

Solution Overview

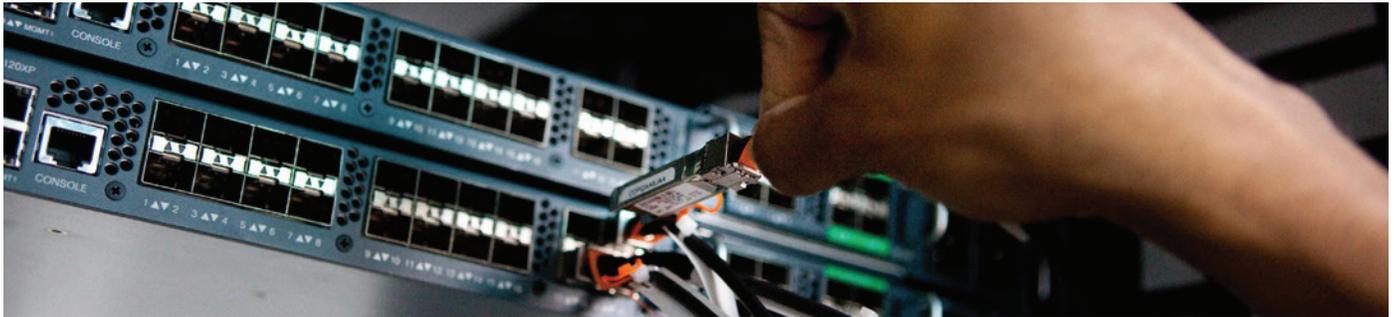
Cisco
SingleConnect
Technology:
Simplify Server
Connectivity

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Cisco SingleConnect Technology: Simplify Server Connectivity

Solution Overview
August 2013



The Challenge

Today's data center networks are burdened by unnecessary complexity that increases cost and reduces data center performance and agility. As processor power and the number of cores per CPU continue to increase, applications have become starved for I/O bandwidth. Separate physical network links for every type of data in a rack partition bandwidth, limit sharing, reduce available bandwidth, and reduce ROI. Traditional blade servers reproduce a rack's worth of complexity in each chassis, compounding the complexity by the number of chassis in a rack. Cabling and network configuration is manual, tedious, and error prone. After they are dedicated to a task, servers rarely leave their infrastructure silos, so the cost of reinstalling I/O interfaces, managing error-prone configurations, and recabling racks prohibits repurposing of resources. The resulting silos reduce utilization and flexibility. Virtualized workloads increase the challenge because traditional I/O infrastructure is not prepared for the rapidly changing network demands and virtual server movement that typify virtualized and cloud computing environments.

The Solution: Cisco SingleConnect Technology

Cisco® SingleConnect technology provides an exceptionally easy, intelligent, and efficient way to connect and manage computing in the data center. Cisco SingleConnect technology is an exclusive Cisco innovation that dramatically simplifies the way that data centers connect to:

- Rack and blade servers
- Physical servers and virtual machines
- LAN, SAN, and management networks

The solution addresses the challenges of today's data center, and the result is a simple, intelligent, and efficient fabric:

- **Easy:** Cisco SingleConnect technology provides a “wire once and walk away” solution that eliminates traditional manual, time-consuming, error-prone

processes and instead makes connecting servers to the Cisco Unified Computing System™ (Cisco UCS®) fast and easy.

- **Intelligent:** the technology is intelligent because it uses a zero-touch model to allocate I/O connectivity (LAN, SAN, and management) across any type of server: physical rack and blade servers and virtual machines. The network intelligence helps Cisco UCS adapt to the needs of applications. Rather than limiting applications to specific servers, Cisco UCS makes it easy to run any workload on any server.
- **Efficient:** the technology is highly efficient because LAN, SAN, and management connections are shared over a single network, increasing utilization while reducing the number of moving parts compared to traditional approaches with multiple networks.

Cisco SingleConnect technology increases economic and organization efficiency through automation and radical simplification. It dramatically reduces infrastructure cost per server, simplifies management, and reduces complexity.

Cisco SingleConnect technology is implemented with an end-to-end system I/O architecture that uses Cisco Unified Fabric and Cisco Fabric Extender Technology (FEX Technology) to connect every Cisco UCS component with a single network and a single network layer. As customers expect from Cisco, the Cisco UCS I/O architecture is based on open standards and is reliable, available, and secure.

Single Unified Network

The same network brings LAN, SAN, and management connectivity to each rack and blade server in Cisco UCS using Cisco Unified Fabric. Now every server—rack or blade—has equal access to all network resources, eliminating the need to support three physical networks, each with its own network interface cards (NICs), host bus adapters (HBAs), transceivers, cables, and top-of-rack switches. Infrastructure silos are eliminated because software—not cabling—determines how each server connects to the network, making every server ready to support any workload at a moment's notice through automated configuration.

