE2 Interconnect Switch offers maximum flexibility and investment protection supporting enterprise networking requirements today and in the future. Each GbE2 Interconnect Switch includes a 10-Gb (10,000 Mb/s) internal fabric. This fabric is based on the Broadcom HiGig™ technology for sophisticated chip-to-chip interconnection enabling intelligent packet switching at 20 Gb/s data bandwidth full duplex.

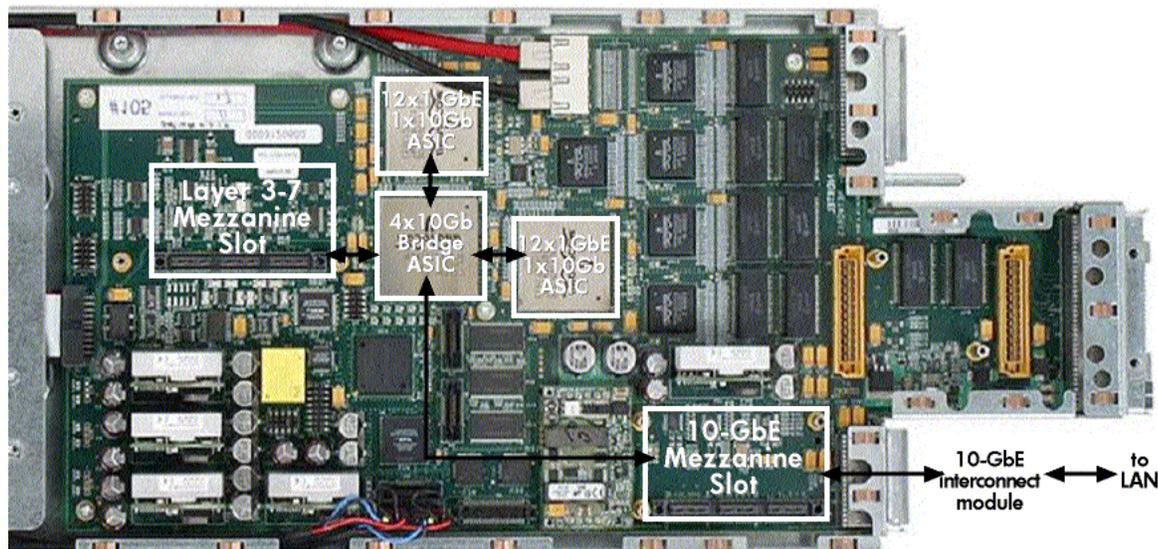
The 10-Gb fabric supports future planned upgrades including:

- A layer 7 option that provides network routing and IP load balancing content delivery switching. The 10-Gb fabric for each switch includes an internal card slot that supports an optional layer 7 mezzanine card (Figure 3).
- A 10-Gb Ethernet uplink upgrade, which is ideal for bandwidth-intensive applications and convergence of IP-based network and storage systems. Users can add a 10-Gb Ethernet switch mezzanine card to each GbE2 interconnect switch via a second option card slot in the 10-Gb fabric (Figure 3). The existing Gb LAN interconnect modules are replaced with new interconnect

module that contain a 10-Gb Ethernet high-bandwidth uplink. The 10-Gb LAN interconnect modules may also contain Gigabit Ethernet ports, if space permits.

With these future planned options for the GbE2 Interconnect Switch, an administrator will be able to independently select the switching layer as well as the uplink bandwidth, all within a single switch. Both options can be installed by users in the field without powering down the server blades or the server blade enclosure. Availability of these options will be announced in the near future.

Figure 3. ProLiant BL p-Class GbE2 Interconnect Switch 10 gigabit fabric



Crosslink ports

The two GbE2 Interconnect Switches are connected through a pair of redundant, 10/100/1000 Mb/s Gigabit Ethernet crosslink connections that are bundled in a 2000 Mb/s Cisco EtherChannel compatible multi-port trunk. The signals are routed as Ethernet from switch to switch via individual CAT5e specified signal traces on the passive backplane assembly of the server blade enclosure. The crosslinks permit communication between the switches, if desired. They also provide the ability to:

- Manage both switches, perform PXE server boots, and access all iLO interfaces using any number of external switch ports. Therefore, a single switch uplink can be used to perform all Ethernet management tasks.
- Configure the p-Class system for advanced ProLiant Network Adapter Teaming including switch fault tolerance. See the section “ProLiant Network Adapter Teaming” for additional information.
- Communicate with any server network adapter from any switch uplink port. As a result, any single uplink port may be used to communicate to all 32 NICs. This permits the 32-to-1 cable reduction and provides additional system redundancy. If uplinks on one switch or the connection to a switch were to fail, all NICs still can be accessed via the other switch.

Maximizing network cable reduction

For maximum (97 percent) cable reduction, the 32 Ethernet signals within the server blade enclosure can be concentrated into any one external Ethernet port. This results in a total of six Ethernet connections for a fully configured 42U rack of six server blade enclosures containing 192 network adapters.

Applications that utilize a single uplink port include testing and evaluation systems, server blade enclosures with a few installed servers, and applications that require minimal bandwidth. On a heavily utilized system, using a single uplink port for all 32 network adapters can cause a traffic bottleneck. For example, using one uplink from interconnect switch A requires the traffic from all the network adapters routed to switch B to travel over the two crosslinks (a 2000 Mb/s path), previously shown in Figure 2. The crosslinks are intended primarily as a failover route and generally are not used as a primary path. For more optimal performance, at least one uplink port on each interconnect switch would be used. However, system administrators may use any combination from one to all twelve external Ethernet ports to increase bandwidth, to separate network and management data onto physically isolated ports, or to add redundant connections to the Ethernet network backbone.

Another means to achieve network cable reduction is to link the GbE2 Interconnect Switches with other ProLiant BL e-Class and p-Class interconnect switches from different server blade enclosures. This is ideal for customers with multiple blade enclosures within a rack. It also allows the network administrator to define the desired level of network blocking or oversubscription.

