

# HP Virtual Connect technology implementation for the HP BladeSystem c-Class

technology brief



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## Abstract

As datacenter density and complexity increase, so do demands for IT efficiency and responsiveness. As a result, simplifying system interconnections becomes significantly more important. HP has developed a new interconnect solution, the HP Virtual Connect architecture, to boost the efficiency and productivity of data center server, storage, and network administrators. HP is implementing the Virtual Connect architecture first in the HP BladeSystem c-Class.

This paper explains how Virtual Connect technology virtualizes the connections between the server and the network infrastructure (server-edge I/O virtualization) so that networks can communicate with pools of HP BladeSystem servers and administrators can change servers in minutes instead of days or weeks. It also explains how implementing Virtual Connect:

- Reduces cables without adding switches to manage
- Maintains end-to-end connections of preferred fabric brands
- Cleanly separates server enclosure administration from LAN and SAN administration
- Relieves LAN and SAN administrators from server maintenance
- Makes servers ready for rapid change at any time, so that server administrators can add, move, or replace servers without affecting the LANs or SANs

## Overview of Virtual Connect technology

HP BladeSystem c-Class integrates the Virtual Connect architecture from the ground up. The benefits of this technology are derived from capabilities built into the communication and control infrastructure. Support from these built-in capabilities is essential for achieving the level of functionality provided by the HP BladeSystem c-Class; that is, intuitive ease of use, smooth integration, and scalable implementation. If these capabilities are not built in, they cannot be bolted on.

The HP BladeSystem c-Class using the Virtual Connect architecture resolves datacenter difficulties related to density and complexity: too many cables, switches, and administrators.

Densely stacking servers with many Ethernet and Fibre Channel (FC) connections can result in hundreds of cables coming out of a rack. Multitudes of cables are inherently risky, and cable intensive interconnect schemes such as patch panels or pass-thru modules are typically the most expensive connection methods.

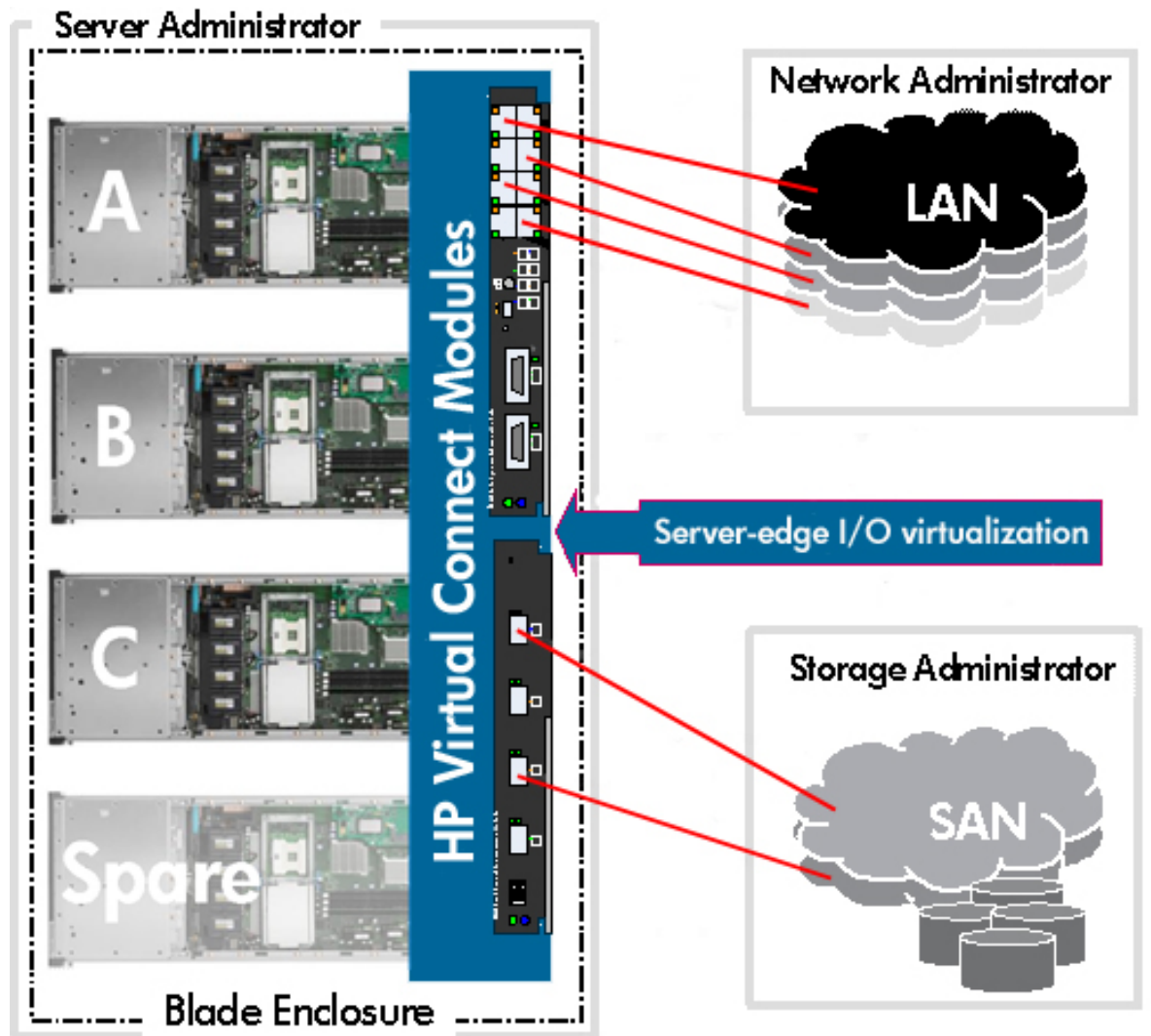
While use of switches can greatly reduce the number of required cables, adding switches creates additional management overhead. Moreover, a FC storage area network (SAN) fabric can include only a limited number of switches. Because switches integrated into blade server environments are, by design, small compared to the large, standalone switches typically used in data centers, blade systems require more switches. Consequently, FC SANs must sometimes connect to blade servers using pass-thru methods to stay within the fabric limits.