Single Network Layer

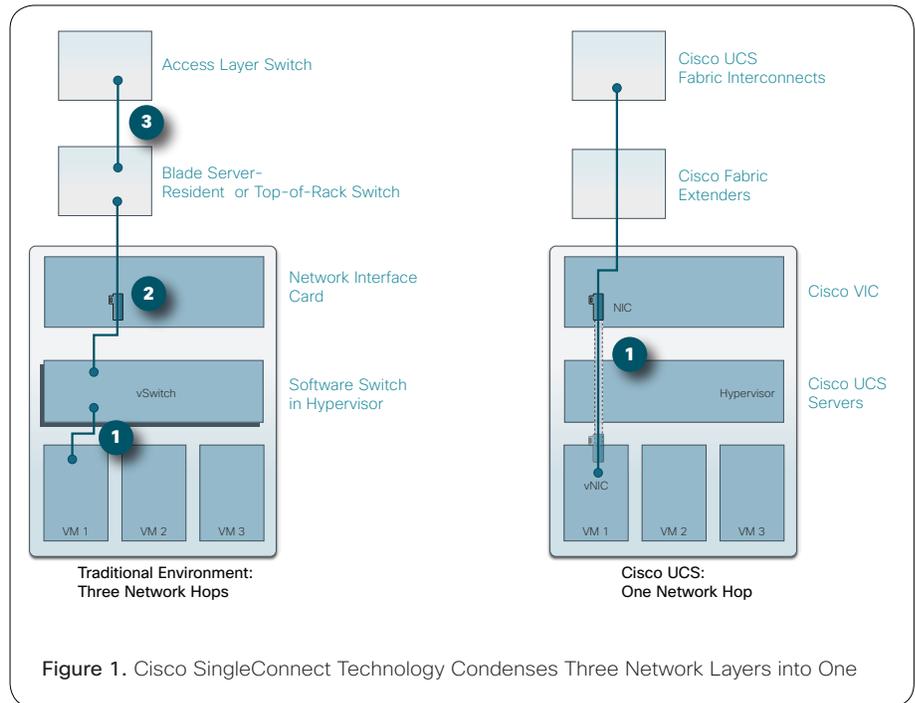
A single network layer brings the unified fabric to every blade chassis and server rack. Cisco FEX Technology reduces three network layers to one, eliminating hypervisor switches and blade-chassis-resident switches and replacing them with a single point of management and connectivity (Figure 1). In Cisco UCS, low-cost, low-power, and zero-management Cisco UCS and Cisco Nexus® fabric extenders pass all traffic from servers and virtual machines to the system's fabric interconnects. This approach reduces infrastructure cost per server and interconnects servers with a single hop, in contrast to the multiple hops and higher latency inherent in traditional environments. The combination of the system's fabric interconnects, fabric extenders, and Cisco UCS virtual interface cards (VICs) establishes a centrally managed yet physically distributed system that can contain both blade and rack servers.

Connecting to Physical Servers and Virtual Machines

Cisco VICs directly connect the network to physical rack and blade servers and virtual machines. Static PCI Express (PCIe) interfaces are configured on demand

Cisco SingleConnect
Technology Condenses Three
Networks into One





to adapt servers to meet the best-practices needs of any operating system or hypervisor, providing the NICs and HBAs they need without requiring any special driver software. Dynamic interfaces are configured and attached to virtual machines, giving them direct access to the network. After they are attached, a virtual machine’s network interfaces migrate from server to server along with the virtual machine, simplifying virtual network management and providing air-gap security to virtual environments. This Cisco Data Center Virtual Machine Fabric Extender (VM-FEX) technology coordinates the movement of virtual network connectivity in concert with the leading hypervisors.

Based on Open Standards and Accelerated by Silicon

Cisco SingleConnect technology uses existing open standards (such as Fibre Channel over Ethernet [FCoE]) and promotes new ones as necessary (such as the IEEE 802.1BR Bridge Port Extension standard). Cisco embodies these innovations in silicon to increase performance (Figure 2). Customers gain the functional benefits of open-standard innovations with the improved performance that hardware implementations deliver.

The implications of the Cisco UCS I/O architecture are profound. The system is logically centralized with a single point of management for all I/O in the system: network, storage, and management. The system is physically distributed so that a single management domain can span both blade server chassis and racks, bringing up to 160 servers into what can be viewed as a single logical blade server chassis. The result is dramatically reduced cost and complexity compared to traditional rack and blade server deployments (Figure 3).

