10 Gigabit Server Access Architecture for Traditional HP Blade Servers

Executive Summary

With the growing need to build state-of-the-art data centers that deliver greater operational efficiencies, customers are seeking the best ways to use 10 Gigabit Ethernet, IEEE Data Center Bridging (DCB), and Unified Fabric technologies such as INCITS Fibre Channel over Ethernet (FCoE) and low-latency Ethernet to reduce costs.

Where applicable, the Cisco Unified Computing System™ provides a comprehensive solution that integrates LAN, SAN, and compute elements into a single system, using IEEE DCB and INCITS FCoE as well as new technologies such as network interface virtualization (NIV), which serves as a precursor to the IEEE 802.1Qbh draft standard for virtualization-aware networking.

In environments with other blade enclosures, customers still can reap the benefits of the abovementioned technologies by allowing the network to provide these intelligent services by transparently connecting the individual blade servers to unified fabric-enabled components such as the Cisco Nexus® 5000 Series Switches and Cisco Nexus 2000 Series Fabric Extenders. This transparent connectivity is achieved through using HP 10GbE Pass-Thru Modules, which do not intrude on policies that are required to be pervasive across the fabric.

Table 1 summarizes the increased capabilities of the Cisco Nexus solution with the HP 10GbE Pass-Thru Module compared to the HP Virtual Connect Flex-10 solution.

Table 1. Network Functionality Comparison

	HP 10GbE Pass-Thru Module with Cisco Nexus	HP Virtual Connect Flex-10
1 and 10 Gigabit Ethernet Support	Yes	Yes
Unified Fabric Support	Yes	Hardware upgrade required
Quality of Service (QoS)	Yes	Egress only
Network Monitoring	Yes	Minimal
In-Service Software Upgrade (ISSU)	Yes	No
Cisco Trusted Security (CTS)	Yes	No
Modular, Fault tolerant Operating System	Yes	No
Comprehensive Layer 2 Feature Set	Yes	No

Solution Overview

The Cisco Nexus 2232PP 10GE Fabric Extender is a second-generation fabric extender supporting 32x10 Gigabit Ethernet server-facing ports and 8x10 Gigabit Ethernet network uplinks. Like the Cisco Nexus 2248TP GE Fabric Extender and the Cisco® UCS 2100 Series Fabric Extenders, the Cisco Nexus 2232PP operates as a remote line card (32x10 Gigabit Ethernet ports) of the Cisco Nexus 5000 Series. The HP 10GbE Pass-Thru Module is an unmanaged device operating within the blade server chassis that offers 1:1 10 Gigabit Ethernet transparent connectivity to each blade server. A pair of Cisco Nexus 5020 Switches in combination with the Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module can then provide secure, intelligent server access switching for up to 320 blade servers and their virtual machines.

The main advantages of the Cisco Nexus 2232PP with HP 10GbE Pass-Thru Module architecture are the removal of managed switching elements within the blade server chassis and the addition of transparency. The reduction in managed switching elements lowers capital expenditures (CapEx) and operating expenses (OpEx) within the blade chassis and enables a more stable server access network. Transparency enables delivery of the Cisco Nexus solution to traditional blade servers and helps ensure support for Unified I/O and server virtualization without the need for costly blade switch upgrades. Adoption of Unified I/O further reduces complexity and cost within the blade server access layer through the removal of Fibre Channel blade switches and host bus adapters (HBAs).

In summary, the Cisco Nexus 2232PP in conjunction with the HP 10GbE Pass-Thru Module delivers a server access architecture that is simpler to manage, more flexible in supporting virtual machine and Unified I/O implementations, and fully capable of delivering the advanced networking capabilities of the Cisco Nexus family of data center-class switches.

