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HP Virtual Connect

FOR DUMMIES®

Learn:

- What's new with Virtual Connect and all about the new FlexFabric module
- How HP Virtual Connect simplifies your data center, lowers costs, and saves time
- About the HP Virtual Connect product family

Eric Butow
Bill Dicke
John Joyal

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HP Virtual Connect FOR DUMMIES® 2ND EDITION

by Eric Butow, Bill Dicke, and John Joyal

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Introduction

With the second decade of the 21st century close at hand, most companies have 20 to 30 years of experience working with computer networks. Despite all that experience, companies have put up with network configurations that require intricate choreography among highly trained and specialized network, storage, and systems personnel to set things up, and then to keep everything running smoothly.

HP has a better way. *Server edge virtualization* is a technology that simplifies all that by separating the management of computer servers from the management of the networks connected to them.

With HP Virtual Connect, you can simplify your server connectivity to your networks — and reduce equipment sprawl at the server-to-network edge by up to 95 percent. System administrators become self-sufficient to add or replace servers and move workloads from one server to another, while freeing LAN and SAN administrators from common server tasks. By implementing Virtual Connect technology with the Flex-10 Ethernet and FlexFabric modules, you can also reduce the amount of network connection equipment by up to 95 percent, reduce network hardware costs up to 65 percent, and network power consumption up to 40 percent. So, read on, and see whether HP Virtual Connect sounds like the right answer for your company!

About This Book

This is the second Edition of *HP Virtual Connect For Dummies*. We've updated the text to include information on the Virtual Connect FlexFabric 10Gb/24-Port module and FlexFabric Adapters and their capabilities and benefits. We also touch on HP Converged Infrastructure and how Virtual Connect supports a Converged Infrastructure strategy.

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This book introduces the core concepts and technologies for HP Virtual Connect and uses information supplied by HP so you can get a good idea of how HP Virtual Connect lives up to its billing as the most complete and advanced server edge virtualization solution available. This book was written for HP.

Consider this an easy reference tool that you can go back to whenever you need to learn more about what HP Virtual Connect is all about. Like any book in the *For Dummies* series, the information in this book is easily accessible so even when we start getting into technospeak (and some of that is inevitable) you won't feel overwhelmed. And there aren't any quizzes at the end of the chapters, so don't feel pressured to remember anything you read in this book.

Icons Used in This Book

Throughout this book, you'll notice a couple of helpful little icons that mark certain types of information.

Get out your pen! This icon marks important information that you should keep in mind.

Yeah, yeah, we know this book includes a fair share of technical information. This icon marks areas that delve more deeply into technical details.

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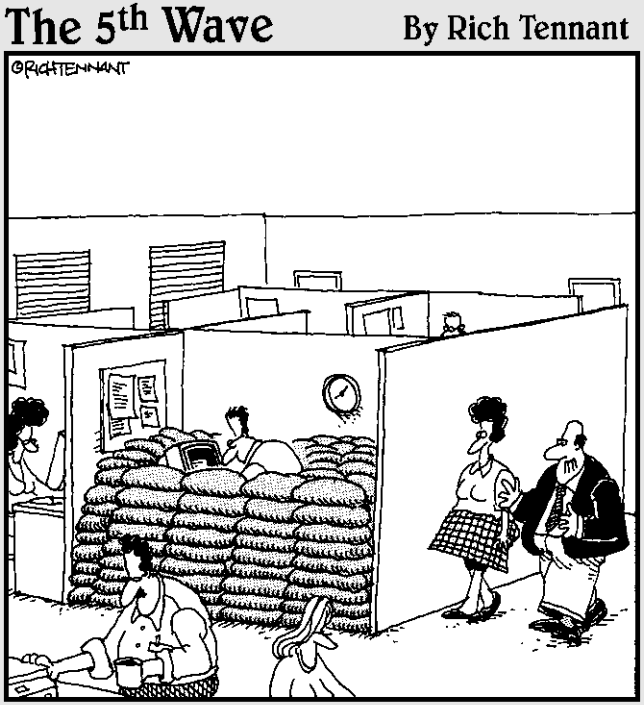
Part I

Networking and Virtual Connect Basics



"I assume everyone on your team is on board with the proposed changes to the system architecture."

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In this part . . .

If you need to find out about the basics of networking, this is the part for you. We also cover some need-to-know info about HP Virtual Connect so you can get up to speed ASAP.

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Chapter 1

A Quick Introduction to Networking

In This Chapter

- Knowing what parts you need
- Getting to know those who work on your network
- Dealing with cables and switches

You probably use computer networks every day from your own PC, whether it's a private network within your own company or when you use the Internet for research or communication. However, if you don't know what's "under the hood" of your network, then you won't know how virtualizing connections can help your business become more efficient and save money. Building and managing corporate networks can be a very complicated topic. However, in this chapter, we talk about how to connect your computer servers to a network at a high level. If you feel you need to learn more about the basics of networking or you're simply curious, read on.

The Parts You Need

Today's computer networks have several different parts that you need in order to connect to the information you require.

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Infrastructure refers to all the servers, cables, storage, power supplies, fans, enclosures, racks, and networking components that make up your computing environment. Sometimes the term also includes the software that runs on all this gear.

Servers and blades

You've probably heard of computer servers and wondered what the difference is between a server and other computers. A *server* is a computer that provides common, centralized *services* to client computers — that is, client computers connect to the server and can access files and services on the server. The server is designed with more memory, more processing power, access to more storage space, and usually with more network connection capacity. Servers must also be online constantly and must therefore be very reliable. Many servers include redundant features such as additional power supplies and network connections that can take over in case one fails.

As your business information needs grow, you can add more servers and connect them together to create a larger infrastructure with more power and capacity. Fortunately, you don't need to have all your servers connected to individual monitors and keyboards so you can manage them. More streamlined and modular servers called *server blades* save space but still provide all the compute power you may need.

These server blades, an example of which is shown in Figure 1-1, sit in a *blade enclosure,* which also houses the connectivity, cooling, and power equipment. These enclosures sit in a frame called a *rack,* also shown in the figure. The enclosure has a number of mounting slots called *bays.*

Some racks are small and sit in regular office space. You may also place a rack in a specific area, such as a cooled server room, for security reasons or to provide a central location for monitoring, maintaining, and expanding your infrastructure.

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Figure 1-1: HP BladeSystem servers in c7000 enclosures in a rack.

More on enclosures and bays

Fortunately you don't have to keep server blades lying around everywhere in a pile (and they wouldn't work well if you kept them in a pile anyway). Instead, you place the server blades in an enclosure that provides similar components to what you find in your desktop or laptop computer including:

- Power for all server blades in the enclosure.
- Fans for cooling, because servers produce heat, and as the enclosure becomes more populated, more heat is generated. (Many are also in air conditioned server rooms.)
- A number of expansion slots called *bays,* which house server blades or other types of blade devices including switching, and storage or backup devices.

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- Networking interconnect devices to connect the server blades to client computers and other devices (like storage) outside of the enclosure.
- An enclosure midplane to connect many of these components together without wires. In a laptop or desktop, something similar is a motherboard that provides connection without all the wires.

Network adapter

Another essential component to your network is the *network adapter,* which enables all your servers, clients, switches, storage, and other devices to communicate with each other. Network adapters have typically come in two flavors: Ethernet and Fibre Channel. And they're beginning to show up in a third flavor: a Converged Network Adapter (CNA).

Ethernet

You may be surprised to know that we're still using networking technologies that were developed in the 1970s. When people were sporting big hair and loud clothing, the smart people at the Xerox Palo Alto Research Center created *Ethernet,* a group of networking technologies that define a number of wiring and signaling protocols. Ethernet was standardized around 1980 and as the years have gone by, the speed of Ethernet (and the networking components) have become ever faster.

An Ethernet adapter is called a *Network Interface Controller,* known popularly as a *NIC.* Most computers (including perhaps the one you use now) have NICs built right into the main circuit board (or motherboard) of the computer. Depending on the server blade you buy, the motherboard can include a NIC, which is referred to as a LAN on Motherboard (or LOM). Many NICs have two ports so you can make two separate network connections from one NIC.

Fibre Channel

If you've heard about your company having a storage area network (also known by its acronym SAN) then you may have heard about *Fibre Channel,* or FC. Fibre Channel provides the means to connect your network to a separate (and sometimes

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remote) computer storage device through a Host Bus Adapter (or HBA).

For example, you may have a disk array that contains numerous hard disks connected to your network for storage. The SAN connects the hard disks to your servers and is typically shared by all the servers.

What happens if you don't have enough NICs and/or HBAs connected to the server? You can always add more by installing add-on cards, also referred to as *mezzanine cards* (whether you can do this depends on the capability of your server blade, though).

Converged Network Adapter

You may have heard about the Converged Network Adapter (CNA) recently. This type of network adapter has the ability to communicate over Ethernet links and supports both Ethernet and Fibre Channel. The Fibre Channel data is carried by a new protocol called Fibre Channel over Ethernet (FCoE). So a CNA consolidates your LAN and SAN traffic over one adapter that acts as both NIC and HBA.

HP incorporates these capabilities right into its server blades so there is nothing extra to buy! No extra NICs, no extra HBAs — they're already there. HP also incorporates iSCSI offload technology that allows its CNAs to support Ethernet, Fibre Channel, and high performance iSCSI. In fact, HP provides more capabilities in its CNAs, which is why they are called FlexFabric Adapters. We talk more about them in Chapter 2.

Cables

Wireless networking has become pretty common, especially among home network users, and you may be wondering whether anyone actually uses cables anymore. Didn't those go the way of analog TV signals? Sorry guys, if you have a business network, the only way to connect a server to the network is by *hard-wiring* it — not only because wiring is more reliable and faster than wireless, but also because it provides greater security than wireless connections. Businesses primarily use Ethernet and Fibre Channel interconnect technologies today.

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Ethernet

As of this writing, the fastest Ethernet speed for servers (that is, the fastest rate that the Ethernet protocol can transmit data over an Ethernet cable) is 10 gigabits per second (often written as 10 Gb). The organization that sets Ethernet standards, the IEEE (Institute of Electrical and Electronics Engineers), is working on 40 Gb and 100 Gb Ethernet standards for the near future. In the meantime, Ethernet cables have a number of different speeds including 10 megabits per second (10 Mb), 100 megabits per second (or Fast Ethernet), and 1 gigabit per second (or Gigabit Ethernet).

Fibre Channel

Although the name suggests that Fibre Channel connections are typically made with fiber-optic cables, you can have Fibre Channel run with copper wire as well. Like Ethernet, you typically connect Fibre Channel cables between two devices through a Fibre Channel switch.

However, Fibre Channel speeds are different from Ethernet speeds. FC speeds come in two categories:

- The **interoperable category** has FC cable speeds of 1 gigabit per second, 2 gigabits per second, 4 gigabits per second, and 8 gigabits per second. By *interoperable,* we mean these connections can automatically adjust to the fastest speed that equipment on both ends of the cable can handle.
- The **high-speed category** has FC cable speeds of 10 gigabits per second and 20 gigabits per second. These cables don't support lower speeds and are used primarily for connecting multiple FC switches.