When a server is added, moved, or replaced in any server system, the local area network (LAN) and SAN must be adjusted. Therefore, LAN and SAN administrators must become involved in routine server activities. This creates delay for the server administrator waiting for schedule coordination.

Virtual Connect is an industry standard-based implementation of server-edge I/O virtualization. It puts an abstraction layer between the servers and the external networks so that the LAN and SAN see a pool of servers rather than individual servers (see Figure 1). Once the LAN and SAN connections are made to the pool of servers, the server administrator uses a Virtual Connect Manager User Interface to create an I/O connection profile for each server. Instead of using the default media access control (MAC) addresses for all network interface controllers (NICs) and default World Wide Names (WWNs) for all host bus adapters (HBAs), the Virtual Connect Manager creates bay-specific I/O profiles, assigns unique MAC addresses and WWNs to these profiles, and administers them locally. Local administration of network addresses is a common industry technique that Virtual Connect

applies to a new purpose. Network and storage administrators can establish all LAN and SAN connections once during deployment and need not make connection changes later if servers are changed. As servers are deployed, added, or changed, Virtual Connect keeps the I/O profile for that LAN and SAN connection constant.

**Figure 1.** Server-edge I/O virtualization. Virtual Connect technology puts an abstraction layer between servers and the external networks, creating a logical multi-host endpoint. The server administrator assigns server I/O connections to the Virtual Connect interconnect modules, and the LAN and SAN administrators treat its ports as the endpoint of their networks.



## How Virtual Connect works

The ability to implement Virtual Connect is built in to each component of the HP BladeSystem c-Class, including the Onboard Administrator (OA), PCI Express mezzanine cards, HBAs, NICs, and the iLO communication channels. HP Virtual Connect modules are required to activate the full server-edge I/O virtualization across the system.

No special mezzanine cards are required; HP Virtual Connect works with the standard Ethernet NICs and FC HBAs that are available with HP BladeSystem c-Class server blades. HP Virtual Connect Ethernet and FC interconnect modules are new options to simplify connection of those server NICs

and HBAs to the data center environment. Virtual Connect extends the capability of the standard server NICs and HBAs by providing support for securely administering their Ethernet MAC address and FC WWNs.

No virtual devices are created; the WWNs and MAC addresses are **real**. They are the only WWNs and MAC addresses seen by the system, the OS, and the networks. Virtual Connect has the unique ability to manage the WWNs and MAC addresses presented by the hardware without recabling and without requiring the assistance of multiple administrators. Although the hardware ships with default MAC addresses and WWNs, Virtual Connect resets the MAC addresses and WWNs prior to boot, so PXE/SAN boot and all operating systems will see only the Virtual Connect managed values. Virtual Connect securely manages the MACs and WWNs by accessing the physical NICs and HBAs via the enclosure's OA and the iLO interfaces on the individual server blades.

During setup of the Virtual Connect environment, the administrator can select MAC/WWN values from one of the following groups:

- Factory default MACs/WWNs
- A specific, user-defined range of MACs/WWNs
- One of several HP pre-defined ranges of MACs/WWNs

The use of factory default MAC addresses is not recommended as they cannot be moved to another server blade.

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**NOTE:**

HP is registered as an Ethernet and FC vendor with the appropriate standards bodies and has reserved pre-defined MAC address and WWN ranges for exclusive use with Virtual Connect. These reserved ranges will never be used as factory default MACs/WWNs on any hardware. System administrators must be careful to use each reserved range only once within their enterprise environment.