Network load balancing

ProLiant BL systems configured with the interconnect switch support three network load balancing solutions. Options exist for providing this functionality integrated within or exterior to the server blade enclosure.

For load balancing within the server blade enclosure, the p-Class GbE2 Interconnect Kit future layer 3-7 upgrade (discussed in the section titled "10-Gb fabric") or the currently available F5 Network BIG-IP Blade Controller (BIG-IP) may be used. BIG-IP is a software option for ProLiant BL e-Class and p-Class systems that provides a very economical solution to load balancing and traffic management between multiple server blades that reside in a single to multiple server blade enclosures.

BIG-IP is available from F5 Networks as a software option installed on ProLiant server blades. One license is installed on a server making the server blade into a "dedicated" load balancer; no additional software can be installed on the server blade. For a redundant solution, two copies of BIG-IP are installed on two server blades. The server blade(s) with BIG-IP installed may perform load balancing on blade servers that reside in the same or different server blade enclosures, both e-Class and p-Class. The blade servers may be located anywhere on the network as long as load balanced traffic to and from the servers pass through the BIG-IP Blade Controller. For more information on BIG-IP Blade Controller for ProLiant BL systems, see <http://h71028.www7.hp.com/enterprise/html/4557-0-0-0-121.html>.

For load balancing exterior to the server blade enclosure, a third party layer 7 Ethernet switch or network load balancing appliance may be used. This traditional approach uses a multi-tiered architecture where the interconnect switches are connected to one or more layer 7 switches or network load balancing appliances. Layer 7 switches and network load balancing appliances are available from several network vendors including Cisco, F5, Nortel, and others. This solution is supported on both e-Class and p-Class configured with any interconnect kit.

Investment protection

The GbE2 Interconnect Kits are fully supported in the p-Class server blade enclosure with any combination of ProLiant BL20p, BL20p G2, and BL40p server blades.

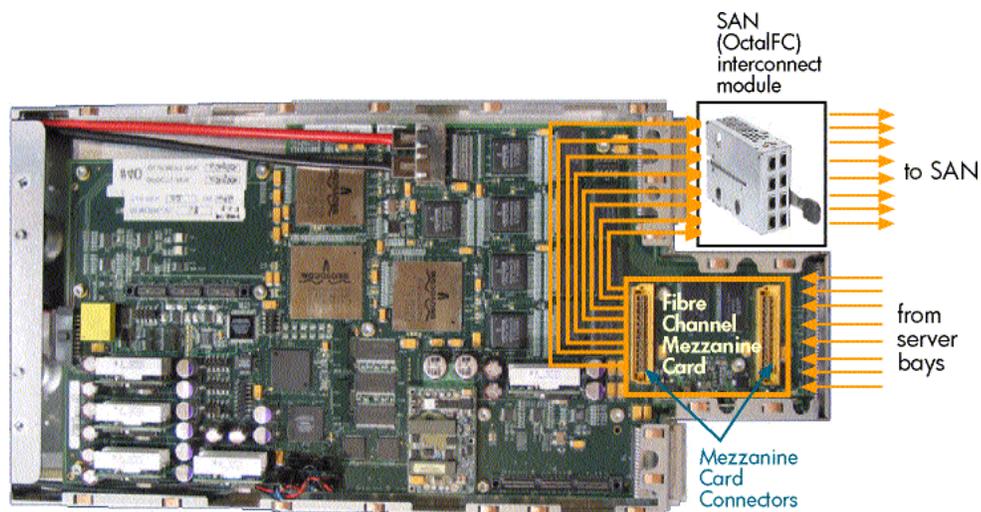
Users can upgrade to the GbE2 Interconnect Kit from existing RJ-45 Patch Panel, RJ-45 Patch Panel 2, and GbE Interconnect Kits without powering down the server blade enclosure or server blades. If users upgrade from the GbE Interconnect Kit, one GbE Interconnect Switch may be replaced at a time while the other switch remains operational. This allows critical network resources to be transferred from one switch to the other.

Fibre Channel pass-through

The GbE2 Interconnect Kits offer the ability to pass-through BL20p G2 Fibre Channel signals using the optional GbE2 Storage Connectivity Kit. Therefore, both Ethernet LAN signal consolidation and Fibre Channel SAN signal pass-through is now possible with a single interconnect. The GbE2 Interconnect Switch chassis is simply used as a carrier to pass-through the Fibre Channel signals. The Ethernet LAN and the Fibre Channel SAN signals are completely isolated from each other even though they share the common GbE2 chassis.