Traditional connection choices

There used to be two choices when it came to connecting your server blades to your network: Pass-Thru and blade switches. The following sections discuss these options in more detail.

Pass-Thru modules

A *Pass-Thru module* is an interconnection device that provides a one-to-one direct link between each blade Ethernet NIC or

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Fibre Channel HBA and a switch outside the enclosure. Each connection uses a separate cable.

The problem with Pass-Thru modules is that you have many network cables coming out of every module. If you have a medium- to larger-sized network, the number of cables can be overwhelming to manage. They also add a lot of expense because they require so many costly switch ports at the other end of those cables.

Blade switches

Blade switches are available for a number of network types. However, blade switches are relatively small and one enclosure with 16 servers might need 6 or 8 switches. If you have a large network with many more servers, then you will require an awful lot of switches, which will be very difficult to manage.

The People You Need

Who are these people you need to keep your compute infrastructure humming along? You may have passed these people in the hall and know their names from the company directory, but you may not know what they do each day to keep the data and information flowing.

System administrator

The *system administrator* manages your computer servers and everything that runs on them, like your business applications, your operating systems, your virtual machines, and connections to your communication and storage networks. Those responsibilities can involve everything from installing and maintaining anti-virus and anti-malware protection, to implementing drivers and new operating systems, to setting backup policies.

If you have a one-person technical staff, the system administrator is also responsible for the work of the LAN and SAN architecture and operation, besides the server stuff. This includes designing the infrastructure, troubleshooting bugs, and being responsible for overall company system and data

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security. This job can be even more complicated than when there are more people to share the load. So simplifying IT operations is even more critical for this person.

LAN administrator

The *LAN administrator* is the person responsible for keeping the network online day in and day out. This person is responsible for the networking connections, security, performance, reliability, policy administration, and maintenance.

When connections aren't working, it could mean that a component failed or someone changed a server or storage device, so coordination with the server and storage administrators is very important. The LAN administrator is responsible for resolving any connection and conflict issues.

SAN administrator

The *SAN administrator* may also be called the storage administrator. This person is also a specialist who is responsible for setting up, assigning, and maintaining the storage arrays shared by the servers and the network that connects them to all devices. As in the LAN administrator case, the SAN is a complicated network and its administrator must ensure its connectivity, security, performance, reliability, and overall smooth operation. If any problems arise with the SAN, then the SAN administrator is tasked with finding the problem, offering solutions, and managing any interruptions in service. The SAN administrator is also responsible for managing the addresses used in the Fibre Channel connections. These addresses are called Worldwide Names or WWNs.

The Problem with Cables and Switches

When you add up the number of people and parts you can have in an IT operation, and especially as the number of people and parts (like server blades) grow, everything gets very complicated, so a common directive in IT is to keep the compute infrastructure as simple as possible. Yet companies

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are daunted by many logistical problems that keep them from optimizing their networks.

Too many cables

A rack full of servers can have hundreds of network cables — especially when using individual rack-mounted servers or Pass-Thru devices in blade servers. As your IT demand grows, especially as you virtualize more servers, you'll need more network connections on each server, and Pass-Thru modules can render the flood of cables practically unmanageable.

Too much to manage

Switches can lower the number of cables, but as your compute infrastructure grows, you grow the number of switches as well. Every switch needs maintenance, updates, and coordination. So, the more switches you add, the greater the management load you're forcing on the LAN and SAN administrators. And server virtualization multiplies the number of switches you will need, so the management effort can get out of hand, fast!

The Introduction of Server Virtualization

Historically, as companies grew and built up their infrastructure, they added new servers, networks, and storage capacity for each new application. This *application isolation* often offered simpler set-up, better performance, and more reliability. Most importantly, if one business application and the infrastructure supporting it needed to change or had a problem, it didn't cause problems for other applications.

However, this *silo* application deployment approach left excessive pockets of unused server capacity. Virtual machines (VMs) — essentially many server environments within one physical server — helped address these issues.

Setting up networks, IP addresses, VLANs, subnets, and so on requires substantial planning and coordination between

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server and network teams. Although planning for a single server might not seem like a huge effort, provisioning multiple VMs on many rack or server blades can result in greater complexity. The problem isn't initial provisioning as much as the inevitable adjustments that ripple back and forth because a routine server change can force adjustments up and down the line.

The Problem that's Grown Over Time . . . and the Solution

There is a problem that has cropped up with server virtualization. As more applications have been consolidated onto virtual machine containers on fewer servers, the server I/O demand has increased. The end result is the complexity of the I/O at the server edge, and business managers have rightfully listed this as a concern when considering virtualization solutions. Fortunately, Hewlett-Packard has created Virtual Connect, a server edge virtualization solution that simplifies the equipment and operations complexity of connecting your servers to your networks and addresses the management of network resources. The rest of this book explains how Virtual Connect works and shows you what it can do for your company.

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Chapter 2

The HP Virtual Connect Solution

In This Chapter

- Taking a fresh look at IT Infrastructure
- Growing your network over time
- Managing smarter
- Looking at Virtual Connect from different perspectives

Hewlett-Packard (HP) has created a combination hardware and software server edge virtualization solution called Virtual Connect. This unique approach sets HP apart in the IT infrastructure market. So what makes the HP solution so great?

Rethinking Infrastructure

HP started by rethinking IT infrastructure and developed HP BladeSystem (see Figure 2-1), which brings together the traditional features of *racked* environments, including the server, storage, power and cooling, and networking. Then HP improved on them by building an integrated system to save cost, energy, and time, and to make the infrastructure change-ready for today's ever-evolving IT demands.

BladeSystem also improves the infrastructure by eliminating all the server-to-network connection cables and adding built-in infrastructure management tools like the Onboard Administrator.

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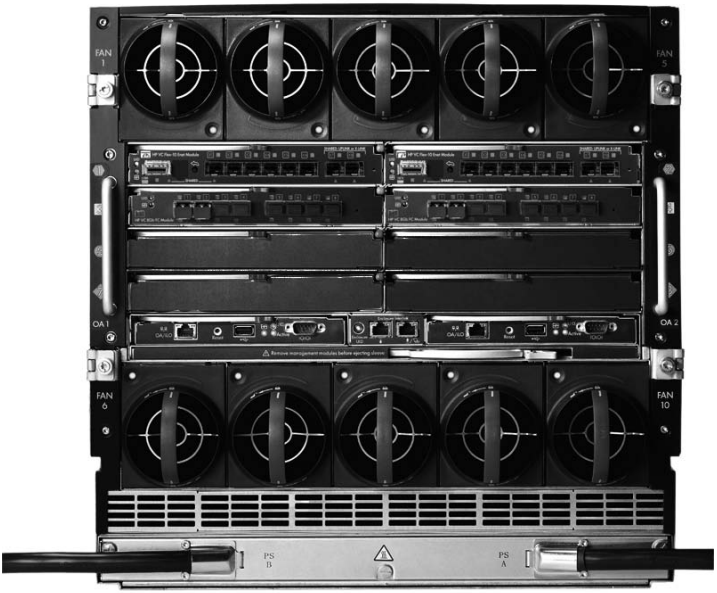

Figure 2-1: Back of HP BladeSystem showing interconnects and fans.

While bringing all the infrastructure pieces together in the HP BladeSystem, HP added another huge advance to server connectivity and management with server edge virtualization. Virtual Connect frees up administrators from the constraints of a traditional infrastructure by adding a virtualization layer between the network and the servers. The HP Virtual Connect solution allows system administrators to perform such tasks as adding or changing a server, or moving the workload from one server to another without needing to involve LAN and SAN administrators in every change.

HP created Virtual Connect to adapt to the needs of your network and business applications. For example:

- You can use HP's Virtual Connect Flex-10 10Gb Ethernet or Virtual Connect FlexFabric 10Gb/24-Port modules, and Flex-10 NIC and FlexFabric Adapters to save on cost and equipment, and to increase flexibility and bandwidth control. (You can find out more about these later in this chapter.)

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- If you have another vendor's network switches already incorporated in your business, HP Virtual Connect can integrate seamlessly — so you don't have to start again from scratch.

HP Virtual Connect FlexFabric and Flex-10 Ethernet modules and FlexFabric and Flex-10 Adapters are already capable of the faster 10Gb speed, but can talk to any 1Gb Ethernet or 2, 4, or 8 Gb Fibre Channel equipment at the slower speed. This means that Virtual Connect will work with your slower equipment now, and also work with any faster 10Gb Ethernet network equipment you buy going forward. The same is true for the Virtual Connect 8Gb FC modules — they will communicate with your slower FC equipment, but are ready for faster speeds when you upgrade. This means you can upgrade at your own pace as your budget allows — instead of being forced into a *forklift upgrade.* That is, you won't have to undergo a massive upgrade to your network that will require a lot of new hardware, money, and effort.

The end result is a flexible infrastructure that lets you add or replace servers and move workloads quickly to meet *your* needs, instead of forcing your business application to adjust to the demands of a rigid set of equipment.

Grow Your Infrastructure over Time

HP Virtual Connect supports as many as 16 servers — and hundreds of virtual machines — in a single BladeSystem c7000 enclosure. That doesn't mean you need to start with 16 servers — you can start small and as your company grows you can build up your infrastructure. HP also offers a smaller c3000 enclosure that holds up to eight half-height server blades.

All you need to do is have your system, LAN, and SAN administrators provision your LAN and SAN connections once in Virtual Connect. The next time you add a server, your system administrator won't have to call the LAN or SAN administrators — the system administrator can add the new server blade into the enclosure, assign the appropriate server profile containing your defined network connections, and go. There is no need to coordinate with the LAN and SAN administrators. (Don't

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worry — we talk about the Virtual Connect hardware and how to set it up later in this chapter.)

Because the LAN and SAN administrators don't have to be involved after deployment, you might worry they would lose control of their networks. But actually, they don't lose any control. Virtual Connect isn't part of the LAN or SAN; it just connects the servers to those networks. Built-in authentication controls establish role-based authority. There are some configuration tasks that are reserved for LAN administrators, some for SAN administrators, and others for system administrators. Everyone keeps the authority and responsibility they had before Virtual Connect — the difference is that now they're more productive and get the work done faster.

Smarter Management

Although you can reduce the number of cables with switches in your network, HP Virtual Connect goes several giant leaps further.

To set up and administer the network addresses, connection profiles, and other Virtual Connect resources, HP provides management options for large and small environments. HP Virtual Connect Manager provides a built-in Web GUI interface and a fully scriptable Command Line Interface (CLI) designed to manage single Virtual Connect domains. A Virtual Connect *domain* is a collection of up to four BladeSystem enclosures full of servers and network connections that are cabled together as a single manageable element.

Virtual Connect Enterprise Manager (VCEM) is a software application that centralizes server connectivity and workload management for hundreds of Virtual Connect domains and thousands of servers from a single console. Virtual Connect Enterprise Manager can control up to 1,000 enclosures today — that's a whopping 16,000 blade servers!

If you're new to Virtual Connect, then your initial step will be to access Virtual Connect Manager through your Web browser to set up your first Virtual Connect Domain as shown in Figure 2-2.