Advanced technology such as multihop FCoE and Cisco Direct Connect technology gives organizations the flexibility to integrate servers with shared storage as

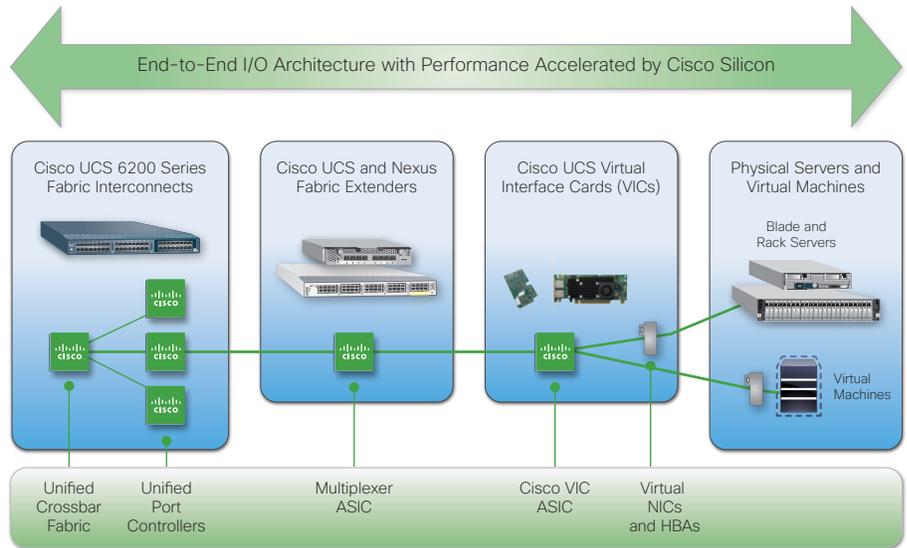


Figure 2. Cisco Embraced and Created New Open Standards, Accelerating Performance Through Custom Silicon

business needs dictate, without the limits of traditional network. Open standards-based separation between Ethernet traffic lanes helps ensure lossless handling of FCoE storage traffic and secure separation from other traffic types.

This graph compares the 3-year TCO for 80 HP ProLiant DL380p Gen8 Servers and 80 HP BL460c G8 servers with the 3-year TCO for 80 Cisco UCS C240 M3 Rack Servers and 80 Cisco UCS B200 M3 Blade Servers. Each server has two Intel Xeon processor E5-2609 CPUs and 64 GB of memory. HP networking includes two 10 Gigabit Ethernet and two 8-Gbps Fibre Channel connections for the HP rack servers, plus HP FlexFabric modules in the HP blade chassis. The Cisco solution includes the Cisco VIC 1225 dual-port 10-Gbps unified fabric adapter for Cisco rack servers and Cisco VIC 1240 for Cisco blade servers, plus corresponding switches. Pricing is as of August 8, 2013.

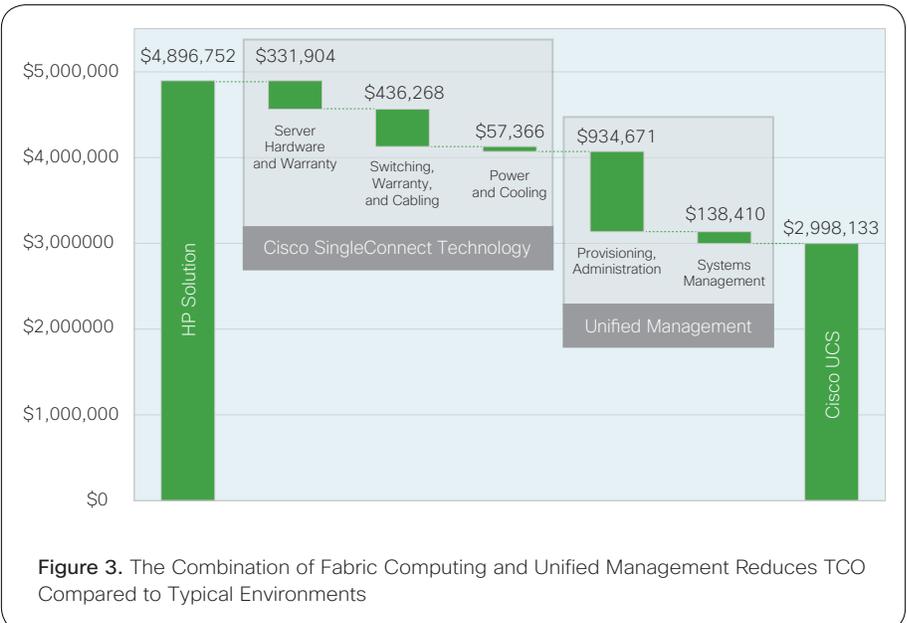


Figure 3. The Combination of Fabric Computing and Unified Management Reduces TCO Compared to Typical Environments

Intelligence Makes the Fabric a Strategic Asset

Cisco SingleConnect technology combined with Cisco Unified Management makes the network fabric a strategic asset. The approach of using a single fabric to interconnect multiple systems to support all I/O modalities places Cisco UCS as the first in a class that Gartner Group refers to as “fabric computing.”

