Cisco UCS and HP BladeSystem: A Comparison
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Imagine your IT department adapting easily to rapidly changing business needs. In contrast to vendors of traditional approaches, we deliver a state-of-the-art architecture that makes your dream a reality.

What You Will Learn

Cisco Unified Computing System™ (Cisco UCS®) is more than a traditional blade solution. Unbound from traditional products and thinking, Cisco UCS is the first truly unified data center platform that combines industry-standard, x86-architecture servers with networking and storage access into a single system. This radically simplified solution is intelligent infrastructure that is automatically configured through integrated, model-based management to accelerate deployment of all your enterprise-class applications and services running in bare-metal, virtualized, and cloud-computing environments.

Traditional blade architectures—such as the HP BladeSystem—originally evolved from the idea of repackaging rack servers and switching into a smaller form factor. As density and performance increased, so did complexity. As a result, these traditional blade solutions have failed to deliver the promised consolidation. Cisco revolutionized blade servers through the unification of networking and management fabrics and delivers on the original vision of true consolidation of resources, time, and energy. This document shows you how.

Chassis Compromises

The problem with traditional blades and with the HP BladeSystem architecture begins with the blade chassis itself. Rack-in-a-box blade architecture takes all
the complexity of a rack (top-of-rack (ToR) switches, management modules, etc.) and squeezes it into every blade chassis. When you replicate this complexity multiple times per rack, you get even more complexity. In fact, you get far more complexity than a rack full of traditional servers with ToR switches. The HP BladeSystem architecture turns each chassis into an individual island that doesn’t allow bandwidth to be shared outside each chassis. Changing applications or scaling resources requires you to reconsider the way that all components in the chassis are connected. Customers must determine when a new HP Virtual Connect module is necessary, what kind of I/O adapters are used on each affected blade, and whether or not recabling is required. Changing networking modules or updating blades to take advantage of new Intel architecture requires administrators to continually rethink and manage each island. HP’s aging architecture limits flexibility and innovation in several ways:

- Multiple local management modules are necessary and an external software overlay is required to present these individual components under a common interface sold at additional cost.
- Multiple internal switching devices are necessary to connect each chassis to the outside world. This dependency, results in 2 switches for every 16 blades, or 1 switch for every 8 blades.
- Support for modern memory footprints is limited. HP blade servers do not have as many DIMM slots as Cisco UCS blade servers. Today, HP has a maximum of 16 DIMM slots compared to 24 DIMM slots in Cisco UCS blade servers.

Support for the full range of Intel® Xeon® processors is limited. Even with some Intel Xeon processor E5-2600 family CPUs, HP blades can use only 12 DIMMs instead of the full 16. HP supports the newest and fastest Intel Xeon processor E7-4890 v2 and E7-8893 v2 running at 155 watts (W) in the HP DL580 rack server but not in any of its blade servers, limiting performance and choice. When we developed Cisco UCS, we took an approach that solved these problems. By simplifying the chassis with unified fabric and Cisco® fabric extender technology, we removed the complexity and touchpoints, providing an architecture ready for future technology generations. The Cisco UCS chassis:

- **Has no management modules**: Cisco UCS was designed from the beginning using a model-based unified management architecture that is fully redundant; has revolutionary Cisco UCS service profiles for immediate, secure reconfiguration; and adapts to changes in the environment, including accommodation of multiple blade generations and types.

- **Has no switching in the chassis**: Each chassis incorporates zero-management, low-power fabric extenders that simply forward all blade traffic to the system’s fabric interconnects, and do so faster and more efficiently than switches do.

- **Enables incremental scalability**: Cisco UCS eliminates the “seventeenth blade server” problem, in which lots of expensive infrastructure must be purchased to support one more blade server than a single HP chassis holds. Instead of a 16-blade domain as in HP’s system, Cisco UCS allows hundreds of blades per domain.

- **Avoids network and management complexity**: Cisco UCS allows greater flexibility, scalability, and generational growth, based on application needs.
The result is lower infrastructure cost per server (Figure 1).

**Cisco Unified Fabric**

Cisco UCS is the only integrated system that reduces the number of hardware components and combines both blade and rack servers on a single unified fabric and management domain (Figure 2). Our approach eliminates management and networking devices in every chassis, reducing the cost of powering, cooling, configuring, managing, monitoring, and maintaining the infrastructure. Cisco UCS places all management functions and configuration information in the fully redundant and highly available Cisco UCS Manager. Cisco unified fabric, with its wire-once capability, helps you scale data centers easily, quickly, and efficiently without requiring a reevaluation of networking infrastructure every time you add new servers. With Cisco UCS, the network is established once, with no changes necessary as it scales to 160 servers per domain (or multiple domains of up to 10,000 servers). Through aggregation of management and connectivity in the fabric interconnects, every server in the domain is automatically connected northbound to the LAN or SAN without time-consuming and risky reconfiguration at the chassis and server levels.