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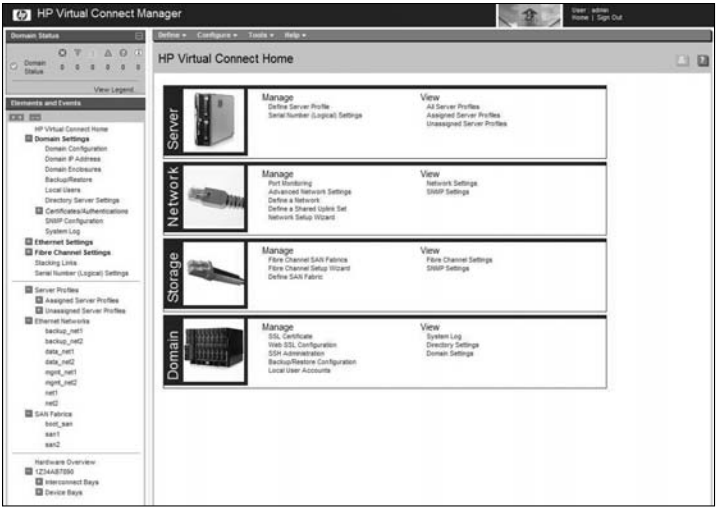

Figure 2-2: HP Virtual Connect Manager GUI.

The Virtual Connect Manager, also called VC Manager, contains utilities and a Profile Wizard that allows the system administrator to create and allocate server connection profiles to servers. These server connection profiles include the NIC media access control (MAC) addresses, Fibre Channel host bus adapter (HBA) worldwide names (WWNs), SAN boot configurations, and other information that enables a server to establish connections to preferred LANs and SANs.

As part of the initial Virtual Connect configuration, the system administrator must work with the LAN and SAN administrators to set appropriate policies that identify which networks the servers may connect to. Once the networks are identified, the system administrator can define these in VC Manager as available resources as shown in Figure 2-3.

Virtual Connect technology separates the management of server connections from the management of networks. The LAN and SAN administrators are still responsible for defining and presenting the networks and sub-networks, but the system administrator is now self-sufficient to define and modify server connections to those networks when needed.

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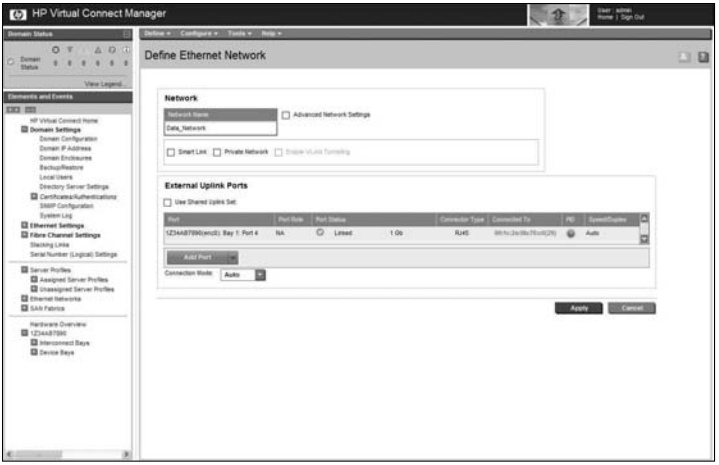

Figure 2-3: HP Virtual Connect Manager Define Ethernet Network screen.

The system administrator can now use VC Manager to create and assign server connection profiles to individual servers and establish network connections as shown in Figure 2-4.

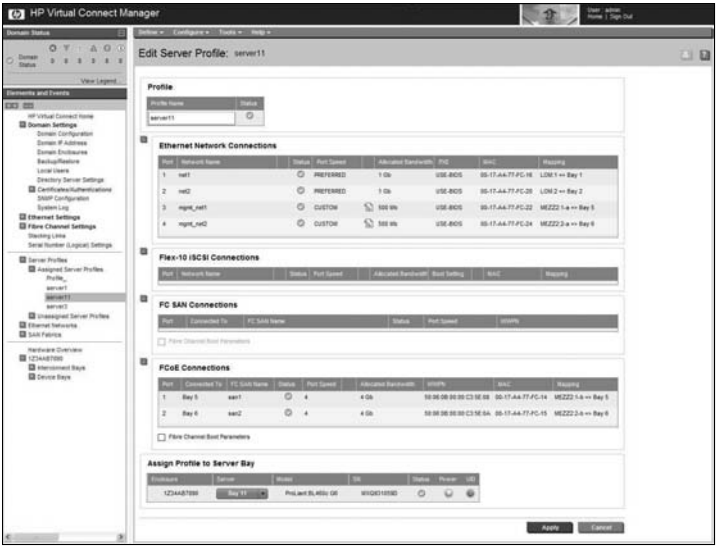

Figure 2-4: HP Virtual Connect Manager Server Profile contents.

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Connection profiles are actually assigned to the enclosure bay and not the server that's plugged into the bay, which provides constant network connectivity and enables several benefits that include:

- Network connections can be pre-assigned to empty bays to provide rapid server deployment — just add servers and Virtual Connect does the rest.
- Allows servers to be replaced in minutes by the system administrator without involving LAN and SAN administrators — any server located in a bay will always use the connection definitions in the associated profile.
- Connection profiles can be moved to different enclosure bays — this allows system administrators to quickly reallocate server connections and workloads to spare servers in the event of a server failure, or to perform simple migrations.

All network assignments and other parameters defined in a connection profile always remain with the profile, even when it's moved to another server.

Managing Larger Virtual Connect Installations

If you have a larger infrastructure to manage, typically four or more BladeSystem enclosures, the Virtual Connect Enterprise Manager (VCEM), shown in Figure 2-5, simplifies connection and change management, reduces risk, and provides automated profile failover for thousands of server blades.

The core capabilities provided by VCEM include the following:

- A single intuitive console that manages connectivity for hundreds of Virtual Connect domains and thousands of servers.
- A central repository that administers all the MAC addresses and WWNs, which simplifies address management and eliminates the risk of conflicts.

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Figure 2-5: HP Virtual Connect Enterprise Manager GUI.

- The ability to manage groups of Virtual Connect domains using common configuration profiles. This capability increases configuration consistency, limits errors, simplifies enclosure deployment, and enables network connection changes to be made once and pushed to multiple Virtual Connect domains.
- The ability to move server connection profiles and associated workloads between Virtual Connect Domains. This enables system administrators to add or replace servers and move workloads across the data center in minutes without help from LAN and SAN administrators. Profile movement can be controlled manually from the VCEM user interface, via a command line script, or automated using the VCEM Profile Failover feature (see Figure 2-6), which automatically selects a new target server from a pool of user-defined spares.

VCEM is a highly scalable solution that keeps pace with your management needs as the network grows.

VCEM profile movement and failover can be used to perform common data center tasks faster and more efficiently, such as:

- Server blade recovery
- Hardware maintenance with reduced downtime
- Rapid server repurposing to meet changing workload and application priorities

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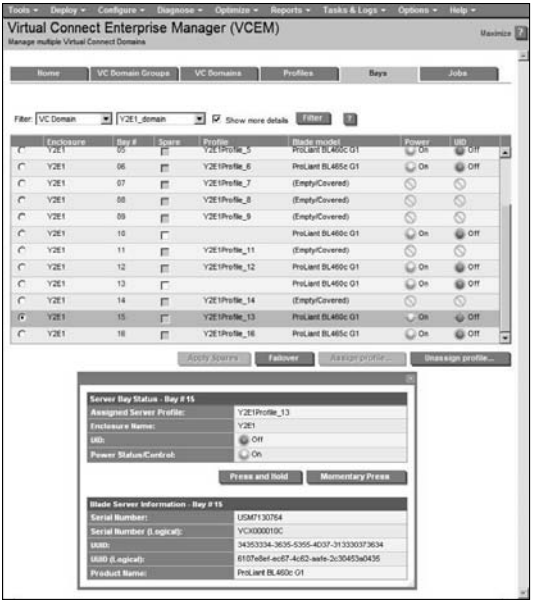

Figure 2-6: HP Virtual Connect Enterprise Manager Failover and Spares screen.

When moving Virtual Connect server profiles, the fastest completion times are achieved when the source and target servers are configured for *boot-from-SAN*. The automated profile failover functionality delivered in VCEM requires a boot-from-SAN environment.

Flexibility

You would expect HP to follow industry standards, and that's what they've done with Virtual Connect. HP recommends having two identical Virtual Connect Modules side by side when looking to implement redundancy. Each port of a dual-ported server NIC or FlexFabric Adapter can connect to a different Virtual Connect module to create separate connections for use with built-in NIC teaming for failover or simple load balancing.

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HP Virtual Connect Flex-10 Technology

Virtual Connect Flex-10 is an HP network connection technology that's available only with Virtual Connect — and is built into Flex-10 modules, NICs, and HP servers.

Virtual Connect Flex-10 technology can save you 75 percent of the modules or switches you might need otherwise. What's more, it can save you 100 percent of the NICs you'd need to buy because they are built right into the server motherboard. (Won't you miss choosing the right NIC to order?)

So what makes these Flex-10 NICs so special? When you connect one of these NICs to a Virtual Connect Flex-10 10Gb Ethernet Module, each port becomes four individual NICs (called FlexNICs) that share 10Gb of bandwidth. Each FlexNIC offers full hardware-level performance.

Because HP's Virtual Connect Flex-10 module is 10Gb fast, you can take advantage of 10Gb connection speed when you're ready to upgrade any slower network components. With Virtual Connect Flex-10, there are a number of benefits that the following sections discuss in detail.

Two hardware components are needed to make a Flex-10 connection:

- Virtual Connect Flex-10 NICs, which are built into most of the industry-leading HP BladeSystem servers as dual-port NICs (called *LAN on Motherboards* or *LOMs*) or available as dual-port NIC mezzanine cards.
- The Virtual Connect Flex-10 10Gb Ethernet Module.

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Reduce interconnect modules

You can reduce the number of switches by 75 percent and the number of NICs by 100 percent! How is this possible, you ask?

Each standard network adapter on a server blade needs to connect to a switch or Pass-Thru module. Therefore, if you need four redundant Ethernet networks, you need eight NICs on each server blade and eight interconnect modules in the enclosure interconnect bays. (By the way, these bays can fill up quickly, especially if you need Fibre Channel and/or InfiniBand in the enclosure as well.)

What's more, each of those eight standard NICs has a fixed speed — either a 1Gb NIC or a 10Gb NIC (for which you'll pay more). Many applications could really use more than 1Gb but very few need the entire 10Gb; however, when using standard NICs, you must pick one or the other when it comes to setting the bandwidth. So your application is either starved for bandwidth and you must trunk together multiple NICs for your applications to run properly, or you plug in a 10Gb NIC and underutilize its bandwidth.

HP thought there must be a better way, and they created it with Virtual Connect Flex-10 (see Figure 2-7). To get those same eight NICs and four redundant networks using Virtual Connect Flex-10, you don't need any mezzanine cards and you only need two Virtual Connect Flex-10 interconnect modules in the enclosure. Therefore, you only have to buy two modules instead of eight. (And you need to power only two instead of eight — think of how green you'll be!)