The flexible, agile I/O infrastructure integrated into Cisco UCS lets organizations move more quickly than their competitors by responding instantly to changing workload conditions and business priorities. With policy-based automation accelerating configuration and helping ensure consistency, the network becomes a strategic asset to business organizations.

Wire-Once Model

The Cisco Unified Fabric uses a wire-once model in which IT departments configure Cisco UCS for the level of desired capacity at deployment time. After configuration, all I/O resource allocation within that capacity is controlled through software, resulting in zero-touch, instant server and I/O configuration that increases business agility, increases capital utilization, and reduces capital and operating costs. Time to value is shortened through more rapid deployment.

Flexible Pool of Resources

Intelligent networking brings the server and I/O resources of Cisco UCS together as a flexible pool of resources that can be applied on demand to meet any workload challenge. Workload silos are a thing of the past because server power and I/O connectivity can be allocated instantly and accurately through software. Now processes such as tasks to meet a transient workload spike, scale an enterprise application, replace a failed server, increase the size of a big data cluster, and elastically grow or shrink a private cloud can be accomplished without the need for human intervention. With pooled computing and I/O resources, utilization increases due to the dynamic sharing among all types of I/O, all controlled through flow control and quality-of-service (QoS) mechanisms.

Application-Centric Configuration

In Cisco UCS, the system adapts to the needs of applications, in contrast to systems in which applications run only on servers that have been designed to support them. Consider a hypervisor whose best practices dictate Fibre Channel access to shared storage, a separate network for management, another network for virtual machine movement, and multiple networks for production LAN traffic. Cisco SingleConnect technology can create a pair of Fibre Channel HBAs and separate NICs for each separate LAN, all in moments before the hypervisor is booted.

After they are created, network profiles dictate security and QoS policy for each separate network. For example, a web server may need to have access to a specific VLAN, a characteristic that can be enforced through policy-based automation. Voice traffic may require a higher class of service, for example, than web traffic, and these characteristics can be set through network profiles.

Intelligent Failover for High Availability

Cisco UCS is typically configured with a resilient network consisting of two separate fabrics supported by two fabric interconnects. This standard configuration supports

active-active links, increasing asset utilization and reducing total cost of ownership (TCO). With two fabrics plus the automated fabric failover supported by Cisco VICs, even the failure of an entire fabric will not bring down the system's I/O infrastructure, helping organizations provide uninterrupted access to enterprise applications

Solving Problems with Virtual Networks

Cisco SingleConnect technology treats physical servers and virtual machines in the same way. In Cisco UCS, every I/O connection, whether for networking, storage access, or management, is virtual. Every network link originates in the fabric interconnects and is brought to each blade server, rack server, and virtual machine through Cisco FEX Technology (Figure 4). So, for example, if a web server or voice application is run in a virtual machine, dynamically created NICs can attach to the virtual machine with the right security and QoS settings established for the duration of the virtual machine's lifecycle

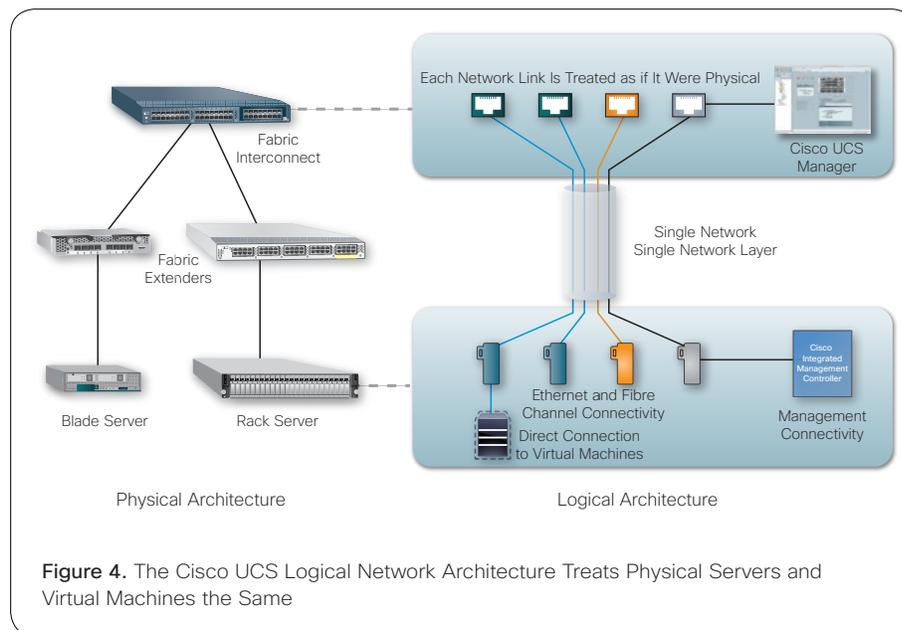


Figure 4. The Cisco UCS Logical Network Architecture Treats Physical Servers and Virtual Machines the Same

Improving Manageability

For business organizations struggling to manage virtualized environments, the visibility into the network and control over connectivity provided by Cisco SingleConnect technology offers much-needed benefits. Cisco Unified Fabric combines the manageability of the physical network with the scalability of the virtual network and allows smooth connectivity between physical and virtual servers.