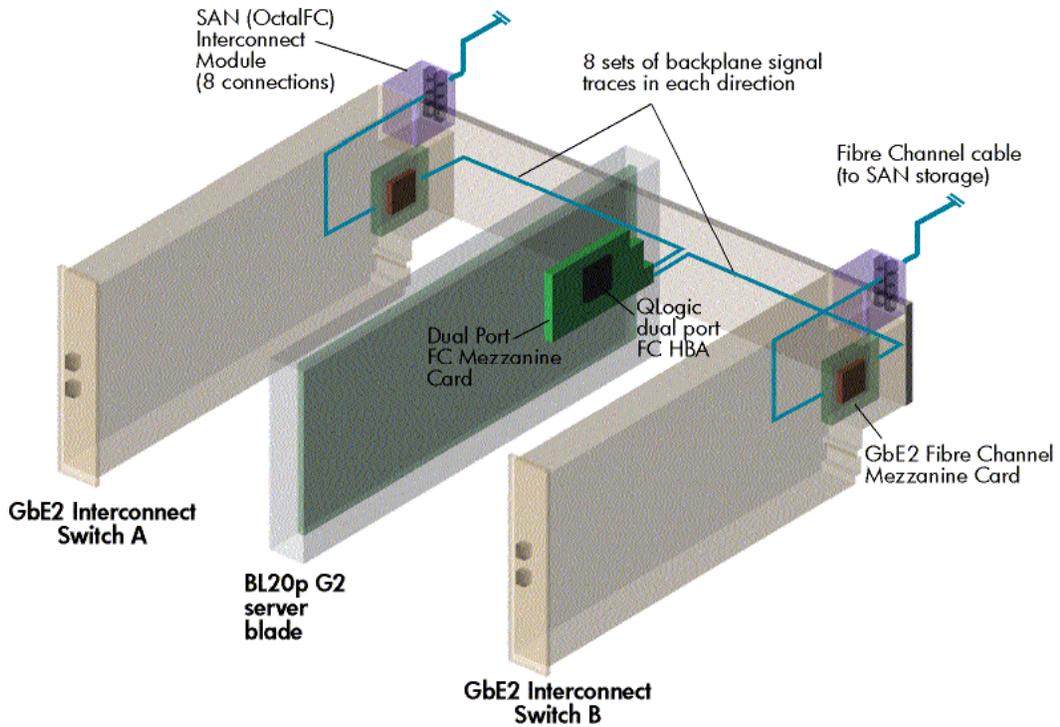
The GbE2 Storage Connectivity Kit provides components for one p-Class server blade enclosure. This kit contains two GbE2 Fibre Channel Mezzanine Cards (one per switch) consisting of a retimer to recondition the Fibre Channel signals and two 8-port SAN (OctalFC) interconnect modules (Figure 4). Customers plug the GbE2 Fibre Channel Mezzanine Card into the connectors provided in each GbE2 Interconnect Switch prior to loading the switches into the interconnect bays. A OctalFC interconnect module is installed into each interconnect bay from the back of the server blade enclosure. Each OctalFC interconnect module contains eight slots for connection to the SAN. Customers plug the small-form-factor pluggable (SFP) transceivers (included with the BL20p G2 Dual Port Fibre Channel Mezzanine Card) into the OctalFC interconnect module SFP slots.

Figure 4. GbE2 Interconnect Switch with GbE2 Storage Connectivity Kit



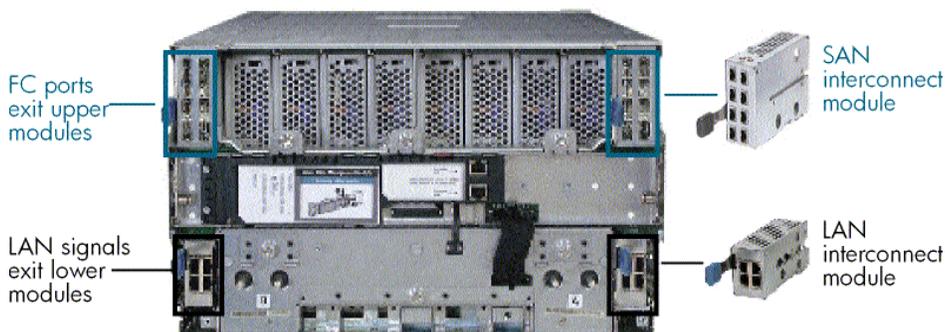
Providing redundant, independent path access to the SAN, one Fibre Channel signal from each ProLiant BL20p G2 server blade bay is routed through the blade enclosure backplane and to the chassis of each GbE2 Interconnect Switch. The Fibre Channel signals travel through the GbE2 Fibre Channel Mezzanine Card (for signal conditioning) and then directly to the OctalFC interconnect module (Figure 5). The GbE2 Storage Connectivity Kit supports Fibre Channel signal pass-through from eight BL20p G2 servers for a total of 16 Fibre Channel signals per server blade enclosure (8 signals routed through each GbE Interconnect Switch chassis). The ProLiant BL40p server blade does not require Fibre Channel signals to be routed to the interconnect bays.

Figure 5. BL20p G2 Fibre Channel signal routing with the GbE2 Interconnect Switch



With the GbE2 Storage Connectivity Kit installed, both Fibre Channel SAN and Ethernet LAN signals exit the rear of the server blade enclosure, each type of signal on its dedicated interconnect module (Figure 6). Just like the LAN QuadT2 and QuadSX interconnect modules, the SAN OctalFC interconnect module has a robust connector assembly and includes a guide pin to ensure that the module is properly aligned as it is inserted. This unique modular design allows the switch to be hot-swapped in seconds without re-cabling. The GbE2 Interconnect Switch front panel includes a SAN LED indicating if a SAN interconnect module is installed.

Figure 6. Rear of server blade enclosure with both SAN and LAN interconnect modules installed



For additional information on the p-Class Fibre Channel offerings, please see the [ProLiant BL p-Class SAN storage connectivity](#) technology brief².

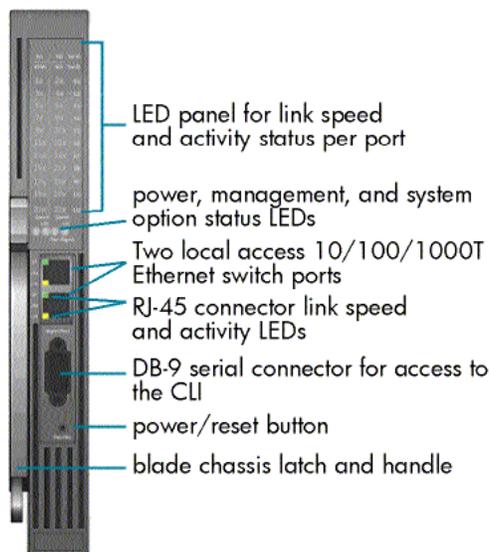
² Available at http://h71025.www7.hp.com/support/reference_library/viewdocument.asp?countrycode=1000&prodid=5726|ProLiant+BL+p-Class+System&source=TC030803TB.xml&dt=21&docid=20366.

Switch management

The GbE2 Interconnect Switch is an industry-standard managed Ethernet switch, which means that users configure and manage the switch like other industry-standard Ethernet switches. To aid users during initial deployment, the GbE2 Interconnect Switch includes a default configuration that is fully operational at initial boot and a step-by-step set-up utility for custom configurations.