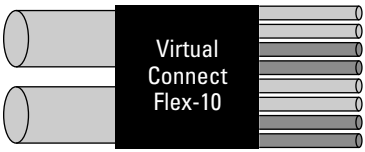

Figure 2-7: With a Virtual Connect Flex-10 dual-port NIC, two 10Gb ports provide eight FlexNIC connections.

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You can also dynamically adjust the bandwidth of each FlexNIC using Flex-10 technology (see the "Control and adjust NIC bandwidth" section later in this chapter).

The LOM dual port Flex-10 NIC provides eight FlexNIC connections. When you add dual port 10Gb mezzanine cards, such as HP's NC532m Dual Port Flex-10 Adapter (see Figure 2-8), a half-height server can support up to 24 NIC connections per server. That's way more than most people need! If you need to support a large number of virtual machines that can only be supported by a true virtualization server (such as HP's BL490c and BL495c server blades), Virtual Connect Flex-10 provides the needed I/O bandwidth to support those connections.

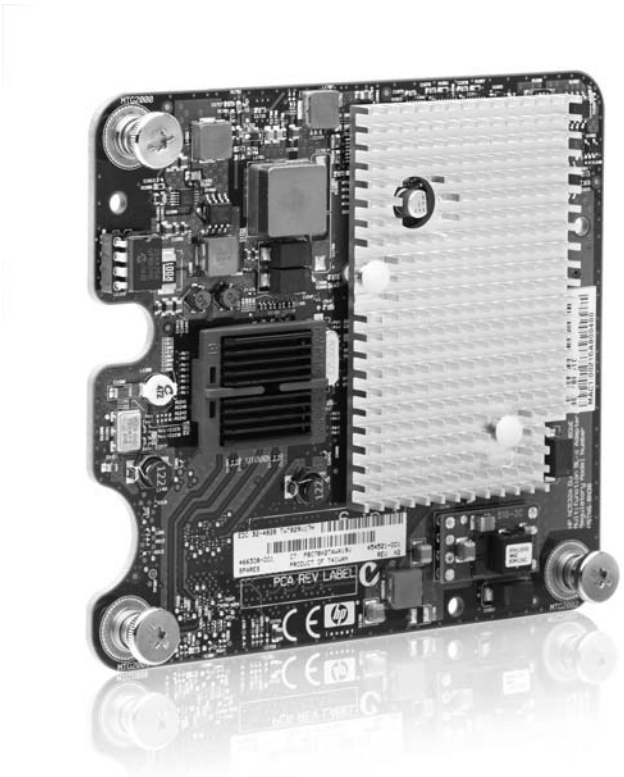

Figure 2-8: HP NC532m Dual Port Flex-10 Adapter mezzanine card.

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Control and adjust NIC bandwidth

Virtual Connect Flex-10 also offers a unique and significant operational advantage: You can dynamically fine-tune the speed of each FlexNIC in 100Mb increments from 100Mb to 10Gb.

Most applications need bandwidth within a certain range, and until Virtual Connect Flex-10 came along, IT departments were hamstrung by their infrastructure. If a management console required only 500Mb of bandwidth, you would overprovision by 100 percent with a 1Gb NIC. If you needed much more bandwidth, you would consider either trunking several 1Gb NICs or buying all the more expensive equipment (such as adapters and switch ports) for 10Gb NICs — and probably underutilize the full capacity that you paid for with a 10Gb network.

With Flex-10 and FlexNICs, you have 10Gb to share across four FlexNICs. If you want one FlexNIC to have 5Gb of bandwidth and another to have 1Gb, then you can set the other two to any value you want as long as their sum doesn't exceed 4Gb (because you have a maximum shareable bandwidth of 10Gb). You can adjust that bandwidth on the fly so that the bandwidth for a virtual machine application can be adjusted as conditions change.

This flexibility also gives system administrators more peace of mind when it comes to ensuring that there is enough network bandwidth available. Virtual Connect Flex-10 allows the system administrator to set a ceiling on the bandwidth available to any FlexNIC. If the system admin doesn't have a particular value, Virtual Connect can set a recommended value. And the LAN administrator can set limits too, so that demand from the Virtual Connect Flex-10 server connections doesn't overwhelm the network capacity.

Extending the Flex-10 advantage with the FlexFabric module

With the recent introduction of the Virtual Connect FlexFabric module and FlexFabric Adapters, HP can deliver even more consolidation at the server edge. Virtual Connect FlexFabric

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modules are also built on the unique Virtual Connect Flex-10 capability to provide four physical functions for each network port and to allocate and fine-tune network bandwidth for both data and storage connections to make sure that each connection is provisioned just right. Figure 2-9 shows a FlexFabric module.

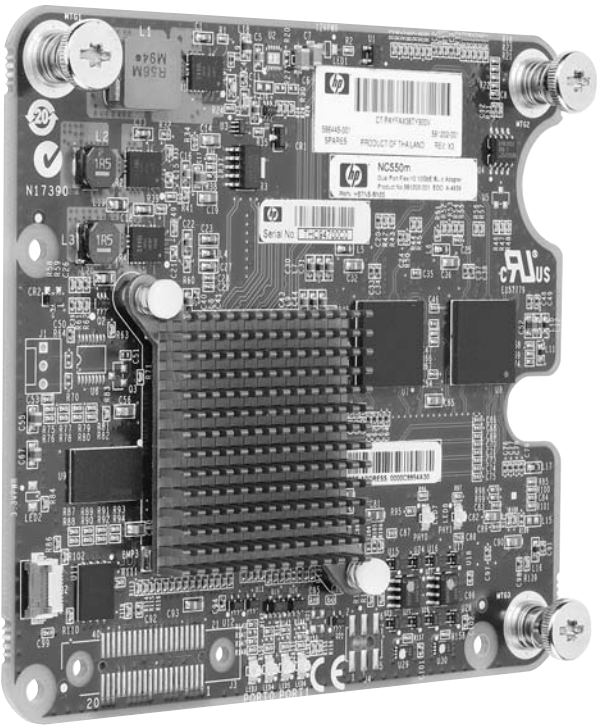

Figure 2-9: HP NC551m Dual Port FlexFabric 10Gb Converged Network Adapter.

With the FlexFabric module and FlexFabric Adapter, you can either configure four FlexNICs per adapter port or you can assign one of those four connections as a FlexHBA function. This combination provides Ethernet plus either a Fibre Channel or an iSCSI offload function. On a dual-port adapter, that's up to eight Ethernet functions or up to six Ethernet and two storage protocol functions.

Many of HP's latest server blades have a FlexFabric Adapter built right into the motherboard. This means you don't have to buy any additional mezzanine cards. Unless you need more

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than six Ethernet and two Fibre Channel or iSCSI connections on a server, you won't ever need to buy a NIC or HBA mezzanine card again.

Challenges with Fibre Channel over Ethernet

There is a lot of talk about Fibre Channel over Ethernet (FCoE) these days. This technology promises to reduce the amount of equipment you need to buy for your LANs and SANs by combining both storage and data traffic over the same Ethernet network. It's a great idea but it comes with a couple of challenges:

- You need a new generation of Ethernet switches if you want to run FCoE everywhere in your data center.
- You may need to work with your LAN and SAN operations teams to update their processes and responsibilities.

FCoE requires an Ethernet network that complies with new IEEE standards referred to as *Data Center Bridging* (DCB). Sometimes this is also referred to as *Converged Enhanced Ethernet (CEE)* or *lossless Ethernet.* Today's version of Ethernet wasn't designed to handle some aspects of Fibre Channel, so representatives on IEEE committees are rewriting the Ethernet specs accordingly.

As of this writing, that work isn't done yet, but when it is, new distribution and core switches will be needed if you want to run FCoE traffic from your servers across a complex *multi-hop* network to storage devices or other targets. (Counting hops is a bit complicated, but if your data passes through two or more switches, you've got a multi-hop network.)

Operationally, FCoE makes the LAN and SAN into the same network. So you'll want to figure out who is responsible for maintaining it, how you can be assured that both types of traffic are handled properly, what you will do if something doesn't work, and so on. You can work all this out over time, but it can be disruptive to your operations until you've sorted it out.

The Virtual Connect FlexFabric advantage

The Virtual Connect FlexFabric module offers a better way to take advantage of FCoE technology. FlexFabric brings you the simplification and cost advantages that FCoE promises, but without any disruption to the way you operate today. What's more, you don't need to buy a new generation of switches until you want to, if ever.

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How does this work? Virtual Connect FlexFabric modules use industry-standard FCoE inside the BladeSystem C7000 enclosure and also bring the data traffic out of the FlexFabric modules in the familiar form of today's industry standard Ethernet, Fibre Channel, and iSCSI. You can save money and avoid operational disruption.

The Virtual Connect FlexFabric Adapter that's built into the server, and also available as a mezzanine card, takes the place of both Ethernet NICs and Fibre Channel HBAs. The industry term for this basic capability is Converged Network Adapter (CNA), but HP greatly enhances its FlexFabric Adapter with the power of Flex-10 capabilities. Sort of like a CNA on steroids, but much more useful for the data center!

Cost Savings

The one thing that's most important to any executive: What's the ROI? The HP Virtual Connect FlexFabric and Flex-10 solutions provide savings in four areas:

- Less equipment to buy and pay for
- Bandwidth control matches supply to your application needs while reducing overall network demand
- LAN and SAN administrators' time isn't wasted because the system administrator is more self-sufficient
- Less equipment means lower power bills

Figure 2-10 illustrates a Virtual Connect Flex-10 configuration when setting up a best-practice network configuration for VMware. The minimum recommendation for NICs in a VMware configuration is six, and they're compared here between traditional 1Gb bandwidth technology and Virtual Connect Flex-10.

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	NIC 1 Service Console (OS, Mgt Net, Backup)	NIC 2 VMkernel (VMotion, iSCSI, NFS)	NIC 3 VM Network	NIC 4 Service Console (OS, Mgt Net, Backup)	NIC 5 VMkernel (VMotion, iSCSI, NFS)	NIC 6 VM Network
Traditional 1 Gb Technology	1Gb	1Gb	1Gb	1Gb	1Gb	1Gb
Virtual Connect Flex-10	0.5Gb	1Gb	8.5Gb	0.5Gb	1Gb	8.5Gb

Comparisons are for six-NIC configurations comparing Virtual Connect Flex-10 to Cisco 3120X 1/10Gb switches.

Figure 2-10: A VMware Best Practice Network Configuration Comparison.

As you can see, with the traditional 1Gb technology each NIC is stuck at 1Gb no matter what your needs for that NIC are. For example, the service console on NIC 1 needs only half of the 1Gb bandwidth for that NIC so you overprovision by 100 percent. With Virtual Connect Flex-10 technology, you can adjust the bandwidth to 500Mb. Then you can increase your bandwidth for other FlexNICs. You're not forced into any infrastructure constraints with FlexNICs.