Putting Networks under Network Administrator Control

In contrast to traditional environments, Cisco UCS places the network under network administrator control because blade-chassis and hypervisor switches that would otherwise fragment the access layer and add management confusion are unnecessary. Network profiles that dictate security and QoS settings for virtual

machines move along with the virtual machines as a result of tight integration with the leading hypervisors.

Easy Debugging

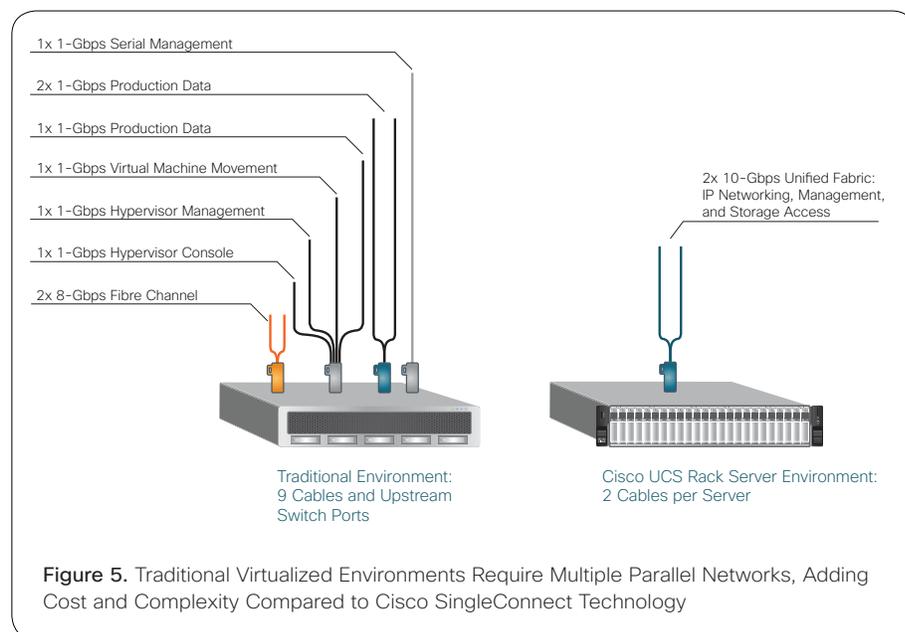
With Cisco SingleConnect technology, administrators can use the same techniques to debug problems as they always have: if a runaway virtual machine begins consuming bandwidth unnecessarily, its port can be identified and turned off just as if it were connected by a physical cable. In traditional virtualized environments, the virtual machines on a server must be evacuated one by one until the one causing the problem is revealed. The benefit of the Cisco approach is massive scalability with lower operating costs.

Simplified Connections Between Physical and Virtual

With smooth integration of the physical and virtual resources in Cisco UCS, organizations no longer need to struggle with interconnection of the two environments. Now organizations have the flexibility to host application components on physical servers or virtual machines without having to handle the network connections to each environment differently. Because physical and virtual resources are the same in Cisco UCS, virtual machines are protected by the same level of security as physical components.

One Cisco VIC Supports All Hypervisor Functions

Cisco SingleConnect technology dramatically simplifies hypervisor support compared to traditional environments. With the combination of Cisco Fabric and Cisco VICs, every interface required by hypervisor deployment best practices can be supported in a single device along with physical connectivity to each virtual machine (Figure 5). With direct connections between the physical network and virtual machines, performance is better than in traditional environments with hypervisor switches.