Challenges of the Data Center Server Access Layer

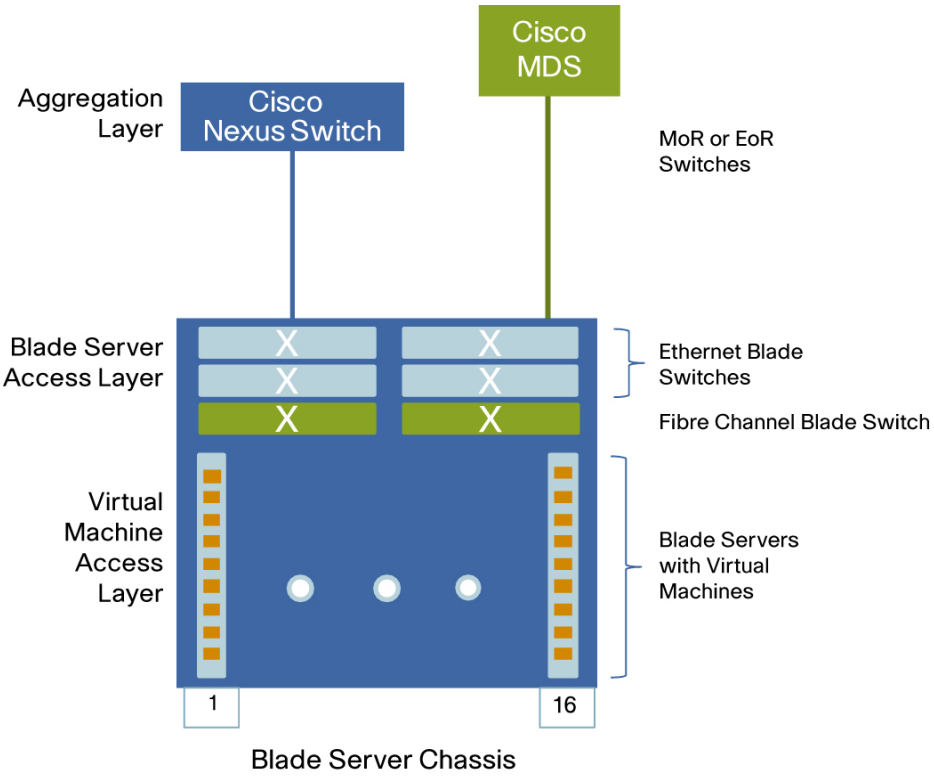
Data centers are becoming more complex as customers move to increase their compute investment and lower their operating costs through the deployment of scale-out architectures based on virtualized, x86 blade servers. While this compute architecture delivers considerable CapEx and OpEx savings, it dramatically increases the complexity of the data center server access. This trend calls for a significant reexamination of the data center server access architecture. The Cisco Nexus 2232PP, aggregating multiple transparent HP 10GbE Pass-Thru Modules, enables an alternative blade server access architecture that alleviates complexity and yields a more manageable data center while retaining many of the advantages of blade servers and server virtualization.

Impact of Blade Servers and Server Virtualization

The data center server access layer has increased in complexity with the addition of blade servers and server virtualization. Prior to the introduction of blade servers, the typical data center access layer consisted of a set of large modular switches, deployed at the end of the row (EoR), aggregating up to 300 servers. Access networking designs incorporating top-of-rack (ToR) fixed switches were required to localize cabling within the rack when supporting more powerful x86 servers with multiple Gigabit Ethernet connections per server.

The use of blade servers to increase server density has expanded the number of switches considerably: from 2 ToR switches per rack to between 4 and 32 switches per rack. The addition of server virtualization has dramatically increased the number of access switches to between 36 and 160 switches per rack. The data center server access layer supporting high-density virtualized blade switches can now consist of a virtual machine access layer and a blade server access layer supported by a middle-of-row (MoR) or EoR aggregation-layer switch (Figure 1).