**Dynamic Sharing**

HP BladeSystem architecture with HP Virtual Connect is more expensive and more complex than Cisco UCS and limits networking and scaling flexibility. HP’s minimum redundant configuration requires customers to purchase a pair of networking switches for every chassis. Without the capability for each chassis to share I/O bandwidth, customers are forced to over provision and over purchase hardware and

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*This graph is based on the Cisco UCS manufacturer’s suggested retail price (MSRP) and HP retail price obtained from hp.com on September 25, 2014.*
port licenses every time they add another 16 blades. Customers must purchase,
configure, maintain, power, and cool one switch for every 8 blades (two HP Virtual
Connect modules per chassis).

Unlike HP’s network, in which bandwidth choices are made at deployment time and
cannot be reconfigured without recabling the network, the Cisco UCS network is
unified and bandwidth is shared dynamically. This approach provides more effective
use of bandwidth and more headroom in the event that the application requires
bandwidth from other modalities. Cisco UCS uses quality-of-service (QoS) controls
to assign bandwidth priorities, and it enables your applications to dictate connectivity
and bandwidth.

For example, Figure 3 shows three types of traffic: virtual machine movement
(green), SAN (yellow), and LAN (blue). Suppose the total available bandwidth is
10 Gbps, and you placed a bandwidth guarantee of 3 Gbps on both the LAN and
SAN and 2 Gbps for virtual machine movement traffic. If each modality offers 3
Gbps of actual traffic, the bandwidth allocation would look like time-step one (t1) in
Figure 3, giving you a spare 1 Gbps. If the LAN has a burst of traffic to 4 Gbps as
shown in time t2 and the bandwidth is available, LAN traffic will be allowed to use
that bandwidth. Time t3 shows a burst of 6 Gbps of LAN traffic. Because the SAN
is using only 2 Gbps of its allocated bandwidth, the LAN traffic is allowed to use 6
Gbps because it can “borrow” unused bandwidth from the SAN.
Deterministic Latency

Cisco UCS unified fabric makes latency consistent and faster. Cisco UCS fabric interconnects centrally manage network traffic within Cisco UCS as well as the traffic in and out of the system. For traffic that is moving from one chassis to another in the same Cisco UCS domain, there is no need to exit the system and send packets through another external switch (see path A in Figure 4). This central connectivity demonstrates one of the ways in which Cisco UCS functions as a single virtual chassis and provides the flexibility to place workloads anywhere in the system with assurance of consistent network performance.

This capability is important because it simplifies placement of virtual machines in virtualized and cloud environments: regardless of location, virtual machines experience the same latency, removing the network as a placement constraint. When trying to reduce latency between servers, the best-case scenario for any vendor is a single network hop for data communicated between servers within the same chassis. The worst-case scenario is three network hops required to move data between servers in different chassis. With HP BladeSystem, traffic between each chassis must first travel through the local HP Virtual Connect modules, through an external ToR switch, and back through the second chassis’ HP Virtual Connect module, resulting in three network hops and greater latency. Although HP refers to Virtual Connect as a module, it contains a switch application-specific integrated circuit (ASIC) that performs switching functions. Therefore, it is a switch.

Actual east–west traffic tests of these identically configured systems show that:

- The **HP BladeSystem c7000 with Virtual Connect** has between 31 and 70 percent more latency than **Cisco UCS**. Cisco UCS demonstrated lower latency than the HP BladeSystem c7000 with Virtual Connect for every test case and every packet size (User Datagram Protocol [UDP], TCP, and TCP round-trip times).
- As packet sizes increased in each test, the HP BladeSystem c7000 with Virtual Connect disadvantage also increased compared to Cisco UCS.
Performance is almost identical for both single-chassis tests and multichassis tests for Cisco UCS. With the HP BladeSystem c7000 with Virtual Connect, after traffic leaves the chassis, latency increases dramatically.

Cisco remains the leader in ASIC and network design optimization for the end-to-end network stack, enabling business applications and virtual environments to perform better.

Better Availability and Better Flexibility

Cisco UCS not only provides an active-active data fabric out of the box, but it also provides a fully redundant unified management subsystem.

HP’s I/O subsystem is compromised by a traditional design that is made to be consistent with HP’s previous products. As with other similar designs, HP blade server I/O connections are fixed and physically mapped in the midplane and cannot be modified in any way. For example, HP network interface card (NIC) port 1 goes to interconnect bay 1, and HP NIC port 2 goes to interconnect bay 2. Any changes in connectivity between a blade and the outside world forces customers to manually remove or add and recable the physical HP Virtual Connect switches and server I/O adapters. This recabling results in downtime. In contrast, Cisco UCS is truly a wire-once technology that allows any changes, including port mapping and I/O assignment, to be fully programmatically implemented and user defined.

Using Cisco UCS virtual interface cards (VICs), Cisco UCS servers can be configured for any workload in minutes, without touching the server. Cisco UCS VICs present up to 256 PCI Express (PCIe) standards-compliant interfaces to the host that can be dynamically configured as either NICs or host bus adapters (HBAs). These adapters can be accessed by the operating system or hypervisor, and they also can be attached directly to virtual machines, accelerating performance. Cisco UCS VICs support fabric failover so that if one fabric fails, the operating system...
never knows about it. You have the option to use OS-based NIC teaming or Cisco UCS hardware fabric failover, or both, depending on application requirements; you can configure this option on a per-virtual NIC (vNIC) basis.