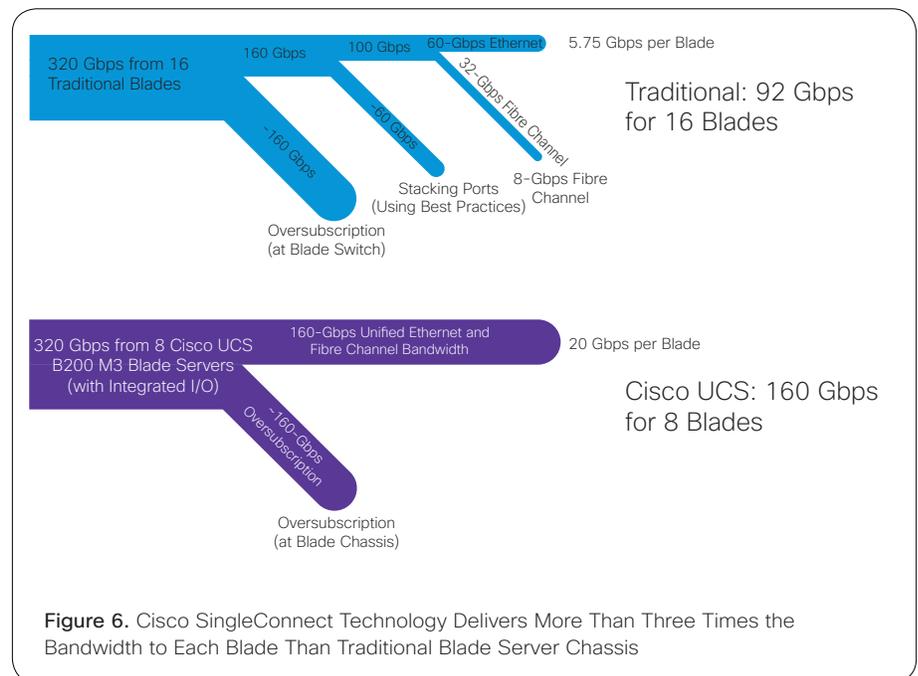


Better Performance

Cisco SingleConnect technology is responsible for increased network bandwidth, accelerating activities such as the movement of virtual machines between servers, and for lower network latency, helping accelerate transactional applications. This better network is one reason that Cisco has set more than 70 world records on industry-standard benchmarks for scenarios ranging from enterprise applications and databases to virtualized and cloud computing environments.

Industry-Leading Bandwidth

Cisco UCS makes more network bandwidth available to its blade servers than does any other solution. With up to 80 Gbps of network bandwidth available to each half-width blade server, and 160 Gbps available to each full-width blade server, more raw I/O resources are available to meet peak workload demands. Cisco SingleConnect technology supports dynamic allocation of network bandwidth, so bandwidth is not fragmented between IP, storage, and stacking connections. Each blade server chassis supports up to 160 Gbps of bandwidth when connected to two fabric interconnects (Figure 6).



More of this bandwidth is available to deliver better application performance than with competing solutions:

- When Cisco measured the time needed to move a virtual machine between servers, Cisco UCS performed better than the leading traditional environments.
- Virtual machines achieve higher bandwidth through the use of Cisco Data Center VM-FEX technology available with Cisco VICs. By directly connecting virtual machines to the network, the virtual machines experience up to 37 percent more bandwidth than with switch emulation using a VMware vSwitch.

- Cisco VICs connect to up to 40 Gbps of network bandwidth in Cisco blade servers, and hardware PortChannels balance the workload across the four 10-Gbps backplane connections, helping increase bandwidth and resource utilization.

Lower Latency to Accelerate Transactional Applications

With a single logically centralized yet physically distributed network, the Cisco solution requires only a single network hop and offers consistent latency. With Cisco UCS, traffic between any two rack or blade servers requires only one network hop (see paths A and X in Figure 7). With traditional environments, intrachassis communication requires only one hop, but communication between chassis or between blade and rack servers requires three hops (see path Y in Figure 7).

For More Information

See the following performance briefs:

- [Cisco UCS Outperforms HP Blade Servers on East-West Latency](#)
- [Cisco UCS Outperforms IBM Flex System Blades on East-West Network Latency](#)

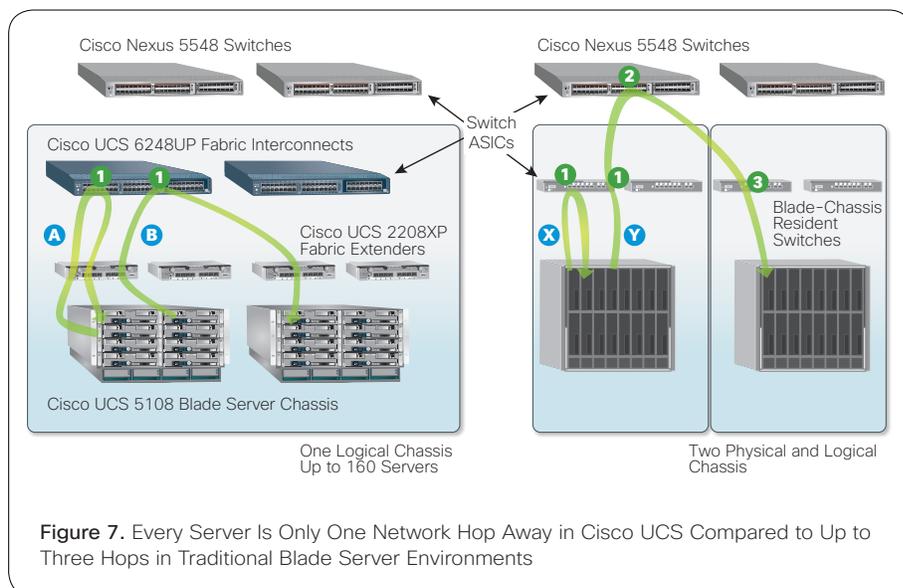


Figure 7. Every Server Is Only One Network Hop Away in Cisco UCS Compared to Up to Three Hops in Traditional Blade Server Environments