Figure 1. Server Access Layer for Virtualized Blade Server Deployments



Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module Solution

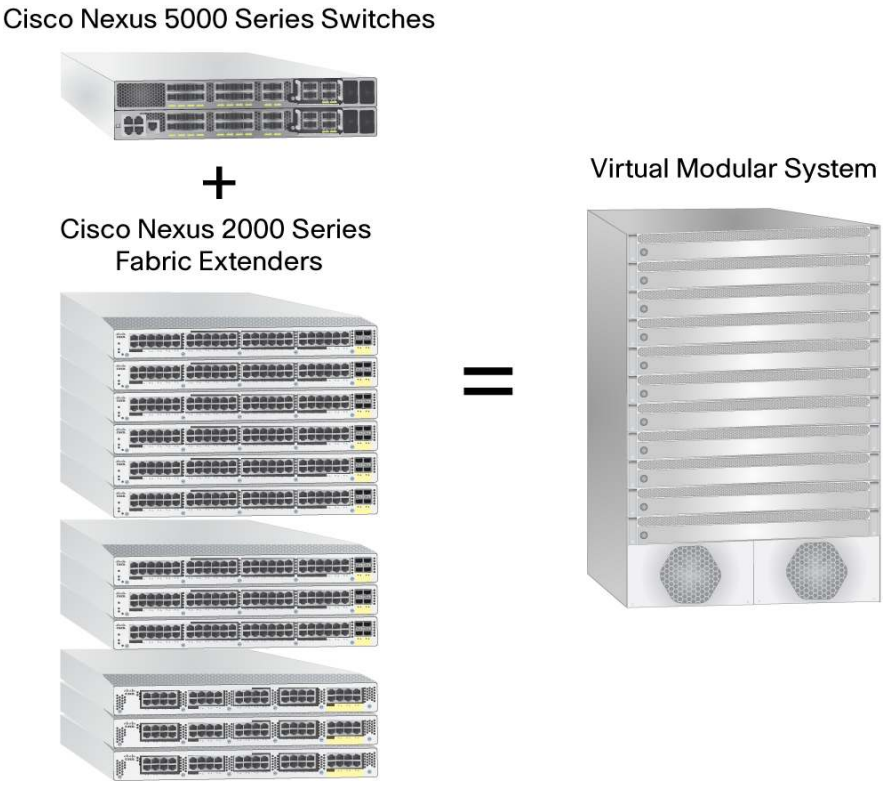
The access design can be simplified in multiple ways: by reducing the number of server access switches through emulation of modular switch architecture, by reducing the need for separate Ethernet and Fibre Channel switches through deployment of lossless 10 Gigabit Ethernet switches, or by a combination of the two. The Cisco Virtual Blade Switching (VBS) capability, Cisco Nexus 1000V Series Switches, and Cisco Nexus 2000 Series Fabric Extenders are examples of solutions for emulating modular switching architecture in the blade access, virtual access, and ToR access layers, respectively.

A VBS system can be created from up to eight Cisco Catalyst® Blade Switches. When the eight switches are cabled together, they form a VBS system that acts as a single switch from a management and network perspective. One of the eight switches is elected master, performing the functions similar to a Cisco Catalyst 6000 Series Supervisor Module, with all eight switches in the system functioning as intelligent line cards. Hence, customers will experience an 8:1 reduction in the number switches, Spanning Tree, and Layer 3 instances to be managed at the blade switch access layer.

The Cisco Nexus 1000V Series has a Virtual Supervisor Module (VSM) that manages up to 64 Virtual Ethernet Modules (VEMs). The VEM resides in the hypervisor and provides local switching to virtual machines running on the same physical server. The VSM can operate as a software appliance on its own virtual machine or as a standalone x86 hardware appliance. The Cisco Nexus 1000V Series therefore enables a 64:1 reduction in the number of switches at the virtual machine access layer.