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If a server is moved from a Virtual Connect managed enclosure to an unmanaged enclosure, the local MAC addresses and WWNs are automatically returned to the original factory defaults. If a server is removed from a server bay within a Virtual Connect domain and is plugged into another bay in the same domain or into a bay in a different domain, it will be assigned the new set of addresses appropriate for that server bay location.

Ethernet network adapters have had for some time the ability to configure locally administered addresses. The difference with Virtual Connect is that the configuration can be done securely in an OS-independent manner and is coordinated with the administration of other aspects of the server's programmable attributes, Fibre Channel HBAs have not typically supported locally-administered addresses, and so securely administering these WWNs is a new, built-in capability offered by HP.

Virtual Connect reduces the required number of Fibre Channel cables by means of an HBA Aggregator. This device is not a switch but an N\_Port ID Virtualization (NPIV) device that allows multiple HBAs to connect with a single FC switch port. Virtual Connect adheres to the ANSI T-11 standards that define all Fibre Channel technologies. Virtual Connect is transparent to the SAN, which sees its connections as a collection of HBAs. Since HBAs do not require management, using Virtual Connect means that no other brands of switches are introduced. Therefore the IT environment can continue to gain the benefits of end-to-end connectivity of the users' preferred network brands.

## Virtual Connect environment with HP BladeSystem c-Class enclosure

The Virtual Connect modules plug directly into the interconnect bays of the HP BladeSystem c-Class enclosure. The modules can be placed side by side for redundancy (see Figure 3). Initial implementations include the HP 1/10Gb Virtual Connect Ethernet Module for BladeSystem c-Class and the HP 4Gb Virtual Connect Fibre Channel Module for BladeSystem c-Class.

**Figure 3.** Rear of HP BladeSystem c7000 Enclosure showing redundant Virtual Connect modules



The initial product release will support only single enclosure module stacking. A future firmware update will provide support for up to four HP BladeSystem c7000 enclosures (for a total of 64 servers) per Virtual Connect domain, two or four Virtual Connect Ethernet modules per enclosure (eight total per Virtual Connect domain), and zero or two Virtual Connect FC modules per enclosure.

For a single-module configuration, install the HP 1/10Gb Virtual Connect Ethernet Module in interconnect bay 1 and for a redundant configuration, install the second module in interconnect bay 2. Avoid using Virtual Connect and non-Virtual Connect interconnect modules in horizontally adjacent bays.

### NOTE:

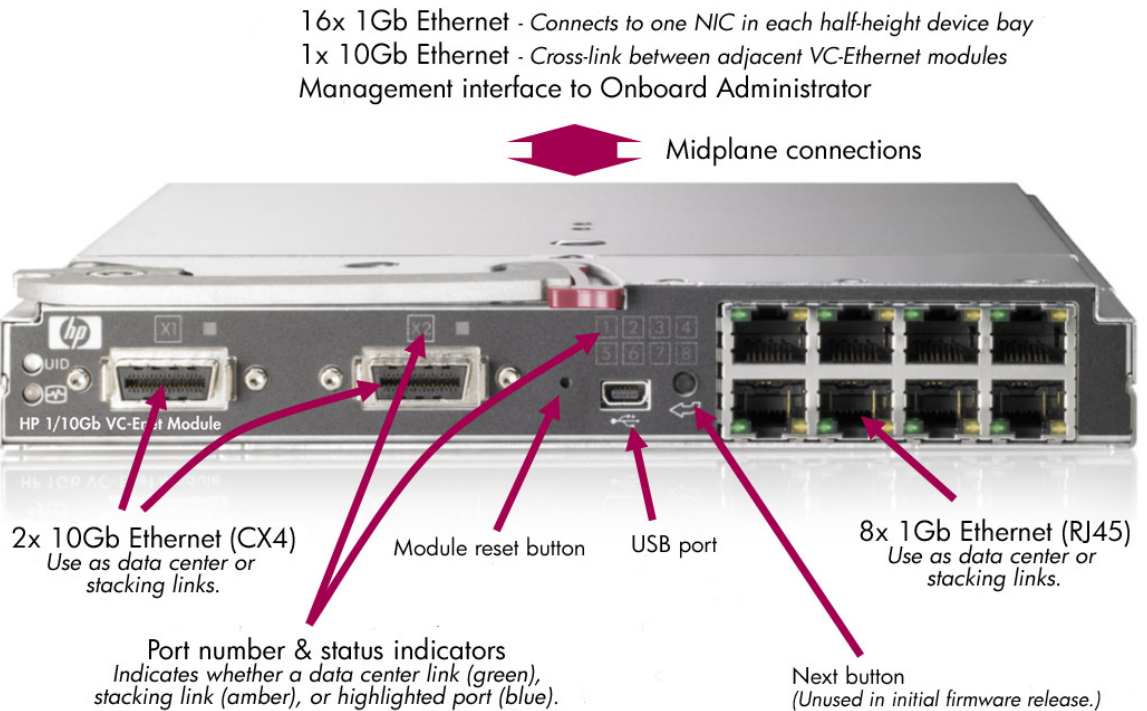
When installing an HP 1/10Gb Virtual Connect Ethernet Module into an enclosure with existing servers, do not change the MAC addresses of the NICs residing in servers that were installed prior to the deployment of the Virtual Connect module. Ensure that all iLOs and HP 1/10Gb Virtual Connect Ethernet Module have received IP addresses. Without IP addresses on all modules, Virtual Connect will not operate properly.