HP crunched the numbers in this VMware comparison and found that when compared to traditional 1Gb technology, HP Virtual Connect Flex-10:

- Is 45 percent less expensive to buy
- Consumes 40 percent less power (given up to 240W per enclosure)
- Offers 3.3 times higher total bandwidth
- Allows 100 times more flexibility to allocate bandwidth across networks
- Has up to 10 times higher bandwidth per link

In fact, in some configurations, Virtual Connect FlexFabric can reduce your hardware at the server edge by as much as 95 percent. This also means you can reduce equipment costs by as much as 65 percent and your power costs by as much as 40 percent.

HP offers two major cost and hassle savers with the Virtual Connect FlexFabric module and FlexFabric Adapter. First,

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HP builds the FlexFabric Adapter into most server blades as standard, so you don't have to buy any mezzanine cards. And second, HP doesn't charge any license fee to allow module ports to pass storage traffic, so you don't have to pay for and track licenses.

Another expense reducer is the standardization of configuration that using Virtual Connect Flex-10 technology provides. Because IT departments and related support divisions are busy enough as it is, businesses with large numbers of applications try to limit the number of different configurations available. In most cases, there will be four or five certified infrastructure configurations that specify how to configure racks, enclosures, servers, network connections, and more.

HP has addressed this all-important issue with FlexFabric or Flex-10 adapters — and the eight Flex functions you get right on the server blades. One pair of modules connected to these adapters may meet the needs of all your server configurations.

Perspectives on HP Virtual Connect Installation

One question that's probably foremost on your mind is: What will your IT team have to do when it comes time to install HP Virtual Connect? The following sections provide some key operational aspects. Though this discussion is pretty high level, this section does get a little more technical in case you want to share this information with your IT team and get their feedback.

Installation planning

The system administrator must work with the LAN and SAN administrators to plan how Virtual Connect will be connected to the networks. Virtual Connect Manager provides installation wizards for the different administrators to make the process simple and straightforward. Here are some of the key steps in the installation process:

- Identify the number of required uplinks based on network bandwidth requirements.

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- Configure upstream Ethernet network switch ports for Link Aggregation Control Protocol (LACP) if needed, or verify that the ports are configured. If link aggregation is required, you must configure the upstream switch ports that connect to the Virtual Connect module for 802.3ad (LACP).
- Determine whether factory MAC addresses and WWNs will be used or whether you will implement Virtual Connect assigned addresses.
- Establish the required connections to connect servers and VLANs to the core network.
- Decide on any other specific VLAN requirements.
- Identify the number of Fibre Channel uplinks based on SAN bandwidth requirements.
- Ensure the upstream Fibre Channel switch ports are configured for N_Port ID Virtualization (NPIV).
- Decide how each server will connect to the Fibre Channel fabrics and establish the required connections.

A physical connection from the server to the network is complete only after you connect the Virtual Connect module(s) to the upstream data center switches, define Virtual Connect networks, and assign server profile(s) in Virtual Connect Manager.

MAC and WWN address choices

MAC addresses and WWNs (World Wide Names — sometimes called World Wide IDs) are critical to how your servers communicate with your LANs and SANs. Virtual Connect offers three choices for setting MAC addresses and WWNs. The LAN, SAN, and system administrators need to agree on which method is most useful for their situation. The addresses can be assigned in these ways:

- Use the factory-implemented MAC addresses that come with the NICs and the factory-implemented WWNs that come with the HBAs. These MAC and WWN addresses are each unique and registered with international agencies to ensure no duplication.

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- Virtual Connect–assigned addresses, which are also uniquely assigned and registered. When you use Virtual Connect–assigned addresses, Virtual Connect assigns the MAC and WWN addresses with the server profile when you create it. Virtual Connect can also move the profile and its assigned addresses from one server to another. For these reasons, HP recommends that you use Virtual Connect–assigned addresses.
- You can also set the MAC and WWN addresses yourself and Virtual Connect will manage them.
- In order to get the Virtual Connect benefits of being able to add or replace a server and moving workloads from one server to another without impacting the LAN or SAN, you will need Virtual Connect to be managing the addresses, whether it assigned them or you assign them yourself. Using the factory-implemented default values will not allow Virtual Connect to provide these benefits.

Virtual Connect Fibre Channel saves fabric domain IDs

One of the great advantages of Virtual Connect for your Fibre Channel SAN is that you aren't limited by the number of switches in your FC SAN fabric. Every FC fabric is limited in the number of switches it can allow. If a user has many server blade enclosures, the number of FC switches needed is often too many to fit into the FC fabric limits.

Virtual Connect Fibre Channel overcomes this problem. Because the Virtual Connect FC modules aren't switches, they don't count against FC fabric limits. So Virtual Connect is able to reduce your FC cable count, even when switches can't do that. At the same time, it provides all the Virtual Connect advantages described earlier.

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Chapter 3

Converging Your IT Infrastructure

In This Chapter

- Examining HP Converged Infrastructure and how it can help
- Discovering the parts of a Converged Infrastructure

Over the past 15 to 20 years, applications and information technologies have become more complex and business processes more inflexible. This *IT sprawl* has driven costs up to the point where about 70 percent of the IT budget typically goes to maintaining the infrastructure (just keeping the lights on), and only 30 percent goes to business innovation.

Businesses know that innovation is important — it opens new markets, drives efficiency, and sharpens the competitive edge. And businesses are ready for the next generation of data centers to overcome IT sprawl and apply more of the IT department's efforts and budgets to building the business.

HP Converged Infrastructure

Servers, storage, networks, power and cooling, and management tools are now designed to be more open, simpler, and much better integrated. HP's Converged Infrastructure offers all these technologies firmly based on industry standards (see Figure 3-1). HP can furnish only the pieces you need or a fully integrated solution so your business can reduce the 70 percent of your IT budget dedicated to keeping your infrastructure up and running.

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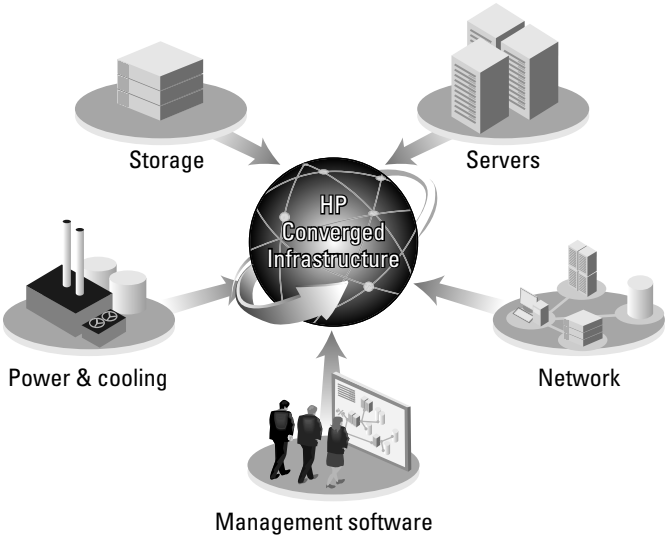

Figure 3-1: HP Converged Infrastructure.

The Four Pillars

Without drilling down too much into how to build your next data center to start flipping those budget ratios around, we want to talk a little about what makes a converged infrastructure and why Virtual Connect is critical to it.

A fully converged infrastructure needs to address four key areas: HP calls them the *key technology pillars* (see Figure 3-2). The pillars address real problems with the way IT infrastructure has been built in the past. The problems can be addressed one at a time, but to get the full benefit in your IT organization you'll want to address all four.

- **Virtual Resource Pools:** The first challenge IT managers face is the lack of, or under-sharing of, network resources. Servers, storage, switches, and so on are of different types with different capacities and the network handles each resource type individually. For example, what if you have two servers that are only 20 percent utilized but are of different types? The first step is for

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your management tools to treat those servers as virtual resource pools. When you start pooling and allocating the remaining 80 percent of those two server resources for various applications, under-utilization becomes a thing of the past.

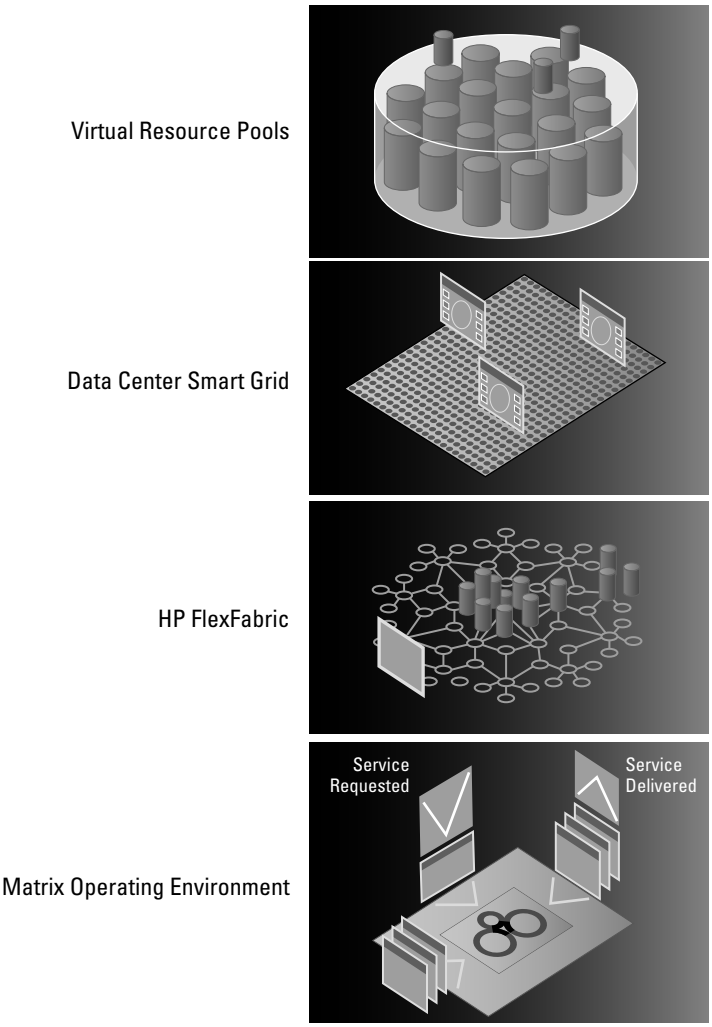

Figure 3-2: HP Converged Infrastructure pillars.

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- **Data Center Smart Grid:** Power and cooling is near the top of everyone's IT issues list today. Rising energy costs and environmental (known popularly as *green*) regulatory pressures are forcing big changes in how businesses use power. HP's Data Center Smart Grid offers integrated approaches that can reduce and control energy usage in real time to improve efficiency under any workload, lower costs, and extend the capacity of existing facilities.
- **HP FlexFabric:** Many business networks are experiencing rapid increases in workloads and connections. The rapid adoption of virtualization is straining existing infrastructure to meet networking demands. HP FlexFabric is a wire-once network infrastructure that delivers a simple, reliable, and highly scalable network fabric to support a truly converged infrastructure. Virtual Connect is a key component of the HP FlexFabric architecture that provides smoothly integrated server connectivity to data center networks.
- **Matrix Operating Environment:** Businesses need automated ways to increase productivity and continuously optimize resources in a uniform way across IT domains. The HP Matrix Operating Environment provides a common management platform that extends from infrastructure-to-application across servers, storage, and networks. Shared services can be created and provisioned quickly, often in a matter of hours instead of months. Virtual Connect is an essential component of the Matrix Operating Environment that enables HP's Insight Dynamics VSE to move workloads across physical and virtual servers without rewiring or reconfiguring connections. (If you're curious, Insight Dynamics VSE is advanced lifecycle management software.)