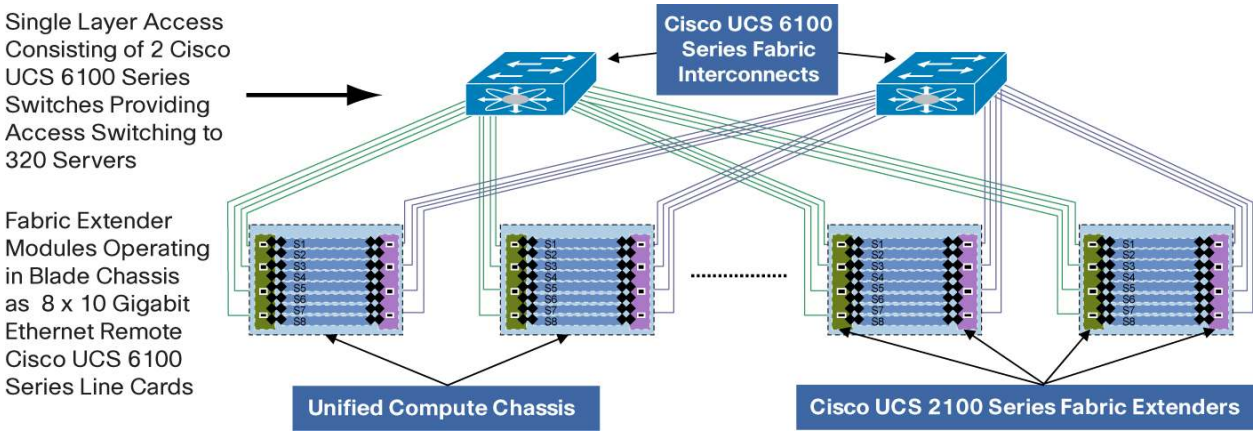
The Cisco Nexus 2148T Fabric Extender acts as a remote line card (48 x Gigabit Ethernet ports) for the Cisco Nexus 5000 Series, extending the switching fabric of the Cisco Nexus 5000 Series to support a sizeable fan-out of Gigabit Ethernet-connected servers depending on the amount of oversubscription desired. By deploying the Cisco Nexus 2148T and the Cisco Nexus 5020 customers, can experience up to a 12:1 reduction in the number of switches to be managed at the ToR access layer. The Cisco Nexus 5000 Series also enable unification of storage and data traffic through support for IEEE DCB and INCITS FCoE standards (Figure 2).

Figure 2. Cisco Nexus 2000 Series Fabric Extenders Behave Like Virtual Line Cards for a Parent Cisco Nexus 5000 Series Switch, Together Forming a Virtual Modular System (VMS)