To install FC, the enclosure must have at least one Virtual Connect Ethernet module, because the Virtual Connect Manager software runs on a processor resident on the Ethernet module.

## HP 1/10Gb Virtual Connect Ethernet Module for BladeSystem c-Class

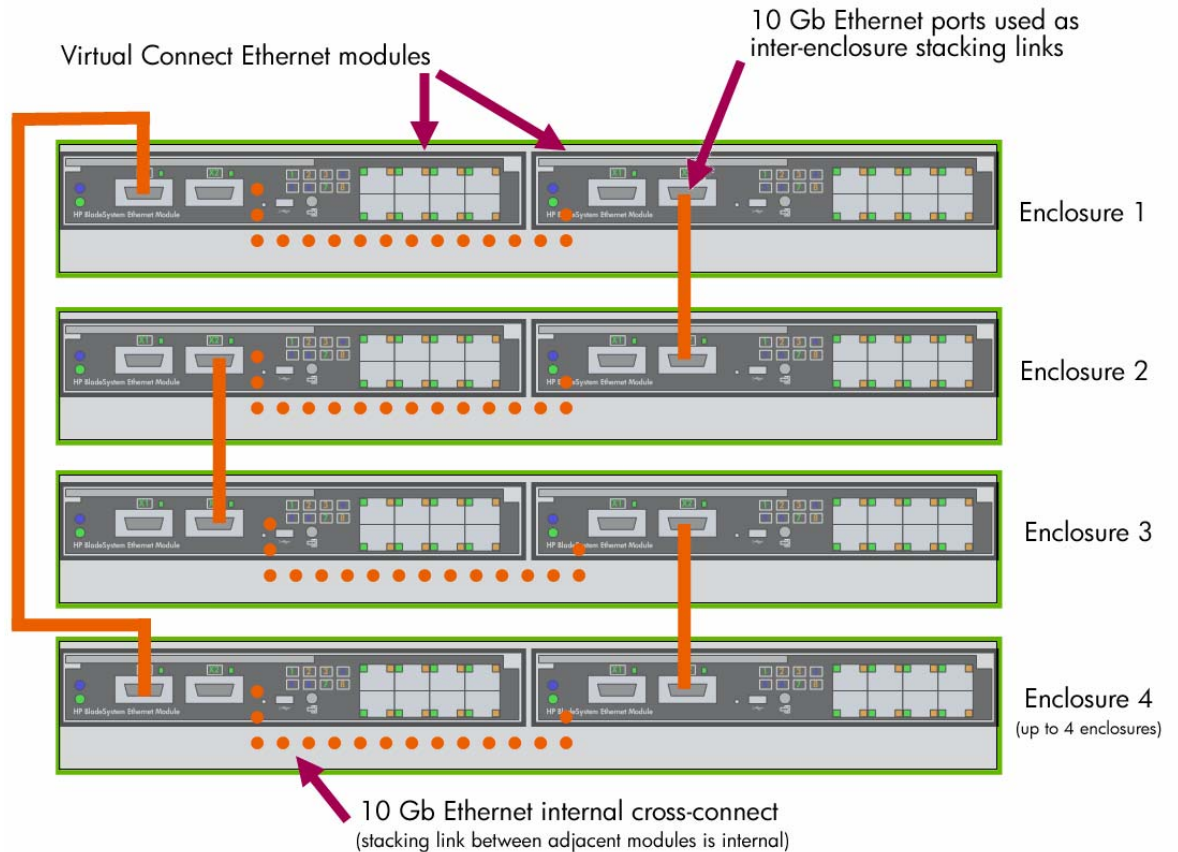
The Virtual Connect Ethernet Module has sixteen 1Gb Ethernet downlinks to servers (connected across the signal midplane in the enclosure), eight 1Gb Ethernet uplinks to networks (RJ45 copper Ethernet connectors), two 10Gb Ethernet connectors (for copper CX4 cables), and one 10Gb Ethernet internal inter-switch link (across the signal midplane in the enclosure) for a failover connection between Virtual Connect modules (see Figure 4). The Virtual Connect Ethernet module can connect selected server Ethernet ports to specific data center networks and provide a connection to any data center switch environment, including Cisco, Nortel, and HP ProCurve.