The best thing about this architecture, and the technologies behind it, is that all this is possible today — not a vague vision of the future. If you'd like to read more about this, check out HP's Web site on the topic at `www.hp.com/go/ci`. We talk more about HP Virtual Connect modules in Chapter 4.

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Part II
Virtual Connect Answers

"So, what's this breakthrough in virtualization you wanted to show me?"

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In this part . . .

If you or anyone else has questions about HP Virtual Connect, you'll find the answers in this part of the book.

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Chapter 4

Virtual Connect Modules

In This Chapter

- Examining the Virtual Connect FlexFabric 10Gb/24-Port Module
- Looking at the Virtual Connect 1/10Gb-F and Flex-10 Ethernet modules
- Getting to know the Virtual Connect Fibre Channel modules
- Building a c-Class enclosure

In this chapter, we discuss the Virtual Connect modules and how they work, so you can get a better idea of how Virtual Connect technology will work in your business and decide which are the best choices for you.

This analysis requires that we get into more technical detail about Virtual Connect — not so technical that it becomes unreadable, but enough to help you get a more in-depth understanding about Virtual Connect products.

Virtual Connect works with the HP BladeSystem c-Class series of enclosures, which comes in two different models: the c7000 and c3000. The difference is that the c3000 holds up to four full-height or eight half-height server blades with four bays for interconnect modules. The c7000 holds double what the c3000 holds: 8 full-height server blades or 16 half-height blades and 8 rear bays for interconnect modules.

The Virtual Connect FlexFabric 10Gb/24-Port Module

Server edge consolidation has improved considerably with the introduction of the Virtual Connect FlexFabric 10Gb/24-Port Module. The Virtual Connect FlexFabric Module allows

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you to bring Ethernet, Fibre Channel, and high performance iSCSI into a single module. Because the Virtual Connect FlexFabric Module uses industry standard Ethernet and Fibre Channel on its uplinks, it will happily communicate in existing environments using those protocols.

The Virtual Connect FlexFabric module also includes 10Gb downlink connections to the servers and offers a combination of uplinks to the data center network. What's more, the Virtual Connect FlexFabric module is single-wide so you can install two of them side by side in the enclosure interconnect bays for redundancy. You can stack the Virtual Connect FlexFabric modules in up to four enclosures and your IT team can manage them using Virtual Connect Manager or Virtual Connect Enterprise Manager.

The Virtual Connect FlexFabric 10Gb/24-Port Module (see Figure 4-1) includes the following features:

- It has 16 10Gb downlinks to servers. That is, the module has one connection to one FlexFabric Adapter on each of 16 half-height servers, or if you have full-height servers, the module connects with two FlexFabric Adapters on each of the 8 servers. The module connects automatically across the signal midplane in the c-Class enclosure.
- It provides ten uplink ports to the data center network including:
    - Four 10Gb SR, LR fiber and copper SFP+ (Ethernet and Fibre Channel)
    - Four 10Gb SR, LRM and LR fiber and copper SFP+ (Ethernet)
    - Two 10Gb internal cross-connect links for stacking and failover when there is another Virtual Connect FlexFabric module beside it
- It supports a wide variety of signal-aggregation methods including NPIV, VLANs, EtherChannel, NIC teaming, and shared port uplinks.
- FlexFabric modules in four enclosures can be stacked together with cables so you can manage four enclosures of Virtual Connect modules as one management domain.

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Figure 4-1: The HP Virtual Connect FlexFabric 10Gb/24-Port Module.

The Virtual Connect Ethernet Modules

HP offers two Virtual Connect Ethernet modules today. As with the FlexFabric module, both modules are single-wide so you can install two of them side by side in the enclosure interconnect bays for redundancy. They can also be stacked in up to four enclosures and can be managed using Virtual Connect Manager or Virtual Connect Enterprise Manager.

The Virtual Connect 1/10Gb-F Ethernet Module

The Virtual Connect 1/10Gb-F Ethernet Module includes 1Gb downlink connections to the servers and offers a combination of 1Gb and 10Gb uplinks to the data center network.

The Virtual Connect 1/10Gb-F (see Figure 4-2) module includes the following features:

- It has 16 1Gb downlinks to servers. That is, the Virtual Connect Ethernet module has one connection to one NIC on each of 16 half-height servers, or if you have full-height servers, the module connects with two NICs on each of the eight servers. The module connects automatically across the signal midplane in the c-Class enclosure.

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- It provides ten uplink ports to the data center network including:
  - Four RJ45 copper Ethernet connectors
  - Two 1Gb SFP for Ethernet fiber or copper media
  - Two 10Gb XFP modules for multiple types of fiber
  - One 10Gb CX4 connector for stacking cables
  - One 10Gb internal cross-connect link for stacking and failover when there is another Virtual Connect Ethernet module beside it
- All external 1Gb and 10Gb ports are active all the time, with 16Gb of connectivity down to the servers and 36Gb available for uplinking to the data center switches. So no bandwidth oversubscription is necessary.
- It supports a wide variety of signal-aggregation methods including VLANs, EtherChannel, NIC teaming, and shared port uplinks.
- Ethernet modules in four enclosures can be stacked together with cables so you can manage four enclosures of Virtual Connect modules as one management domain.

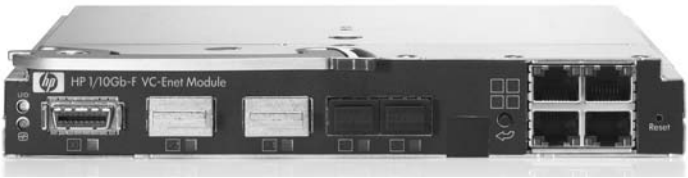

Figure 4-2: The HP Virtual Connect 1/10Gb-F Ethernet module.

The Virtual Connect Flex-10 10Gb Ethernet Module

The Virtual Connect Flex-10 10Gb Ethernet Module (Figure 4-3) looks a bit different than the 1/10Gb-F Ethernet module but the two work seamlessly together.

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Figure 4-3: The HP Virtual Connect Flex-10 10Gb Ethernet module.

You would expect the Virtual Connect Flex-10 module to play well with Flex-10 NICs, but the Flex-10 module will also auto-negotiate to a single 1Gb or 10Gb connection if you connect any other kind of NIC to it.

Each module provides eight 10Gb active uplink ports at one time, two of which are shared with the cross-links. All external ports, except for the CX-4 port, use SFP+ transceiver modules that come in a variety of copper and fiber media versions to fit your specific needs.

The Virtual Connect Flex-10 module is also flexible (hence its name) because its external connection ports can support either 1Gb or 10Gb transceivers. Therefore, you don't need to start with a 10Gb network infrastructure right away — you can plug multiple SFP (small form-factor pluggable) transceivers into the external connection ports and connect all the 1Gb (or slower) ports you need, and/or mix and match 1Gb SFP and 10Gb SFP+ links. This means you can start with the network you have today and grow to a full 10Gb infrastructure at your own pace. The ability to use one NIC port split into four FlexNICs and control NIC bandwidth applies to both 1Gb and 10Gb infrastructures.

The Fibre Channel Modules

HP offers three models of the Virtual Connect Fibre Channel (FC) module today: a 4Gb module and two faster 8Gb modules with more bandwidth to support virtualization or other high

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bandwidth applications. You will need to have at least one Virtual Connect Ethernet or FlexFabric module installed in the same enclosure along with the FC modules because the embedded device monitoring and management, including Virtual Connect Manager, runs on the Ethernet or FlexFabric modules. The following sections go over the three models in more detail.

Virtual Connect 4Gb FC Module

The Virtual Connect 4Gb FC (Figure 4-4) Module connects across the signal midplane to 1 HBA mezzanine cards on each of the 16 half-height servers.

The Fibre Channel modules use *N_Port ID Virtualization,* or NPIV, which is a Fibre Channel standard that enables multiple HBAs to share a single network port. NPIV does a great job of reducing the number of Fibre Channel cables needed in the network, and since NPIV isn't a switch, it doesn't count against a SAN fabric domain ID limit.

Figure 4-4: The HP Virtual Connect 4Gb Fibre Channel module.

This model provides four uplink SFP ports to connect to your data center FC switches, and it also auto-negotiates to match the bandwidth of your 1Gb, 2Gb, or 4Gb Fibre Channel SAN.

Virtual Connect 8Gb 20-Port Fibre Channel Module

The HP Virtual Connect 8Gb 20-Port Fibre Channel (FC) Module (Figure 4-5) operates just like the 4Gb model except it doubles the bandwidth and offers the lowest cost per port.

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It also brings next generation 8Gb technology that includes backward compatibility with 2Gb and 4Gb networks. It is ideal for environments and applications that require high bandwidth connections, increased network management, and role-based security features. (And who isn't looking to save money, get more speed, and acquire easy management features these days?)

Figure 4-5: The HP Virtual Connect 8Gb 20-Port Fibre Channel Module.

Virtual Connect 8Gb 24-Port Fibre Channel Module

The HP Virtual Connect 8Gb 24-Port Fibre Channel (FC) Module (Figure 4-6) operates just like the 20-Port 8Gb model, but it has two additional advantages: It offers twice as many uplink ports for greater flexibility and less oversubscription, and it supports twice as many NPIV connections per HBA. This module offers the greatest density of ports in the Virtual Connect Fibre Channel line and is ideal for virtual machine environments.

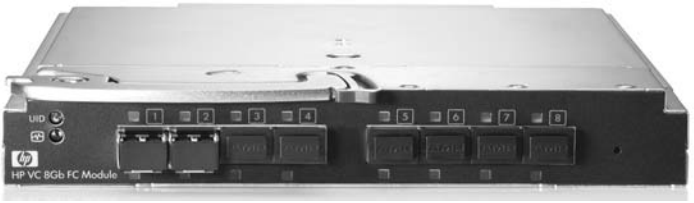

Figure 4-6: The HP Virtual Connect 8Gb 24-Port Fibre Channel Module.

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Building a c-Class Enclosure

Because Virtual Connect modules are built for c-Class enclosures, they all have the same size and form factor so they'll plug into any of the interconnect bays in a c3000 or c7000 enclosure. If you plug in two of the same model side-by-side, you get redundant access to the NICs or HBAs on each server.

To connect to your LANs and SANs using Virtual Connect modules, you need to do the following:

- Connect the Virtual Connect Ethernet modules to the data center Ethernet switches.
- Connect the Virtual Connect FC modules to the data center FC switches. You can connect to a variety of switches including those made by HP, Brocade, Cisco, McData, and QLogic.
- Set up Virtual Connect and assign connection profiles using Virtual Connect Manager or Virtual Connect Enterprise Manager.

That's all there is to it! You're ready to go. Turn to Chapter 5 for a closer look at Virtual Connect (especially if you want to convince your boss of the return on investment).