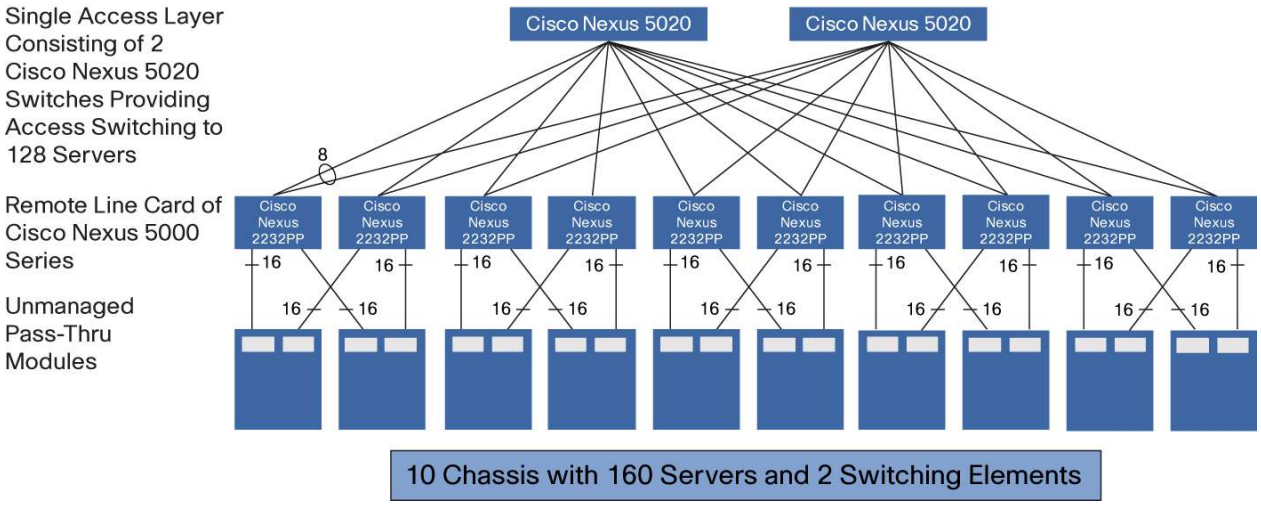
The Cisco Unified Computing System employs a combination of these strategies to reduce server access complexity in a virtualized, blade server compute environment. The Cisco UCS 6100 Series Fabric Interconnects provide lossless 10 Gigabit Ethernet interfaces to the servers with network-facing native Fibre Channel and Ethernet and FCoE ports. The Cisco UCS 2100 Series Fabric Extenders replace traditional blade switches within the Cisco Unified Computing System blade chassis and operate as remote line cards (8 x 10 Gigabit Ethernet ports) of the Cisco UCS 6100 Series. Cisco Unified Computing System network adapters support the aggregation of storage and data traffic over a single 10 Gigabit Ethernet interface as well as the capability to segment traffic from individual virtual machines. The combination of the Cisco UCS 2100 Series and the Cisco Unified Computing System network adapters extends the reach of the Cisco UCS 6100 Series all the way to a virtual machine residing on a Cisco Unified Computing System blade server, removing the need for blade server (Ethernet and Fibre Channel) and virtual machine access layers. Thus, all networking complexity and state is removed from the virtual machine and blade server access layer, enabling a pair of Cisco UCS 6100 Series switches to provide secure, unified access switching to 320 blade servers and their virtual machines (Figure 3).

Figure 3. Cisco Unified Computing System Server Access Design



As in the previous Cisco Unified Computing System example, significant simplification of the data center access layer can be achieved with traditional blade servers through the introduction of the Cisco Nexus 5020, Cisco Nexus 2232PP, and HP 10GbE Pass-Thru Module. The Cisco Nexus 2232PP is a second-generation Fabric Extender supporting 32 x 10 Gigabit Ethernet server-facing ports and 8 x 10 Gigabit Ethernet network uplinks; like the Cisco Nexus 2148T and the Cisco UCS 2100 Series, the Cisco Nexus 2232PP operates as a remote line card (32X 10 Gigabit Ethernet ports) of the Cisco Nexus 5000 Series. The HP 10GbE Pass-Thru Module is an unmanaged device operating within the blade server chassis that offers 1:1 10 Gigabit Ethernet transparent connectivity to each blade server. Using a pair of Cisco Nexus 5020 Series Switches (EoR access layer) in combination with 10 Cisco Nexus 2232PP Fabric Extenders and HP 10GbE Pass-Thru Modules (blade server access layer), the solution provides secure network access switching to 160 blade servers (Figure 4).

Figure 4. Ethernet 10 Gigabit Pass-Thru Topology



Given the transparency of the Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module, this architecture is also particularly well suited to support the unification of storage and network traffic as well as switching between virtual machines. Unified I/O will be supported across the HP 10GbE Pass-Thru Modules, Cisco Nexus 2232PP, and Cisco Nexus 5020 as soon as traditional blade server vendors qualify converged network adapters (CNAs) for their blade servers. Adoption of Unified I/O will significantly reduce the complexity of the blade server access layer through the removal of Fibre Channel blade switches and HBAs.

Virtual machine switching can be accommodated within the Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module architecture today with the Cisco Nexus 1000V Series or when third-party CNAs offer support for Cisco VN-Link technology in hardware (Figure 5 and Table 2).