A web browser-based interface (BBI) and a command line interface (CLI) with scripting capability are pre-installed in the switch firmware to configure, manage, and monitor the interconnect switch. The interconnect switch also supports Telnet access and simple network management protocol (SNMP). Any combination of the downlinks, crosslinks, and external ports can be disabled, enabled, configured, and monitored on a per port basis. Out-of-band and in-band access to the switch management interfaces are supported locally and remotely from anywhere on the network. Administration of both GbE2 Interconnect Switches is possible through any uplink port, the serial port, or the two 10/100/1000T ports conveniently located on the front panel of each switch (Figure 7).

Figure 7. ProLiant BL p-Class GbE2 Interconnect Switch front panel



Rapid deployment, back-up, and restore

HP Rapid Deployment Pack (RDP) for Windows version 1.40 or greater (RDP for Windows) introduces a new feature called server-side scripting. With server-side scripting, interconnect switch scripts can be integrated in an RDP for Windows job for deployment of both blade servers and switches. This is ideal for using RDP for Windows to deploy a blade server and then configure associated switch VLANs; however, any scriptable interconnect switch parameter can be integrated.³

The GbE2 Interconnect Switch supports both trivial file transfer protocol (TFTP) and secure copy protocol (SCP), which allows a copy of the interconnect switch configuration file to be saved and downloaded either to the original switch or to a different interconnect switch. This provides a method to rapidly deploy multiple systems with similar configurations and to provide backup and restore capabilities. Configuration settings can be modified through the user interfaces or directly within the

³ For more information, see the white paper *Using ProLiant Essentials Rapid Deployment Pack for scripted blade-based switch configuration* at http://h71025.www7.hp.com/support/reference_library/viewdocument.asp?countrycode=1000&prodid=5728|ProLiant+BL+e-Class+System&source=TC030905HT.xml&dt=21&dclid=20890.

configuration file. The configuration file has a text-based format, which allows it to be directly viewed, printed, and edited. Each GbE2 Interconnect Switch has three configuration settings in memory (active, back-up, and factory); any one of these settings can be selected as the current runtime version.

Users can perform firmware operating system upgrades by using TFTP through any external Ethernet port after boot-up, and by using XModem through the serial interface during boot-up. Redundant firmware operating system images can be contained in memory; any system image may be selected as the current runtime version. The interconnect switch simplifies system upgrades by retaining its configuration after a firmware upgrade and by supporting the HP Support Paq automated firmware upgrade process for Windows deployment stations.

IP addressing

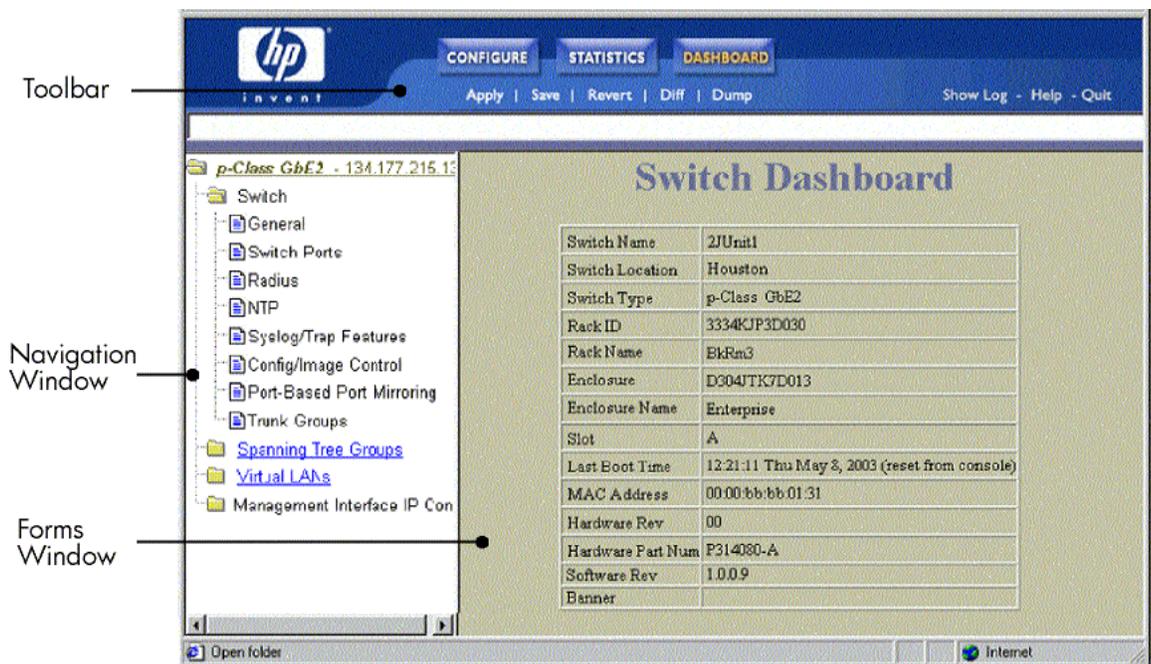
Users can configure the GbE2 Interconnect Switch to automatically obtain an IP address from a bootstrap protocol (BOOTP) server or they can manually assign an IP address through the command line console interface. Users can also assign an IP address from the BBI; however, they would have to reconnect with the newly assigned IP address. For increased security, an administrator can specify the IP-based management network that is allowed to access the interconnect switch.

Web browser-based interface

Users can access the BBI by using Internet Explorer or Netscape Navigator over a TCP/IP network. Thus, access is possible via any external Ethernet switch port. When log-in is complete, the BBI Dashboard page opens by default in the web browser viewing window (Figure 8). The three main regions of the Dashboard area as follows:

- The Toolbar displays the menu options for all windows.
- The Navigation Window contains particular items or features to select.
- The Forms Window contains options for viewing or altering GbE2 Interconnect Switch information.

Figure 8. Browser-based interface for ProLiant BL p-Class GbE2 Interconnect Switch



Scriptable command line interface

The CLI provides the added benefits of scripting, a set-up utility and other enhanced switch management tasks, an out-of-band connection, and more. The main menu opens after a successful log-in (Figure 9). This interface may be accessed locally via the front panel RS-232 console port on each interconnect switch or remotely using a console Telnet session via any interconnect switch external Ethernet port.