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Chapter 5

Looking More Closely at Virtual Connect

In This Chapter

- Reducing costs
- Managing hardware and networks more easily
- Addressing some misinformation

This chapter answers some of the "Yes, but . . . " questions you and your IT team may have, and also dispels some of the myths that HP has run across as they've introduced Virtual Connect to customers around the world.

Hopefully this chapter can help answer many of your questions about Virtual Connect. Though you may be sold on the solution, one or more decision makers in your company may not be. If you need to convince others, be sure to check out Chapter 6 so you can tell people the ten reasons to choose HP Virtual Connect.

Some of the information in this chapter goes into deeper technical details about Virtual Connect for the benefit of your IT staff — and some information is for financial staff that you need to convince, and any executives you need to present with a rock-solid ROI statement. We also discuss some specific advantages of both Virtual Connect Flex-10 and FlexFabric modules. With each section, we include a brief overview of what the section is about in case the person you're trying to convince isn't exactly detail oriented.

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Cost Reductions and TCO

Virtual Connect Flex-10 provides a number of cost reductions over traditional server/network connections — not only on the day you purchase it, but every day going forward. The Virtual Connect FlexFabric module builds on those benefits to save even more. These cost savings include:

- **Lower hardware costs:** First of all, you don't have to buy so much stuff. With the Virtual Connect FlexFabric module, you can reduce sprawl at the server edge by up to 95 percent, cut network connection hardware costs by up to 65 percent, and get four times the number of connections without buying any NIC cards or HBAs (host bus adapters). HP server blades already have the Ethernet and FC capability built into them at no added cost. And, you don't have to buy expensive licenses and keep track of them for storage connectivity.
- **Lower energy costs:** With less equipment to use, you lower your energy costs. Those energy cost savings go up substantially with Virtual Connect, saving you up to 40 percent on power consumption because you need to power substantially fewer LAN and SAN connection components.
- **Lower operation expenses:** Save time and labor. Virtual Connect helps the system administrator be self-sufficient, so they can add a new server, replace one, or move the workload from one server to another in minutes instead of the days or weeks it takes now. It also frees up the LAN and SAN administrators to do their own work without unnecessary interruptions. Just think of the savings in coordinating meeting times!

  Virtual Connect eliminates equipment to maintain and makes the work easier and faster for everyone, and that reduces operations expense.

Easier Hardware Management

Virtual Connect technology provides your IT team with easier hardware management in a number of ways. The following sections go over how in more detail.

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Virtual Connect module isn't a switch

Virtual Connect isn't a switch, isn't part of the network, and it doesn't control anything in the network. And those are all good things. Data center Ethernet switches are complicated machines. They're part of a complex network of switches and routers in which every change needs to be controlled by a LAN or SAN administrator with special skills and insights into that network. Likewise, the server infrastructure is a complicated system that demands the special skills and insights of the system administrator.

Virtual Connect allows servers to connect to the network in a way that doesn't affect the network at all. So the system administrator can add new servers, make server changes, and manage Virtual Connect without the network administrator needing to get involved.

Virtual Connect uses server edge virtualization to allow this seamless interaction. Its Ethernet and FlexFabric modules use tried-and-true Layer 2 bridging functionality, but their primary function is to provide server connection virtualization and management features that don't exist in traditional switches. HP has built in some functions that are common on switches, but they only serve the purpose of allowing Virtual Connect to work smoothly with any brand of Ethernet data center networks.

Likewise, Virtual Connect Fibre Channel modules aren't switches, either. They use industry standard N_Port ID Virtualization to reduce cables without complex switching functionality or using up your limited SAN fabric IDs.

Higher availability and fault recovery

Everyone in the company knows (or should know) that every second your network is down your business is losing money. HP has designed Virtual Connect with both high availability and quick fault recovery.

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Virtual Connect uses configuration check pointing/synchronization across adjacent Virtual Connect Ethernet or FlexFabric modules within each HP c-Class enclosure. In the unlikely event that a Virtual Connect Ethernet, FlexFabric, or Fibre Channel (FC) module fails, the Virtual Connect Domain uses Ethernet or FlexFabric modules in adjacent bays to retain the complete Virtual Connect configuration. Virtual Connect supports plug-n-play, so after the failed Virtual Connect module is replaced, it applies the configuration to the new module automatically.

HP goes a couple of steps further when it comes to bullet-proofing your infrastructure. HP server blades are typically connected to more than one redundant Virtual Connect module, so it's not easy to lose the connection to your network. Virtual Connect also supports exporting the Virtual Connect domain configuration to an external source in case you need to restore the configuration manually.

Virtual Connect uplink failures don't require reconvergence on the external network

If a Virtual Connect module encounters a connection problem with the external network, you don't need to go to the external network and reconverge those uplinks.

Virtual Connect Ethernet and FlexFabric modules don't participate in the data center network spanning tree. They present themselves to the network as a termination endpoint, like a server NIC. Virtual Connect employs an internal loop avoidance method to make sure no loops can be created in the server connections.

Because Spanning Tree Protocol (STP) isn't used to manage Layer 2 redundancy in Virtual Connect, Spanning Tree reconvergence will not occur. Fundamentally, Virtual Connect failovers between Virtual Connect uplinks behave the same way as failovers between server NICs in a NIC Team or NIC Bond. That is, the failover from one uplink or NIC is transparent to the data center network Spanning Tree.

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Can connect to any industry standard network components

Virtual Connect Ethernet and FlexFabric modules are completely IEEE Ethernet standards compliant, so they communicate effectively with any brand of IEEE standard switches. HP Networking offers a full range of products that are all IEEE standards compliant. However, HP realizes that companies use brands of networking equipment other than their own. Network products made by Cisco Systems are popular in the enterprise, and HP makes it easy for you to connect Virtual Connect to Cisco Catalyst and Nexus switches. Over 100,000 Virtual Connect Ethernet modules are operating with Cisco networks every day.

Virtual Connect Fibre Channel modules are also completely compliant with the INCITS T11 industry standards that define all Fibre Channel operation. So any brand of FC switches that meets the T11 standards will work smoothly with Virtual Connect Fibre Channel.

Easier Network Connection Management

Virtual Connect was designed not only to provide server edge virtualization functionality, but also to work smoothly with the LAN and SAN networks it was connected to. So it provides easier connection management in several key ways. The following sections provide more details.

Provides diagnostic tools

Virtual Connect Manager has a lot of different ways for your system and network administrators to use their favorite tools to diagnose, monitor, and configure Virtual Connect. These include:

- You can create scripts in a Secure Shell (SSH) command-line interface.

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- You can use any management tool that supports command-line interface scripts to remotely configure Virtual Connect.
- You can monitor Virtual Connect with any management tool that supports SNMP (Simple Network Management Protocol). Virtual Connect supports both SNMPv1 and SNMPv2 traps as well as traps for key, pre-defined threshold conditions and per-destination configuration of traps.
- Virtual Connect also supports *port mirroring* or monitoring of server NIC traffic to Virtual Connect uplinks for troubleshooting.

Fibre Channel (FC) login distribution and failover features

The Virtual Connect Fibre Channel connection provides login distribution and failover on FC uplinks to the SAN. A failure in your server connectivity with the SAN is a major problem. So HP has designed Virtual Connect Fibre Channel with built-in functionality that can automatically log in to another active Fibre Channel port if a Fibre Channel connection fails.

In other words, Virtual Connect provides Fibre Channel (FC) login distribution and failover features, which means that the SAN administrator can automatically distribute server HBA fabric logins across all Virtual Connect Fibre Channel (VC-FC) uplink ports on the same VC-FC module. Should a port fail or lose the link, the VC-FC module automatically relogs the WWN into the fabric on another active VC-FC uplink port from the same VC-FC module.

Other seasoned technology

To continue the discussion on the use of seasoned technologies to power Virtual Connect and give it the flexibility you need, Virtual Connect supports a large number of other seasoned networking technologies that include:

- Network management tools
- Secure external management

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- Private VLANs
- Deterministic load balancing for multiple LACP channels
- VLAN trunking to server-based NICs
- Network visibility into the Virtual Connect domain for network administrators
- Clusterlike technology between Virtual Connect Ethernet modules
- Stacking multiple Virtual Connect Ethernet modules
- Single Web management window to manage all Virtual Connect modules
- IGMP snooping v1 and v2
- Nested NPIV
- MAC and WWN address management
- Multiple Virtual Connect Fibre Channel fabrics
- Support statistics for all Ethernet ports

Urban Myths about Virtual Connect

A few myths are floating around out there about Virtual Connect, but HP has addressed these myths based on real-life deployments. If you've heard some of these and need the facts, here they are.

Myth: Virtual Connect doesn't provide visibility into the Virtual Connect Domain for Network Admins

Virtual Connect is about keeping things simple. It provides several user interface options and features for managing and monitoring Virtual Connect to fit with the variety of methods HP's customers use. VC supports both a Web interface (HTTPS) and a CLI interface (SSH). In addition, VC supports

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per-interface statistics for every server NIC port, server HBA port, VC Ethernet uplink port, and VC Fibre Channel uplink port. These statistics can be monitored via the management interfaces or via SNMP/SMI-S polling. In addition to local statistics and SNMP polling of statistics, VC provides SNMP traps for events that cause VC Domain status changes. Virtual Connect also supports port mirroring, to an external network analyzer, of Ethernet traffic to/from any server NIC port(s).

Myth: VC Flex-10 doesn't provide the bandwidth control that QoS would

Virtual Connect Flex-10 provides server administrators greater flexibility to prioritize application traffic by dedicating specific FlexNICs for specific networks, and providing segregation of traffic that can't be allowed to coexist on the same physical NIC. Though a virtual server hypervisor could provide rate limiting features to control bandwidth, this doesn't exist for physical servers. Virtual Connect Flex-10 allows either the Server or Network Administrator to set and enforce bandwidth settings at the FlexNIC partition, and Virtual Connect Flex-10 can provide a consistent method of management and segregation regardless of the physical host OS. So in your overall IT configuration, Virtual Connect often offers more bandwidth control than you'd have with QoS.

Myth: Virtual Connect users can't leverage existing network management tools

Not true! Virtual Connect supports configuration scripting via a CLI interface (SSH) and monitoring using SNMP. Any management tools that support CLI scripting can be used to remotely configure Virtual Connect. Any management tool that supports SNMP can be used to monitor Virtual Connect.

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Myth: VC doesn't interoperate with the Nexus 1000v

The Cisco Nexus 1000v is a software vSwitch that works in a VMware hypervisor. It interoperates with any other Layer 2 networking device that supports industry standard protocols. Even the vPC-HM (Virtual Port Channel – Host Mode; where MAC addresses are pinned to dvUplinkPorts) supports Layer 2 devices that can't support LACP upstream. Virtual Connect is pure industry standard Layer 2, so it works just fine with the Nexus 1000v.