Figure 5. Pass-Thru Enables Seamless Server Access Migration

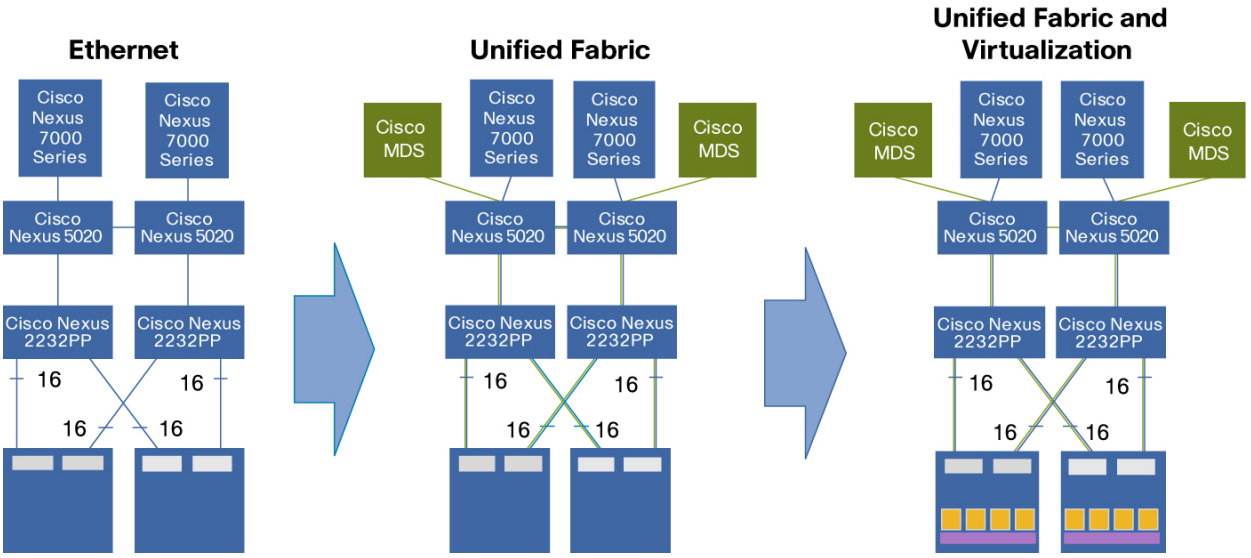


Table 2. Server Access Migration Comparison Between Pass-Thru and Virtual Connect

	HP 10GbE Pass-Thru Module with Cisco Nexus	HP Virtual Connect Flex-10
1 and 10 Gigabit Ethernet Support	Yes	Yes
Unified Fabric Support	Yes	Hardware upgrade required
VNLink SW Support	Yes	Minimal
VNLink HW Support	Yes	Hardware upgrade required

Advantages of Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module Architecture

The Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module architecture offers many advantages over the traditional blade switch or HP Virtual Connect architecture when deploying 10 Gigabit Ethernet to the server. In particular, the transparency of this architecture offers a level of simplicity, flexibility, and advanced networking capability not available in traditional HP Virtual Connect architectures.

Simplicity

The Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module architecture significantly reduces the number of switching elements to be managed (from 22 to 2 in an Ethernet topology and from 36 to 4 in an Unified I/O topology) when compared to traditional blade switch or HP Virtual Connect architecture. Use of a HP 10GbE Pass-Thru Module in a traditional blade server chassis requires no configuration on the part of the server or network administrator because pass-through modules are passive, unmanaged devices. Furthermore, the Cisco Nexus 2232PP is managed through the Cisco Nexus 5020 because the Cisco Nexus 2232PP is acting as a remote line card of this switch (Figure 6 and 7. Table 3).