**Figure 4.** Front view of HP 1/10Gb Virtual Connect Ethernet Module illustrating its connections



Virtual Connect Ethernet modules can be stacked by cabling the Ethernet modules together within a Virtual Connect domain. Every server blade in the domain can then be configured to access any external network connection. Every server has fault-tolerant access to every uplink port. Network connections can be aggregated and can be from different modules. Stacking links can be aggregated, and the stacking link between adjacent Virtual Connect Ethernet modules is internal (see Figure 5).

**Figure 5.** Illustration of stacked Virtual Connect Ethernet modules, this example uses 10 GbE ports for stacking. Single enclosure stacking is available initially, multi-enclosure stacking will be available in a future firmware release.

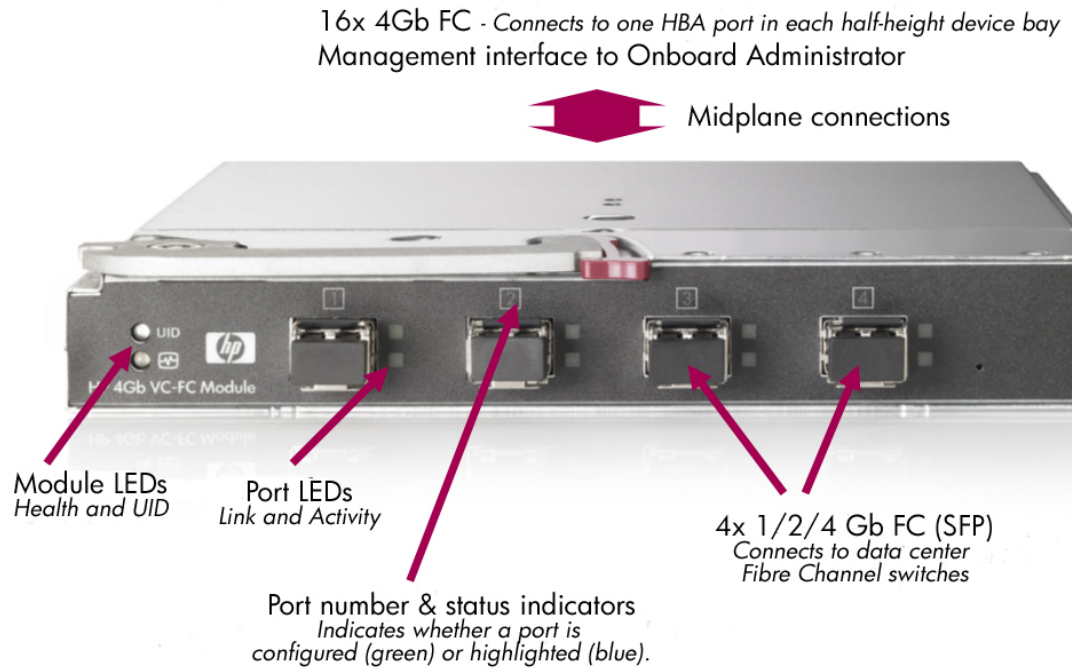


## HP 4Gb Virtual Connect Fibre Channel Module for BladeSystem c-Class

The FC module has sixteen 4Gb FC downlinks to servers and four 1/2/4Gb auto-negotiating FC uplinks to networks (see Figure 6). The FC module can selectively aggregate multiple server FC HBA ports (Qlogic or Emulex) on a FC uplink using NPIV, and can connect the enclosure to data center FC switches. The FC module does not appear as a switch to the FC fabric.

FC modules within different enclosures are each connected directly to the same set of FC SANs. Stacking support for FC modules is not provided; therefore a connection is required from each enclosure to each SAN within the Virtual Connect Domain. With this configuration, the Virtual Connect Manager can deploy or migrate a server blade I/O profile across all four enclosures without any need for additional external SAN configurations.