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Chapter 6

Ten Benefits of HP Virtual Connect

In This Chapter

- Using fewer cables and switches
- Getting more server I/O
- Reducing staff time
- Achieving flexibility and redundant access
- Solving a lot of problems

Despite all the best efforts of this book, you may need to put your arguments in a digestible form so decision makers can quickly understand the benefits of HP Virtual Connect. Some of this information is repeated from earlier chapters so you can use this chapter to help make your case.

Fewer Cables and Switches

The traditional choice for connecting your blade servers to your LAN and SAN is between too many cables and too many switches. Pass-Thru modules leave you with too many cables and expensive switch connections on the network end of the cables. Blade server switches are small, so you end up with too many to comfortably manage.

Virtual Connect is a great alternative for consolidating all your Ethernet and Fibre Channel connections into much less equipment. It reduces the number of cables like a switch would, but is much simpler and doesn't add more load on the LAN

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and SAN administrators who manage the switches. And it also slashes the number of modules and adapter cards you need.

Virtual Connect is part of the server infrastructure and provides a virtualization layer between the servers and the Ethernet and SAN networks so they won't see any changes in the server connections. And the FlexFabric, Ethernet, and Fibre Channel (FC) Virtual Connect modules have plenty of ports. What's more, when you incorporate Virtual Connect Flex-10 Ethernet or FlexFabric modules as part of your infrastructure, each port becomes four individual physical functions that share 10Gb of bandwidth among them, so you have less network connection equipment to buy and less to power. HP stepped up consolidation even further with FlexFabric modules and FlexFabric Adapters, which eliminate the need for separate HBA cards and SAN switches.

More Applications on Fewer Servers (More Server I/O)

As you virtualize your infrastructure by consolidating applications onto virtual machines on fewer servers, the I/O demand for each of those servers increases. HP Virtual Connect Flex-10 technology provides eight functions on a single integrated adapter built into the server to handle all the additional connections. And if you really need more connections, you can get a total of 24 per server blade by adding more mezzanine cards to support even greater virtual machine I/O demands.

Lowered Expenses

Virtual Connect has a model for nearly every IT need. If you need more than two NICs on each server, which is often the case, you can dramatically lower your expenses by using Virtual Connect Flex-10 or FlexFabric modules. With Virtual Connect FlexFabric modules, you can reduce network sprawl at the server edge by up to 95 percent. That includes switches, cables, network adapters, storage adapters, and more. You can reduce your cost for network connection hardware by up to 65 percent.

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With fewer hardware components that need electricity, you'll also save on power costs of — you could save up to 40 percent of the power with Virtual Connect FlexFabric modules.

Reduced Staff Time on Configuration and Management

When servers are directly connected to switches, those switches must be managed by the LAN and SAN administrators. Whenever there is a change in the network, like adding a new server blade, your system administrator, as well as the LAN and SAN administrators, must plan the changes that could take days, weeks, or even months to implement.

With Virtual Connect, your IT team only needs to plan the network connections once and apply them to each bay in the enclosure using Virtual Connect server profiles. When you need to add and replace servers, the system administrator can make those changes and the LAN and SAN administrators don't have to do anything. The network provisioning was already done, and that frees up your LAN and SAN administrators from the disruption of server maintenance.

Virtual Connect makes the system administrator self-sufficient. Why tie up three people when one can get the job done?

Scalable Management That Grows with You

HP provides flexible management options for small and large data centers. Use the built-in Virtual Connect Manager if you don't intend to manage more than four enclosures of Virtual Connect. If you plan to grow your data center, Virtual Connect Enterprise Manager is a scalable application that administers connections and workloads for hundreds of Virtual Connect Domains and thousands of servers from a single console.

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Match Bandwidth Supply to Application Demand

Virtual Connect Flex-10 technology allows your system administrator to match the amount of bandwidth for each adapter port to the needs of the application using that connection. It allows you to set the bandwidth for each FlexNIC or FlexHBA. Furthermore, the administrator can change bandwidth settings on the fly without the need to reboot, so you can quickly adjust to variations in application demand.

Connect to Any Brand of LAN or SAN

Virtual Connect supports industry standard network protocols so you can incorporate it easily into your existing infrastructure. By using standard Ethernet, Fibre Channel, and iSCSI protocols, you are assured that Virtual Connect modules will work seamlessly with any brand of existing networking infrastructures. All the faster Virtual Connect modules are backward compatible with slower networking hardware, so you can upgrade on your own timetable as budgets permit.

Flexibility with Server Models

Virtual Connect provides all kinds of flexibility. It interoperates with all HP BladeSystem servers. Most server blades already come with FlexFabric Adapters built into them. Older blades have Flex-10 Adapters built into them. And both Flex-10 and FlexFabric Adapters are available as mezzanine cards. FlexFabric, Flex-10, and the other Virtual Connect modules are interchangeable with each other and have a wide variety of backward and forward compatibilities. HP has tried to make it so that every logical combination of servers and modules work together in simple, economical ways to meet your needs. If you're curious, check out the details with your HP sales representative.

Virtual Connect Flex-10 technology brings you the ultimate flexibility for your server configuration standards. Instead of

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needing four or five different interconnect configurations to meet the needs of your different standard server configurations, you'll probably only need a pair of Virtual Connect Flex-10 or Virtual Connect FlexFabric modules — period. No mezzanine cards. No variety of interconnect devices. Fewer spare parts, and fewer part numbers to worry about.

Failover Process and Redundant Access

Virtual Connect provides enterprise-class resilience. It uses configuration check pointing/synchronization across adjacent Virtual Connect Ethernet modules within each HP c-Class enclosure. In the unlikely event that a Virtual Connect FlexFabric, Ethernet, or Fibre Channel module fails, the Virtual Connect Domain uses Ethernet or FlexFabric modules to retain the complete Virtual Connect configuration. Virtual Connect supports plug-n-play standards, so that after the network administrator replaces the failed module, the configuration is applied to a new module automatically.

With the design of Virtual Connect, HP server blades are typically connected to more than one redundant Virtual Connect module so there's no single point of failure in your system. Virtual Connect also supports the export of the Virtual Connect domain configuration to an external source in case you need to restore the configuration manually.

A Complete Server Network Connection Solution

HP Virtual Connect is the most complete server network connection solution available because it solves problems that most IT operations face every day: They have too many cables and too many switches, too much management burden, too much power consumption, and too much expense.

Virtual Connect simplifies network connectivity so your IT organization can work smarter, reduce costs, and respond faster to business needs.

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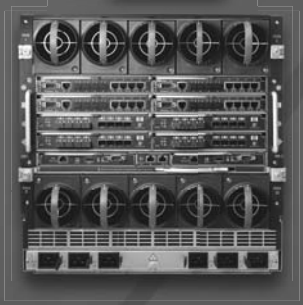
Broadcom®
10G C-NIC
used with
HP® Server Blades
and
HP Virtual Connect

Broadcom
NetXtreme II®
10G Controllers



HP Virtual
Connect Flex-10
10 Gb Ethernet
Modules

Broadcom 10G C-NIC with HP Virtual Connect Flex-10 used with HP Server Blades lowers TCO through storage, networking convergence, and infrastructure consolidation. Enables and simplifies End-to-End networking of all servers deployments through centralized management.

Contact your HP sales representative for more information

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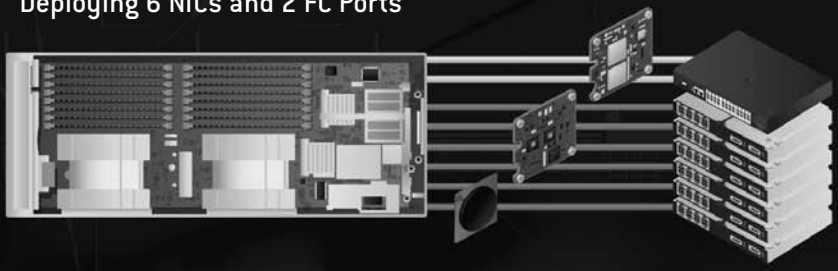
EMULEX CONNECTED

Bringing Networks Together

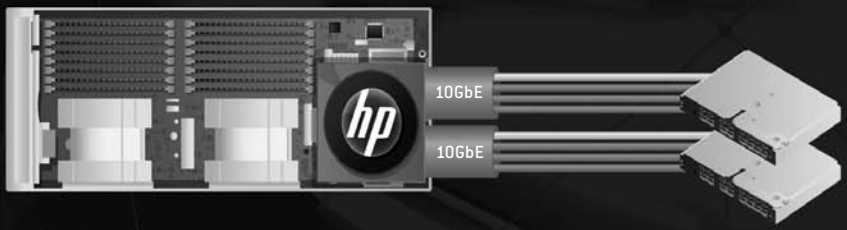
Before Convergence

Deploying 6 NICs and 2 FC Ports



After Convergence

Deploying 6 NICs and 2 FC or 2 iSCSI Ports



HP Virtual Connect FlexFabric Module and HP ProLiant G7 Server Blade with integrated FlexFabric Adapter

- 95% less cards, switches, cables & SFPs
- 65% lower interconnect & adapter costs
- 40% lower network power & cooling costs
- Plus less to install & manage

Emulex has entered the Converged networking market, and is working with HP by providing our OneConnect Universal Converged Network Adapter (UNCA) technology for use in HP's ProLiant G7 server blades' integrated FlexFabric adapter and FlexFabric adapter mezzanine card – converging storage and network traffic when combined with HP's Virtual Connect FlexFabric module. Emulex technology represents a new generation of server I/O technology that promises to reduce networking complexity and costs for IT organizations. **www.emulex-hp.com**

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HP VIRTUAL CONNECT

Build | Flex | Converge

Integration of Virtual Connect Enterprise Manager (VCEM) and Simple SAN Connection Manager (SSCM) via Virtual Connect API

•

Provides unique end-to-end view of server to storage connectivity in the fabric

•

Manage connections to 1000s of servers from a single console with HP VCEM

•

Supported with all HP H-Series Fibre Channel Switches

•

QLogic is the original Fibre Channel partner for HP BladeSystem

•

3 Million Virtual Connect ports shipped

www.qlogic.com/go/hp/virtualconnect

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The Ultimate in Performance

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Overcome today's server connection complexity while reducing costs and power consumption

With HP Virtual Connect, you can simplify your server connectivity to your networks — and reduce cables without adding switches to manage. System administrators become self-sufficient to add or replace servers and move workloads from one server to another in minutes, while freeing LAN and SAN administrators from common server tasks.

- ***Understand server networking — before learning about HP Virtual Connect, first get the basics***
- ***Discover the HP Virtual Connect approach — Virtual Connect simplifies server connections to LANs and SANs, and any needed changes to those connections***
- ***Find out how easy it can be — how HP Virtual Connect enables server administrators to easily move workloads and to add, move, and replace servers on the fly***
- ***Get the lowdown on HP Virtual Connect benefits — all the details you need to know to understand what Virtual Connect does and what it can do for you***

Open the book and find:

- **A list of reasons why Virtual Connect will benefit your organization**
- **A section about how Virtual Connect really works**
- **How VC FlexFabric modules eliminate up to 95 percent of server connection sprawl**
- **The simple, powerful management tools for Virtual Connect**
- **Answers to your questions on Virtual Connect**
- **A new chapter on converging your IT infrastructure**

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