Figure 6. Fewer Switching Elements: Ethernet Topology

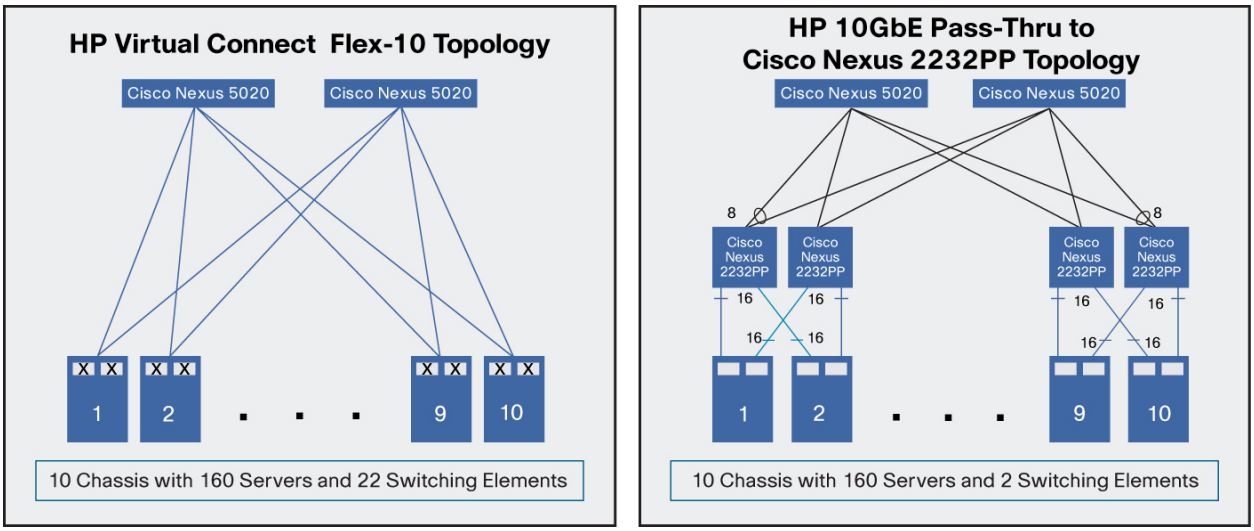


Figure 7. Fewer Switching Elements: Unified I/O Topology

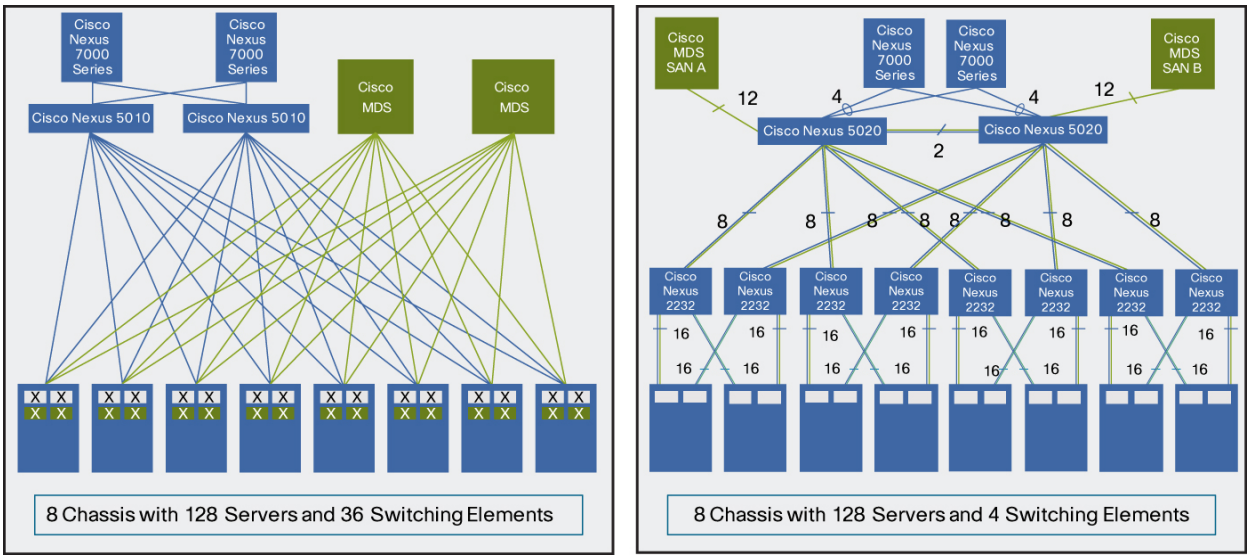


Table 3. Pass-Thru and Virtual Connect Cost Comparison

	Ethernet Switches	Unified Fabric Switches	I/O List Price per Chassis	I/O Power per Chassis
HP 10GbE Pass-Thru Module	2	4	US $9,998*	120 W*
HP Virtual Connect Flex-10	22	36	US $50,396**	240 W