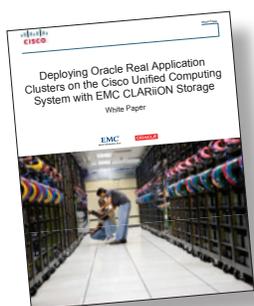
When Cisco measured Cisco UCS network latency compared to latency in traditional environments, Cisco UCS presented lower latency for traffic within a single blade chassis and between chassis for all packet sizes tested. This superior performance makes the network a strategic advantage, accelerating transactional application performance and freeing organizations to place virtual machines anywhere in a cluster with the assurance of consistent latency for communication between them.

Compliance Increases Security

In Cisco UCS Manager, Cisco UCS service profiles enable subject-matter experts to establish policy-based control over connectivity decisions, helping ensure compliance with data center best practices and regulatory requirements. With every aspect of a server's personality, configuration, and connectivity abstracted into a Cisco UCS service profile, creating a noncompliant configuration is nearly impossible. If a system cannot be configured in compliance with a Cisco UCS service profile, the system's unified management will not apply the configuration.

Security for Oracle Real Application Clusters (RAC)

The security of Cisco Unified Fabric convinced Oracle to give Cisco UCS the first Oracle RAC certification using a unified fabric. Cisco demonstrated the degree to which database state synchronization traffic can be separated from production data traffic, helping ensure the security of customer data when using Cisco UCS.



Compliance with Air-Gap Security

Better compliance means better security, and many layers of security are also built into the Cisco UCS unified fabric. Different classes of traffic are prioritized using the IEEE 802.1Qaz Enhanced Transmission Selection standard; for example, management traffic has its own traffic class and is given the highest priority so that unified management can still function during even the most adverse traffic conditions. Individual virtual links are isolated using the IEEE 802.1BR Bridge Port Extension standard that makes every network link in the system as secure as if it were on a separate wire. These features bring air-gap security to both physical and virtual environments, applying the intelligence of the physical network to increase the security of virtual machine I/O.

Virtualized Environments Secured

Traditional virtualized environments struggle to balance flexibility and security, often relinquishing some security so that administrators can move virtual machines anywhere within a virtualization cluster for workload optimization. Cisco UCS eliminates the need to make trade-offs because there is no difference between physical and virtual networks: both are implemented in hardware and have the same level of visibility, control, and security.

With Cisco FEX Technology and Cisco Data Center VM-FEX, individual hypervisor functions and virtual machines can be directly connected to the fabric interconnects as if they were connected by a dedicated wire. Increasing security even more, the direct connections are maintained for the life of a virtual machine, so network security policies remain constant regardless of the virtual machine's location (Figure 8).

Lower Capital and Operating Costs

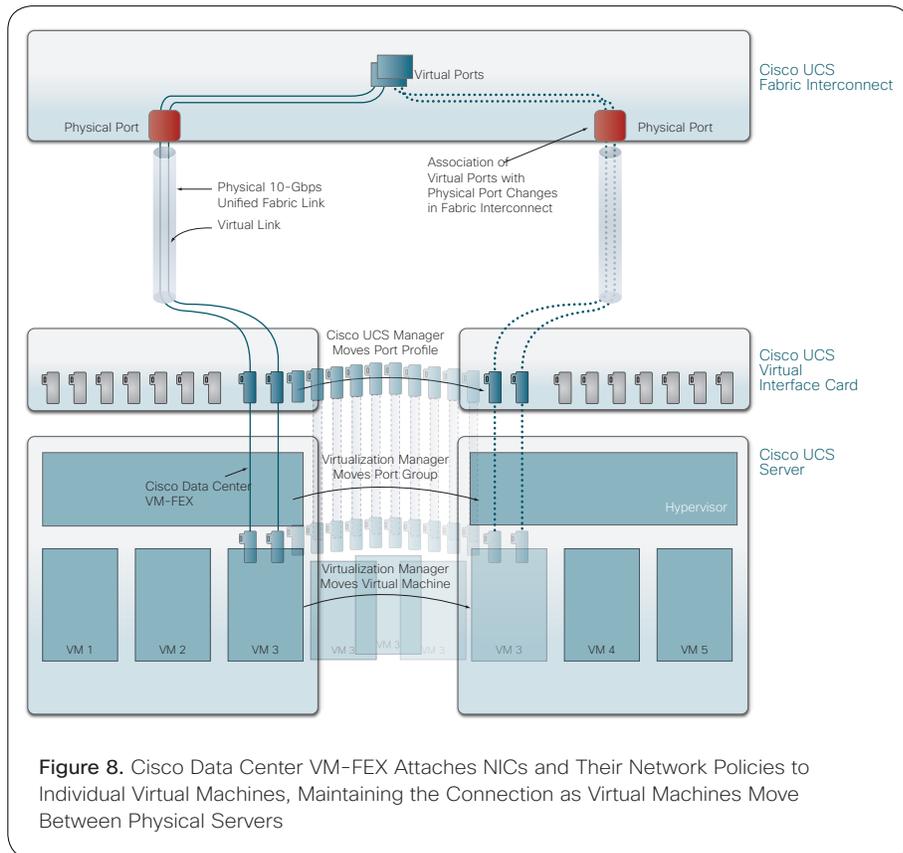
Cisco SingleConnect technology brings lower capital and operating costs to organizations using Cisco UCS C-Series Rack Servers and Cisco UCS B-Series Blade Servers.