Figure 9. Command line interface for ProLiant BL p-Class GbE2 Interconnect Switch

```
[Main Menu]
info - Information Menu
stats - Statistics Menu
cfg - Configuration Menu
oper - Operations Command Menu
boot - Boot Options Menu
maint - Maintenance Menu
diff - Show pending config changes [global command]
apply - Apply pending config changes [global command]
save - Save updated config to FLASH [global command]
revert - Revert pending or applied changes [global command]
exit - Exit [global command, always available]

"Set Up" will walk you through the configuration of System Date and Time,
BOOTP, Spanning Tree, Port Speed/Mode, VLANs, and IP interfaces. [type
Ctrl-C to abort "Set Up"]
-----
Will you be configuring VLANs? [y/n]
```

Main Menu Log-in Screen

Set-up Utility

Simple network management protocol

The GbE2 interconnect switch supports industry-standard SNMP management information bases (MIBs), HP enterprise switch MIBs, and environmental traps. The SNMP agents are pre-installed in the interconnect switch firmware. Redundant community strings and SNMP trap manager hosts can be configured per switch

This capability allows the interconnect switch to be monitored remotely from an SNMP network management station such as [Insight Manager 7](#)⁴ or [HP OpenView](#).⁵ The interconnect switch may also be configured through the HP OpenView Network Node Manager. The unique interconnect switch integration with Insight Manager 7 provides the following additional features:

- A script utility to simplify registering (compiling) the GbE2 Interconnect Switch MIBs.
- Automatic discovery and identification of the interconnect switches upon registration of MIBs.
- Automatic receiving of traps and events from the interconnect switches upon registration of MIBs.
- Graphical representation of the p-Class server blades and interconnect switches (support for GbE2 Interconnect Switches is planned for 4Q2003).

Switch security

Several features are provided on the GbE Interconnect switch to allow the switch administrator to secure the management interfaces. These features include the ability to:

- Configure multiple password protected accounts with various levels of access.

⁴ Available at <http://www.compaq.com/products/servers/management/cim7-description.html>.

⁵ Available at <http://www.hp.com/products1/softwareproducts/software/openview/index.html>.

- Specify the IP-based management networks that are allowed to access each switch.
- Set a user interface idle time-out period and disable web-based and Telnet access.
- Enable a secure shell (SSH) session to the CLI interface.
- Modify default Telnet and HTTP server socket port numbers.

Additional switch security measures include:

- RADIUS RFC 2865 to provide user authentication and authorization.
- Port-based IEEE 802.1Q tagged VLANs for server grouping and data isolation.
- Secure copy protocol (SCP) to securely upload and download the switch configuration file.
- The ability place the switch in an unique "safe mode" configuration with the included example templates.

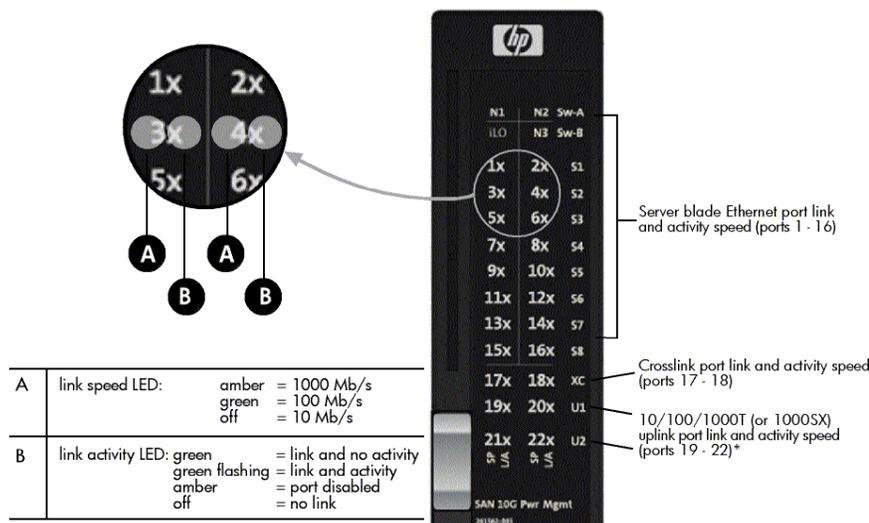
When users insert a new or replacement GbE2 Interconnect Switch into a production/real-time environment, they must ensure that the GbE2 Interconnect Switch configuration is compatible with the production network. Because the factory default configuration of a new interconnect switch may not be same as the production configuration, inserting the new switch may compromise the security aspects and VLAN isolation used by the production network.

A new or replacement interconnect switch can be installed in "safe mode" to address network compatibility and security issues and to allow the administrator to configure the switch and finalize switch deployment on the production network. Network compatibility includes spanning tree protocol loop avoidance. Security issues include items such as VLAN isolation, user-passwords, and SNMP read-write community strings. The GbE2 Interconnect Switch includes an example safe mode template configuration file as a basis to create an appropriate safe mode configuration. The administrator can simply download a final configuration template with the safe mode configuration to deploy the GbE2 Interconnect Switch in the production environment.

Serviceability and diagnostics

The GbE2 Interconnect Switch has several serviceability features such as the front-mounted, hot-swappable interconnect switch blade, the front panel RS-232 port, Gigabit Ethernet ports, and a power re-set switch. The interconnect switch also has system status LEDs and a LED annunciation panel that displays the link speed and activity status for each port (Figure 10).

Figure 10. Front port LED panel for ProLiant BL p-Class GbE2 Interconnect Switch



*Uplink ports on the p-Class C-GbE2 Interconnect Kit are 10/100/1000T. Uplink ports on the p-Class F-GbE2 Interconnect Kit are 1000SX.