* Assuming Unified Fabric deployment within chassis
** 2 x HP Virtual Connect Flex-10 Modules and 2 x HP Virtual Connect 8G Fibre Channel Modules

The transparency of the Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module architecture provides visibility all the way to the server or virtual machine from the Cisco Nexus 5020. This transparency significantly reduces the complexity of troubleshooting networking problems when data center outages occur and enables the rich set of counters, statistics, MIBs, and debug and troubleshooting commands that the Cisco Nexus 5020 provides to be effectively applied to diagnose and resolve complex networking problems quickly. The Cisco Nexus 5020 advanced troubleshooting tools and capabilities are limited when HP Virtual Connect modules are applied in the blade chassis because HP Virtual Connect blocks visibility to the blade server. Troubleshooting is further complicated by the sparse debug and troubleshooting capabilities of HP Virtual Connect.

In addition, the simplicity of the HP 10GbE Pass-Thru Module removes the need to train server administrators in how to configure, manage, and troubleshoot blade server access networks, simplifying management and clarifying data center server access ownership and responsibility as solely in the network administrator's domain.

Flexibility

The Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module architecture is remarkably flexible in its capability to support a variety of network and server designs. This flexibility is leveraged by the capabilities of the Cisco Nexus 5020 and the transparent nature of the Cisco Nexus 2232 and Pass Through module. The Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module architecture supports pure 10 Gigabit Ethernet connectivity, lossless 10 Gigabit Ethernet, Unified Fabric connectivity, and secure switching between virtual machines through Cisco VN-Link, as well as a combination of these technologies. A customer can deploy the Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module architecture today and accommodate future Unified Fabric and server virtualization requirements without the need for costly upgrades to the blade or ToR server access layer switches (Figure 5 and Table 3).

The Cisco Nexus 5000 Series and Cisco Nexus 2232PP combination has the flexibility to support uniformity across the data center server access network regardless of server form factor. Customers can deploy the Cisco Nexus 2232PP and Cisco Nexus 5020 to provide access services to rack-mount and blade servers across the data center and even within the same server pod. A consistent network design enables uniform operating policy, procedures, and training across the server and network data center teams.

Advanced Networking Capability

The transparent design of the Cisco Nexus 2232PP and HP 10GbE Pass-Thru Module solution enables delivery of the full value of Cisco Nexus switches and Cisco NX-OS Software operating system to traditional blade servers. Crucial elements of the Cisco Nexus solution include a comprehensive Layer 2 feature set that is resilient, secure, and standards based; a modular, multithreaded operating system architecture yielding superior scalability and quick development of new features; advanced Ethernet, IEEE DCB, and device management required to manage and segment multiple traffic types within a Unified Fabric; and data center-class reliability through a modular, fault-tolerant operating system and In-Service Software Upgrade (ISSU) support (Table 1).

Conclusion

The Cisco Nexus 2232PP in conjunction with the HP 10GbE Pass-Thru Module delivers a server access architecture that is simpler to manage than previous solutions, more flexible in supporting virtual machine and Unified I/O implementations, and fully capable of delivering the advanced networking capabilities of the Cisco Nexus family of data center-class switches.

For More Information

Cisco Nexus 2000 Series Fabric Extenders: http://www.cisco.com/go/nexus2000

Cisco Nexus 5000 Series Switches: http://www.cisco.com/go/nexus5000

Cisco Unified Computing System: http://www.cisco.com/go/unifiedcomputing

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