**Figure 6.** Front view of HP Virtual Connect Fibre Channel module illustrating its connections



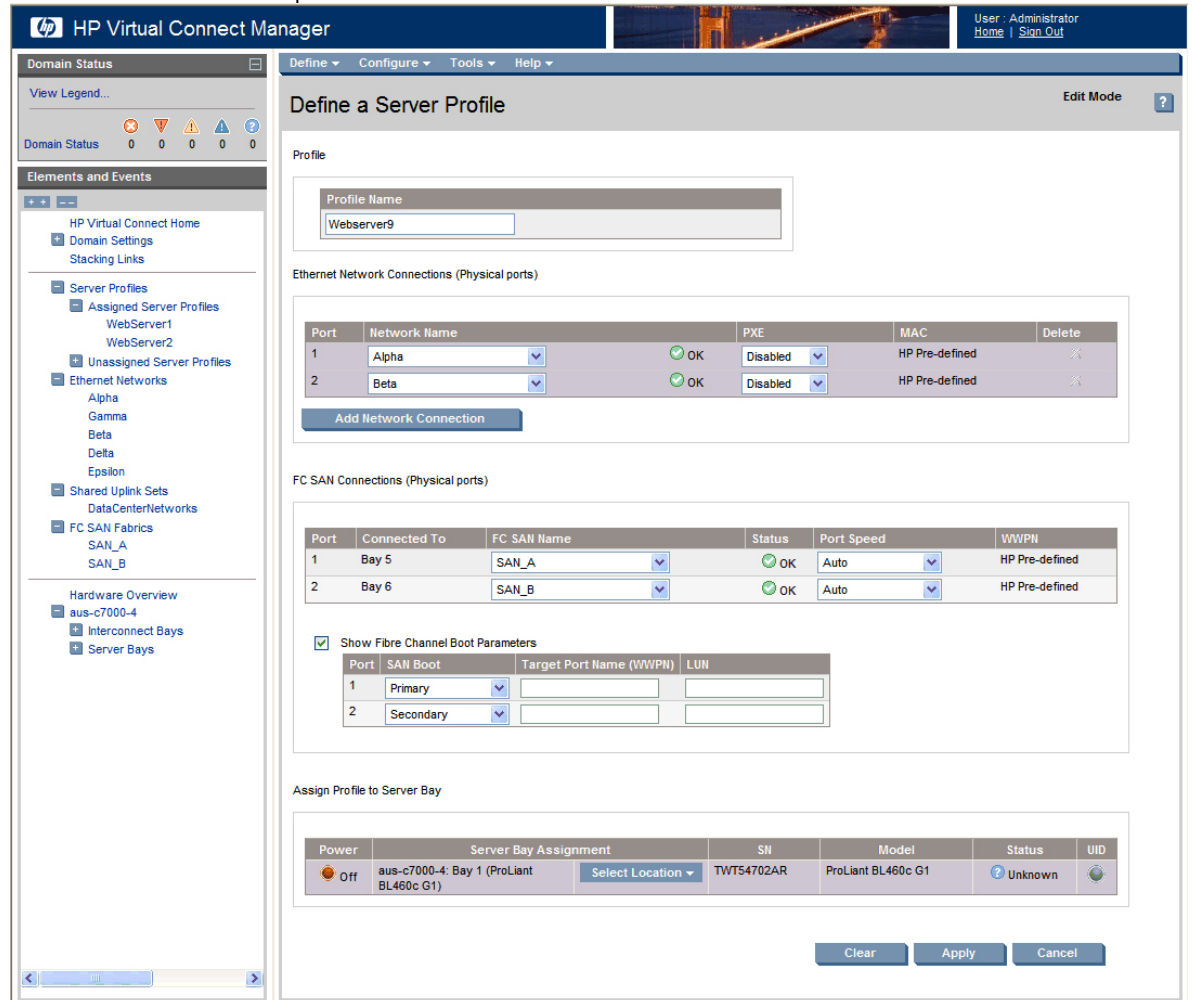
## Virtual Connect Manager

The HP Virtual Connect Manager (VC Manager) manages enclosure connectivity and is seamlessly integrated into both the HP Insight Control Data Center Edition and the HP Control Tower. VC Manager defines available LANs and SANs, sets up enclosure connections to the LAN or SAN, and defines and manages server I/O profiles.

The VC Manager contains utilities and a Profile Wizard to develop templates to create and assign profiles to multiple servers at once. The I/O profiles include the physical NIC MAC addresses, FC HBA WWNs, and the SAN boot configurations. The VC Manager profile summary page includes a view of server status, port, and network assignments (see Figure 7). Customers can also edit the profile details, re-assign the profile, and examine how HBAs and NICs are connected.



**Figure 7.** HP Virtual Connect Manager Profile Summary screen. At this screen IT administrators can create, edit, and delete Virtual Connect profiles.



The VC Manager uses a policy driven approach to assign I/O profiles to servers. The policy can dictate a profile for a specific device bay location; in this case, the profile will be assigned to any server installed in that location. Using the VC Manager policy as a guide, Virtual Connect ensures that each server blade is properly connected to its appropriate LAN and SAN, regardless of its replacement status.

The network administrator defines networks and subnets that will be available to the server administrator. Using the HP Virtual Connect Manager (Figure 8), the server administrator sets up external connections, enables networks to share connections (Figure 9), and supports server aggregation and failover (Figure 10).