The optional HP Diagnostic Station (Figure 11) is available to configure and diagnose an interconnect switch or a server blade that has been removed from the server blade enclosure. The Diagnostic Station provides power to the interconnect switch and can be used to perform any of the following tasks:

- Build the initial interconnect switch configuration.
- Download a switch configuration file.
- Test network adapter and interconnect switch port activity.
- Diagnose interconnect switch status.
- Test an interconnect switch after installing an option or upgrade.

Figure 11. Diagnostic Station



The GbE2 switch provides many additional serviceability and diagnostic features including:

- Port mirroring with the ability to mirror desired type of frames (egress, ingress, or both). A single-source or multiple-source port may be mirrored to a destination port.
- Power on self test (POST) at boot for hardware verification.
- Monitoring screens via the user interfaces for port utilization, data packets received/transmitted, error packets, packet size, trunk utilization, SNMP data, etc.
- Details of system information via the user interfaces such as port parameters and link status, switch asset information, configuration values, log entries, etc.
- The ability to "ping" to identify connectivity and trace routes to determine station-to-station path connectivity.
- Local system log (syslog) with ability to view and clear messages plus remote syslog with support for a primary and secondary syslog servers.
- Settable non-volatile random access memory (NVRAM) diagnostic flags and display of management processor trace buffer and snap or post-mortem trace buffer.
- State information "dump" for tuning and debugging switch performance available in unencoded format.
- Panic command for immediate state dump to flash memory and automatically switch reboot and a watchdog timer for automatic switch reboot in case of switch software "freeze."
- MAC addresses view, clear, and delete from the forwarding database for identifying problems with MAC address learning and packet forwarding.
- ARP table view, clear, entry, and delete for identifying problems with ARP entries.

- The ability to set the interconnect switch to a valid firmware image in case of firmware corruption.

For more detailed information on the administration capabilities of the ProLiant BL p-Class GbE2 Interconnect Switch, see the ProLiant BL p-Class GbE2 Interconnect Switch user guides.⁶

Virtual LAN

The GbE2 Interconnect Switch supports 255 port-based IEEE 802.1Q virtual LANs (VLANs). Members of a VLAN may be untagged and tagged ports according to IEEE 802.3ac VLAN Ethernet frame extensions for 802.1Q tagging. Therefore, GbE2 switch VLANs may span other switches that support 802.1Q tagging located within the network infrastructure.

Spanning tree

The GbE2 Interconnect Switch meets the IEEE 802.1D spanning tree protocol (STP) and provides 16 spanning trees per VLAN basis. The spanning tree per VLAN implementation is compatible with Cisco PVST+ (per VLAN spanning tree). The interconnect switch is also compatible with Cisco PVST when the connecting switch is configured to use 802.1Q tagging or when it is running untagged.

Users can configure STP switch parameters, including priority and cost, on a per port basis. Each interconnect switch can automatically find the STP root bridge on the network. Otherwise, the interconnect switch will act as the root bridge for the STP domain. The spanning tree protocol may also be disabled on a per switch or per port basis, which is ideal for networks designed without loops or individual switch ports connected to server blades or other devices where a loop does not exist.

EtherChannel compatible link aggregation

The GbE2 Interconnect Switch complies with IEEE 802.3ad (802.3-2002) static link aggregation (excluding LACP⁷) compatible with Cisco EtherChannel (Fast EtherChannel, Gigabit EtherChannel). Each interconnect switch supports twelve multi-port trunks with up to six ports per trunk.

Enterprise-class performance

The GbE2 Interconnect Switch includes the following performance features:

- 24 Gb/s external port bandwidth per server blade enclosure (full duplex).
- 17.9 million packets per second maximum external port frame forwarding throughput per server blade enclosure (64-byte packets).
- 2,048 MAC addresses per switch with automatic MAC address learning.
- 128-MB Main, 32-MB flash, and 2-MB packet buffer memory per switch (packet buffer memory shared between ports).
- Internal 10 gigabit fabric for providing packet switching at 20 Gb/s data bandwidth full duplex

ProLiant Network Adapter Teaming

ProLiant Network Adapter Teaming is typically used to provide fault resiliency for the NICs within the team. If one NIC should fail, the surviving NICs maintain network connectivity. However, network adapter teaming may also be used to maintain network services if an Ethernet switch fails. The architecture of the p-Class system allows for both network adapter and interconnect switch fault tolerance when using ProLiant Network Adapter Teaming.

The ProLiant p-Class servers include standard HP NC series network adapters that support all three types of ProLiant Network Adapter Teaming:

⁶ Available at <http://h18004.www1.hp.com/products/servers/proliant-bl/p-class/bl-p-interconnect-switch2.html>.

⁷ Link Aggregation Control Protocol.

- Network Fault Tolerance (NFT)
- Transmit Load Balancing (TLB)
- Switch-assisted Load Balancing (SLB)

When teaming HP NC series network adapters with the interconnect switch, NFT and TLB teaming are the same as with any ProLiant system. However, for SLB teaming, the pre-defined switch-to-server architecture across the server blade enclosure's backplane must be considered. SLB requires that all NICs in the team must be connected to the same switch.

The GbE2 Interconnect Switch's redundant crosslinks add significant advantages when configuring teaming for switch fault tolerance. For details, see the [HP ProLiant network adapter teaming](#) white paper⁸ located on the ProLiant teaming home page.

Conclusion

The ProLiant BL p-Class system is a comprehensive solution for customers operating multi-tiered environments that demand space and power efficiency, on-demand computing, end-to-end system redundancy, rapid hardware and software deployment, and scalable management. The ProLiant p-Class GbE2 Interconnect Kits are part of the family of interconnect options available for the ProLiant BL p-Class system.

Meeting network requirements today and tomorrow, the extensive list of supported features, future layer 7 switching, and 10 Gigabit Ethernet uplink capability built into every GbE2 Interconnect Kit provide the most advanced Ethernet switching technology available in a blade format. Each GbE2 Interconnect Kit includes a pair of fully redundant, managed Ethernet switches that consolidate up to thirty-two 10/100/1000 Mb/s gigabit network adapters to one to twelve external ports. These options are ideal for reducing Ethernet network cabling and the time required to deploy, manage, and service ProLiant BL p-Class systems.