Lower Infrastructure Cost per Server

Cisco UCS replaces top-of-rack switches and blade-chassis-resident switches with low-cost, zero-touch, low-power-consuming fabric extenders that bring Cisco Unified Fabric to each blade chassis and to each server in a rack. This simplified infrastructure results in less infrastructure cost per server compared to both blade and rack servers in traditional configurations.

A single network and a single network layer means fewer NICs and HBAs, fewer cables and transceivers, fewer upstream switch ports, and overall fewer devices to purchase, configure, maintain, manage, power, cool, and secure. Fewer servers are needed to meet workload demands because the servers are part of a single pool of resources that can be allocated dynamically.

Through Cisco UCS service profiles, servers can be repurposed multiple times per day if necessary to help IT departments better meet the needs of rapidly changing workload conditions. This approach leads to greater resource utilization, lower power consumption, and an IT department that can adapt to changing business needs in minutes.



Simplified Operation Model

Cisco SingleConnect technology simplifies operations and results in lower costs and faster time to value.

The wire-once philosophy allows all servers access to the same resources, giving organizations the flexibility to make real-time decisions about workload allocation. For example, with Cisco Unified Fabric supporting FCoE, any server can have access to Fibre Channel-based shared storage simply by dynamically configuring an HBA to appear in a Cisco VIC; there is no longer a per-server expense to support Fibre Channel storage, and no human intervention is required. Even the implementation of the Cisco VIC simplifies operations. The Cisco VIC presents true PCIe standard-compliant interfaces to the operating system and hypervisor, eliminating the need to support special SR-IOV drivers in the operating system.

Operations are further simplified because a single network directly connects rack servers and blade servers in the same management domain. Now rack servers hosting bare-metal applications such as big data can be managed in exactly the same way as the blade servers that host enterprise applications. All data center applications can be hosted on the same low-latency network that swiftly moves data between business applications, shortening the time from insight to decision.

Conclusion

Cisco SingleConnect technology provides an exceptionally easy, intelligent, and efficient way to connect and manage computing in the data center. With Cisco SingleConnect technology, the network becomes a strategic asset. Cisco Unified Fabric and Cisco FEX Technology unite rack servers, blade servers, and virtual machines as equals, increasing business agility and solving the problems entailed in hosting and interconnecting virtualized and cloud computing environments with enterprise applications and a new class of bare-metal applications, including big data.

Cisco SingleConnect technology is implemented with radical simplicity, interconnecting up to 160 blade and rack servers as a single entity. Rather than replicating the complexity of I/O configuration for every rack and blade chassis, Cisco UCS condenses the complexity to a single point of interconnection and management for the entire system.

Dynamic and agile capacity allocation uses a wire-once model that provides uniform access to all types of I/O—network, storage, and management—while allowing just-in-time configuration of server connectivity that eliminates infrastructure silos. Cisco UCS is application centric, adapting to applications so they can run on almost any resources, rather than expecting applications to adapt to different server configurations.

Cisco SingleConnect technology is intelligent, simple, and easy to deploy, helping organizations everywhere deploy and scale business applications more rapidly, respond to demanding workloads with better transactional response, and reduce both capital and operating costs through reduced and unified infrastructure and the automation of unified management.

For More Information

- For more information about Cisco UCS, please visit <http://www.cisco.com/go/ucs>.
- For more information about Cisco FEX technology, please visit <http://www.cisco.com/go/fex>.
- For more information about Cisco Data Center VM-FEX, please visit <http://www.cisco.com/go/vmfex>.
- For more information about Cisco UCS systems management, please visit http://www.cisco.com/en/US/prod/ps10265/cisco_ucs_management.html.



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