Figure 8. HP Virtual Connect Manager screen for defining Ethernet networks and subnets

**Define Ethernet Network**

Network Name: SimpleNetwork

External Uplink Ports

Port	Port Role	Port Status	Port Speed	Connected to	PID	State	Delete
aus-c7000-4: Bay 1: Port 2	NA	Linked	1 Gb	00:17:a4:88:08:40(1)		Enabled	X
aus-c7000-4: Bay 2: Port 2	NA	Linked	1 Gb	00:17:a4:88:08:40(6)		Enabled	X

Connection Mode: Auto

Buttons: Clear, Apply, Cancel

Figure 9. HP Virtual Connect Manager screen for creating Ethernet VLANs

**Edit Shared Uplink Set: DataCenterNetworks**

Uplink Set Name: DataCenterNetworks | Status: OK | PID: [button]

External Uplink Ports

Port	Port Role	Port Status	Port Speed	Connected to	PID	State	Delete
aus-c7000-4: Bay 1: Port 1	NA	Linked	1 Gb	00:17:a4:88:08:40 (4)		Enabled	X
aus-c7000-4: Bay 2: Port 1	NA	Linked	1 Gb	00:17:a4:88:08:40 (3)		Enabled	X

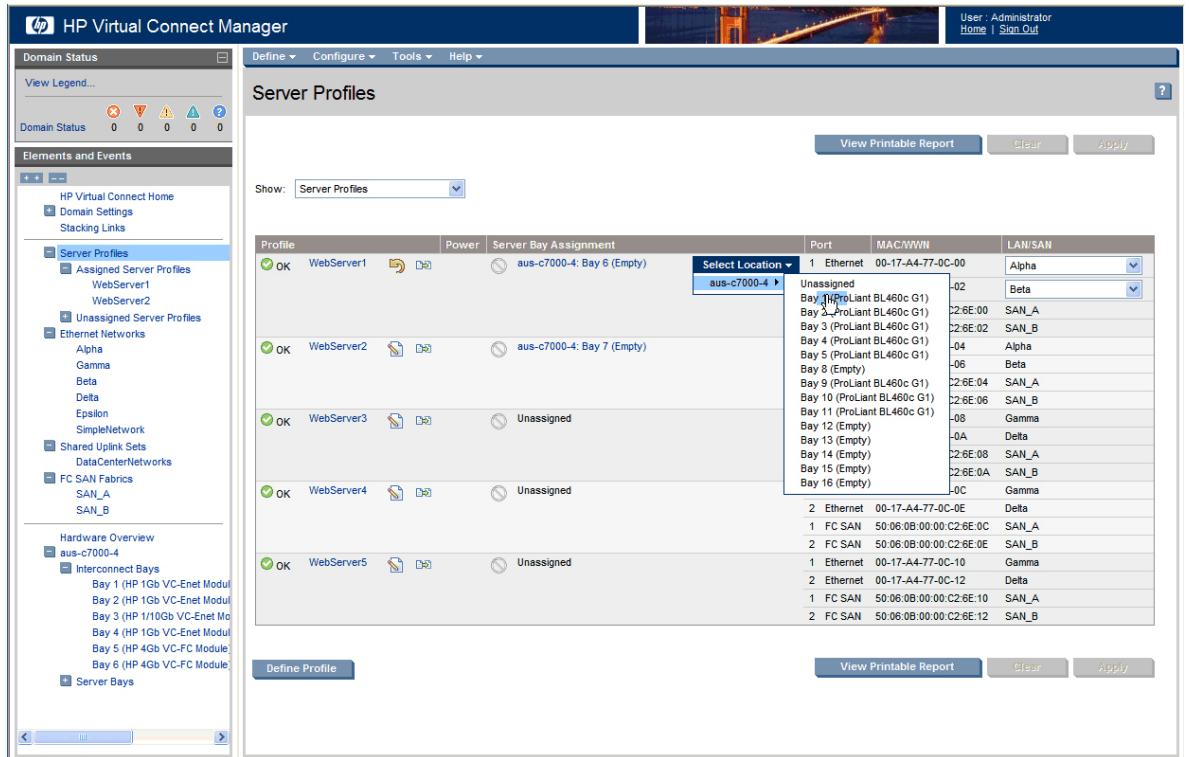
Connection Mode: Auto

Associated Networks (VLAN tagged)

Network Name	VLAN ID	[icon]	[icon]
Alpha	100	[icon]	X
Gamma	120	[icon]	X
Beta	110	[icon]	X
Delta	130	[icon]	X
Epsilon	140	[icon]	X