⁸ Available at <http://ftp.compaq.com/pub/products/servers/networking/TeamingWP.pdf>.

Appendix: Summary of features of the ProLiant BL p-Class GbE2 Interconnect Kit

Switch performance

- Store and forward mode layer 2 switching standard
- Layer 3 routing firmware future internal upgrade capability
- Layer 7 routing and content delivery switching future internal upgrade capability
- Support for 3rd party external layer 7 content delivery switch / appliance
- Support for F5 BIG-IP Blade Controller load balancer and traffic management
- Frame forwarding throughput of 1.488 million packets per second (per Gigabit port)
- 17.9 million packets per second maximum external port (uplink) frame forwarding throughput per server blade enclosure (64-byte packets)
- 24.0 Gb/s External port (uplink) bandwidth per server blade enclosure (full duplex)
- 10 Gigabit Ethernet uplink future upgrade capability
- 128 MB Main, 32 MB flash, and 2 MB packet buffer memory per switch (packet buffer memory shared between ports)
- Auto-negotiation and auto-sensing with full-duplex support and ability to manually force port speed and duplex mode
- Auto-MDI/MDIX on all ports enabled with auto-negotiation
- 2,048 MAC addresses per switch with automatic MAC address learning
- ARP for IP to MAC address resolution

Switch network features

- IEEE 802.3 10Base-T Ethernet, IEEE 802.3u 100Base-TX Ethernet, IEEE 802.3ab 1000Base-T Ethernet, and IEEE 802.3z 1000Base-SX
- IEEE 802.1D spanning tree protocol (mono-spanning tree)
- PVST+ and PVST compatibility when VLANs are untagged or use 802.1Q tagging; up to 16 spanning tree domains per switch
- Enable/disable and configure spanning tree port cost and priority on a per port basis
- IEEE 802.3ad link aggregation (excluding LACP) supporting up to 12 multilink trunk groups with 6 ports per group; compatible with Cisco EtherChannel trunking (Fast EtherChannel, Gigabit EtherChannel)
- 255 IEEE 802.1Q port based VLANs per switch
- IEEE 802.3ac VLAN Ethernet frame extensions for 802.1Q tagging on a per port basis
- Tagged and untagged ports as members of a VLAN
- IEEE 802.3x flow control with manual configuration capability
- NTP (network time protocol) client with time zone support
- Real time clock (RTC) system time

Switch deployment and configuration

- Default pre-configuration for immediate plug-in operation in the server blade enclosure
- Set-up utility for a step-by-step customized configuration
- Communicate to any and all server blade network adapters from any Ethernet external port
- Manage both switches, access all iLO ports, and execute PXE from any external Ethernet port
- Web-based interface accessible from any switch port
- Command line interface (CLI) with scripting capability accessible from any switch port
- Telnet access to the CLI and menu-driven console interfaces accessible from any switch Ethernet port
- Integrated switch scripting within Rapid Deployment Pack for Windows v1.40 or greater
- One serial and two Ethernet ports conveniently located on the front of each switch for additional uplinks and local management, port mirroring, and other administration and diagnostic tasks
- Configurable forwarding MAC address aging time settable to any value from 1 to 65,535 seconds (default is 300 seconds)

- MAC address user management sorting on a per port and per VLAN basis
- Manual, or automatic IP settings via a BOOTP server
- Three switch configuration settings in memory (active, back-up, and factory); any can be selected as the current version.
- Redundant firmware images in memory; either image can be selected as the current runtime version.
- Ability to restore switch to factory default settings
- TFTP and SCP to upload and download (save, restore, and update) the switch configuration file
- TFTP to upload and download (save, restore, and update) the switch firmware
- XModem to download the switch firmware (restore and update) via the serial interface
- Switch configuration retention after firmware upgrade
- HP Support Paq automated firmware upgrade process for Windows deployment stations
- Human read/write configuration file for viewing, printing, and editing
- DNS (Domain Name Service) client supporting primary and secondary DNS servers
- Pre-configured customized port naming with respect to server blade NIC connectivity
- ARP cache management table to display, add, and delete entries
- Ability to name ports on a per port basis
- Full ability to enable and disable any port (both internal and external ports) on both switches
- Two port disable levels: temporary (reverts to enable at switch boot) and permanent disable

Switch diagnostics and monitoring

- One serial port and two Ethernet ports conveniently located on the front of each switch for additional uplinks and local management, port mirroring, and other administration and diagnostic tasks
- Front panel per port speed and per port link activity LED annunciation panel per switch
- System, management, and option compatibility status LEDs
- Per port speed and link activity LEDs adjacent to all external Ethernet ports
- Port mirroring with ability to mirror desired type of frames (egress, ingress, or both)
- Port mirroring single or multiple source ports to single destination port
- Switch statistic monitoring including port utilization, data packets received/transmitted, port error packets, packet size, trunk utilization, SNMP data, etc
- System reporting such as port parameters and link status, switch asset information, configuration values, log entries, etc.
- SNMP v1 with two configurable community strings and SNMP trap manager hosts
- MIB-II, Bridge MIB, Interface MIB, Extended Bridge MIB, Ethernet-like MIB, Entity MIB, RADIUS Authentication Client MIB, 802.3-2002 Link Aggregation MIB, and HP enterprise switch MIBs
- Bridge, remote monitoring, and switch environmental traps
- Script utility to simplify registering (compiling) switch MIBs with Insight Manager 7
- Insight Manager 7 automatic discovery, identification, and receiving of traps and events, upon registration of MIBs
- Insight Manager 7 graphical representations of switches (planned for 4Q2003)
- Insight Manager 7 standard database activities (queries, tasks, reporting, etc)
- Power on self test (POST) at boot for hardware verification
- Portable Diagnostic Station to configure, upgrade, and diagnose an interconnect switch and server blade removed from the rack environment
- Ability to return switch to a valid firmware image in case of firmware corruption
- Local system log (syslog) with ability to view and clear messages
- Remote syslog with support for a primary and secondary syslog server
- Ping capability to test the connectivity on the Ethernet network
- Trace route to identify the path used for station-to-station connectivity across the network
- Settable NVRAM diagnostic flags
- View information, clear, and delete specific MAC addresses from the forwarding database for identifying problems with MAC address learning and packet forwarding
- ARP table view, clear, entry, and delete for identifying problems with ARP entries
- Display management processor trace buffer and snap or post-mortem trace buffer

- State information “dump” for tuning and debugging switch performance available in uuencoded format
- Panic command for immediate state dump to flash memory and automatically switch reboot

Switch security

- Password protected multi-level user accounts supported on all management interfaces
- Configurable user interface idle time-out period
- Ability to disable web-based and Telnet access to the switch user interfaces
- 255 Port-based IEEE 802.1Q tagged VLANs per switch (510 per server blade enclosure)
- Ability to specify the IP-based management network that is allowed to access the switch
- RADIUS RFC 2865 user authentication and authorization
- Unique “safe mode” option to maintain production environment VLAN isolation and security aspects
- Configurable Telnet and HTTP server socket port numbers
- Secure shell (SSH) access to the command line interface
- Secure copy protocol (SCP) to securely upload and download the switch configuration file

Switch availability

- Front-mounted, hot-swappable switch with configuration retention and no need to cable/recable when removing
- Redundant switches per server blade enclosure
- Redundant uplink ports per switch
- Redundant front panel management/diagnostic ports per switch
- Redundant crosslinks for switch to switch communication and failover scenarios within the server blade enclosure
- Redundant pairs of network adapters per server routed to different switches
- Redundant Fibre Channel signals per each server passed through different switch chassis
- Redundant N+N hot-plug redundant power to each switch
- Redundant N+1 on-board cooling per switch
- IEEE 802.3ad automatic multi-link load balancing and link failover (excluding LACP)
- Load balancing of unicast traffic
- ProLiant network adapter teaming
- Redundant configurable community strings and SNMP trap manager hosts
- Redundant default gateways with automatic failover
- Redundant configurable Domain Name Service (DNS) client
- Redundant configurable syslog servers
- Redundant firmware images in memory; either image can be selected as the current runtime version.
- Redundant configuration settings in memory plus a third factory default file; any setting can be selected as the current runtime version.

Switch investment protection

- Layer 3 routing firmware future internal upgrade capability
- Layer 7 routing and content delivery switching future internal upgrade capability
- 10 Gigabit Ethernet uplink future upgrade capability
- Supports any combination of ProLiant BL p-Class server blades
- Optional pass-through of ProLiant BL20p G2 Fibre Channel signals

Switch ports per server blade enclosure

- Eight external 10/100/1000T (C-GbE2) or 1000SX (F-GbE2) Gigabit Ethernet ports on a hot-pluggable rear-mounted interconnect module
- Four external 10/100/1000T Gigabit Ethernet ports on switch front panels
- Two external DB-9 serial ports on switch front panels (one per switch)
- 32 internal 10/100/1000 Gigabit Ethernet ports to server blade network adapters (4 per server bay)
- Two internal 10/100/1000 Gigabit Ethernet inter-switch crosslinks for switch to switch communication and failover scenarios
- 10 gigabit fabric for future layer 7 switching and 10 Gigabit Ethernet uplink capability
- 16 BL20p G2 Fibre Channel pass-through signals (with GbE2 Storage Connectivity Kit)
- I²C Switch to management module communications
- All external Ethernet ports may be used for data, switch and iLO management, and/or PXE remote configuration.
- All internal Ethernet signals routed as Ethernet across individual CAT5e signal traces
- 12 RJ-45 (C-GbE2) or 8 LC fiber and 4 RJ-45 (F-GbE2) external Ethernet port connectors
- 16 pluggable, small form factor external slots for Fibre Channel port connectors (with GbE2 Storage Connectivity Kit)

Switch physical and environmental

- AC power input (at server blade system level)
- Direct facility -48 DC power input
- 81 Typical and 113 maximum power consumption per switch (watts)
- Local front power reset/power cycle button on each switch
- Remote reset/power cycle via user interface
- 10 to 35 operating and -30 to 60 storage temperature (Celsius)
- 20% to 80% operating and 5% to 95% storage relative humidity
- FCC Class A, ICES-003 Class A, AS/NZS 3548 Class A, and VCCI Class A electromagnetic interference (EMI) certifications
- UL/CUL and CE safety certifications
- 12.0 pounds per interconnect switch and interconnect module

For more information

For additional information, refer to the resources detailed below.

Resource description	Web address
<i>ProLiant BL p-Class GbE2 Interconnect switch home page</i>	http://h18004.www1.hp.com/products/servers/proliant-bl/p-class/bl-p-interconnect-switch2.html
<i>ProLiant BL p-Class Networking Overview white paper</i>	http://h18004.www1.hp.com/products/servers/proliant-bl/p-class/bl-p-interconnect-switch2.html
<i>ProLiant BL p-Class SAN storage connectivity technology brief</i>	http://h71025.www7.hp.com/support/reference_library/viewdocum ent.asp?countrycode=1000&prodid=5726 ProLiant+BL+p- Class+System&source=TC030803TB.xml&dt=21&docid=20366
<i>Using ProLiant Essentials Rapid Deployment Pack for scripted blade-based switch configuration white paper</i>	http://h71025.www7.hp.com/support/reference_library/viewdocum ent.asp?countrycode=1000&prodid=5728 ProLiant+BL+e- Class+System&source=TC030905HT.xml&dt=21&docid=20890
ProLiant BL p-Class GbE2 Interconnect Switch user guides	http://h18004.www1.hp.com/products/servers/proliant-bl/p-class/bl-p-interconnect-switch2.html
ProLiant network adapter teaming	http://www.compaq.com/products/servers/networking/teaming.html
F5 BIG-IP Blade Controller for ProLiant BL systems	http://h71028.www7.hp.com/enterprise/html/4557-0-0-0-121.html

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