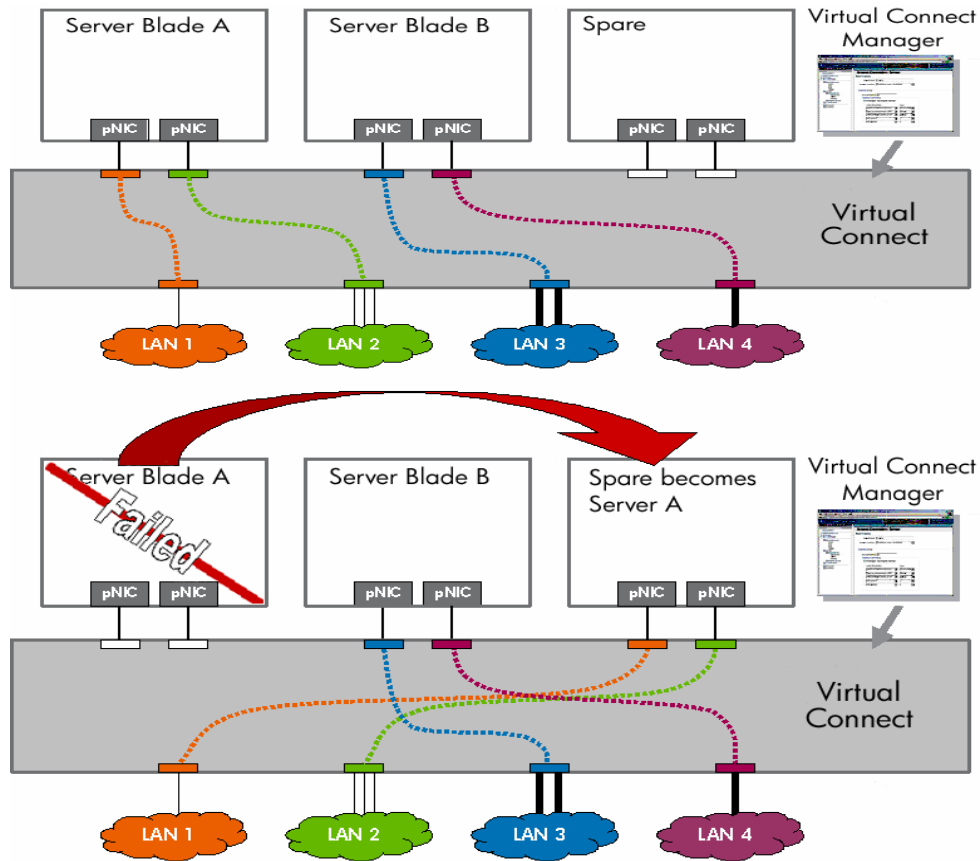
Buttons: Refresh, Delete, Clear, Apply, Cancel

**Figure 10.** HP Virtual Connect Manager screen summarizing all Virtual Connect profiles



VC Manager facilitates the upgrade and/or replacement of a server by enabling the server administrator to reassign the I/O profile to a new server (Figure 11). Additionally, VC Manager enables the administrator to move a Virtual Connect profile from a failed server to a spare server. All of this functionality is embedded in the Virtual Connect Module. Future automation capability will automate these processes.

**Figure 11.** A migration showing how the administrator can move the Ethernet MACs, FC WWNs, and FC boot parameters of a failed server to a spare server.



## Conclusion

HP Virtual Connect technology provides a simple, easy-to-use tool for managing the connections between HP BladeSystem c-Class servers and external networks. It cleanly separates server enclosure administration from LAN and SAN administration, relieving LAN and SAN administrators from server maintenance. It makes HP BladeSystem c-Class server blades change-ready, so that server administrators can add, move, or replace those servers without affecting the LANs or SANs.

## Appendix: Acronyms in text

The following acronyms are used in the text of this document.

**Table A-1.** Acronyms

<b>Acronym</b>	<b>Acronym expansion</b>
FC	Fibre Channel
HBA	Host bus adapter
iLO	Integrated Lights-Out
LAN	Local area network
MAC	Media access control
NIC	Network interface card
NPIV	N_Port ID Virtualization
OA	Onboard Administrator
PCI	Peripheral component interconnect
SAN	Storage area network
VC Manager	Virtual Connect Manager
WWN	World wide name

## For more information

For additional information, refer to the resources listed below.

Topic	Resource Hyperlink
HP BladeSystem technology briefs: HP BladeSystem c-Class architecture HP BladeSystem c-Class Enclosure Managing the HP BladeSystem c-Class	<a href="http://h18013.www1.hp.com/products/servers/technology/whitepapers/proliant-servers.html#bl">http://h18013.www1.hp.com/products/servers/technology/whitepapers/proliant-servers.html#bl</a>
HP 1/10Gb Ethernet Module	<a href="http://h18013.www1.hp.com/products/servers/technology/whitepapers/proliant-servers.html#bl">http://h18013.www1.hp.com/products/servers/technology/whitepapers/proliant-servers.html#bl</a>
HP Systems Insight Manager	<a href="http://www.hp.com/support/hpsim">http://www.hp.com/support/hpsim</a>
Performance Management Pack	<a href="http://www.hp.com/servers/proliantessentials/pmp">http://www.hp.com/servers/proliantessentials/pmp</a>
Rapid Deployment Pack	<a href="http://www.hp.com/servers/rdp">http://www.hp.com/servers/rdp</a>

## Call to action

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