As Figure 5 illustrates, NIC 1 is configured with a primary path to fabric A, with failover configured on fabric B. Similarly, NIC 2 is configured with a primary path to fabric B, with failover configured on fabric A.

![Figure 5. Fabric Failover Is Supported on the Cisco UCS VIC 1340](image)

**Right-Size Networking Bandwidth for Less Cost**

Network bandwidth is crucial to getting information to the right place at the right time. Not only do companies need the flexibility to meet current application bandwidth requirements, but they must also be prepared for future bandwidth growth. Rather than a rigid, fixed-I/O topology that requires customers to add more in-chassis switches, Cisco unified fabric allows any server in the domain to access the total uplink bandwidth to accommodate traffic bursts. For example, you can double the bandwidth simply by increasing the number of uplink cables between the chassis and the fabric interconnects and enable them with no downtime or application impact. No planning, configuration, or cabling to the chassis switch is required, as would be the case with HP Virtual Connect. Cisco UCS can scale blade bandwidth as applications demand: up to 40 Gbps with the mezzanine LAN-on-motherboard (LOM)-format Cisco UCS VIC 134-, or up to 80 Gbps with the Cisco UCS VIC 1340 plus a port expander card. You are not forced to purchase and overprovision in-chassis switches regardless of application requirements. Because Cisco UCS architecture requires fewer components to scale your bandwidth for peak traffic flows, you don’t pay for bandwidth or the associated components that you don’t need.
Revolutionary Management

With Cisco UCS, servers, connectivity, and management are inseparable. The complete abstraction of configuration information creates an on-demand, zero-touch environment. Cisco UCS was designed from the beginning with embedded, all-inclusive, model-based management through Cisco UCS Manager. Cisco UCS is intelligent infrastructure that is self-aware and self-integrating. Every server connected to Cisco UCS, whether it is a blade server or a rack server, is automatically detected and placed in a resource pool and even automatically configured if you so desire. The system is built from the foundation so that every aspect of server identity, personality, and connectivity is abstracted and can be applied through software using a Cisco UCS service profile. With Cisco UCS, servers are configured automatically, eliminating the manual, time-consuming, error-prone assembly of components into systems. With Cisco VICs, even the number and type of I/O interfaces are programmed dynamically, making every server ready to power any workload at any time. Cisco service profiles can be quickly created from templates, enabling fast configuration of one or 100 blade and rack servers in just a few minutes.

Cisco UCS Manager is integrated, model-based management. With Cisco UCS Manager, administrators manipulate a model of a desired system configuration and associate a model’s service profile with hardware resources, and the system configures itself to match the model. This automation accelerates provisioning and workload migration, delivering accurate and rapid scalability. For the first time, you have an automated, policy-based mechanism for aligning server configuration with workload. The result is increased IT staff productivity, improved compliance, and reduced risk of failures due to inconsistent configurations.

Cisco UCS Manager can be accessed through a GUI, a command-line interface (CLI), or an open, standards-based XML API that is used by a large ecosystem of management tools. Cisco UCS Central Software, an extension of Cisco UCS Manager that uses this XML API, enables management of multiple Cisco UCS deployments across geographic locations, with the first five Cisco UCS Central Software licenses free.

With HP BladeSystem and Virtual Connect, management is an afterthought, requiring a dedicated server appliance to handle basic functions such as chassis management, server configuration, and limited policy capabilities. HP OneView is a licensed, top-down software tool that is required if customers want any policy or profile capabilities. HP OneView continues an established pattern seen with top-down software managers inspired by traditional systems. Policies cannot adapt to changing configurations or server types. Server profiles cannot cross server or processor generations or even create networking policies for rack servers. There is no capability to truly create templates and resource pools for automated assignment. HP OneView is visually appealing, but remains a costly, licensed software stack working hard to try to correct the limitations of an aging platform.

In brief, Cisco UCS enables complete hardware abstraction. HP OneView falls short.

- Cisco UCS provides the capability to automatically adapt server configurations to any server type or generation. HP OneView does not.
• Cisco UCS provides Cisco UCS service profile automation and templates, including resource pool creation and global policy creation and automation. HP OneView does not.

• Cisco UCS enables comprehensive and detailed firmware policy creation and distribution to both blade and rack servers. Cisco UCS provides detailed access control and multitenancy, enabling enterprise role-based access control (RBAC). HP OneView does not.

• Cisco UCS Manager is provided as an integral part of the system without any additional charge. HP OneView has significant licensing costs.

HP ConvergedSystem: Even More Complexity

Figure 6 illustrates how HP ConvergedSystem greatly decreases flexibility while it increases management overhead. A single HP ConvergedSystem 700x can support a maximum of four chassis and 64 blade servers. Whereas FlexPod supports 160 blade servers in a single system, HP customers must purchase three HP ConvergedSystem 700x solutions and populate them with a total of 10 blade chassis. The total number of management points per system, each of which must be purchased, configured, managed, maintained, powered, and cooled, includes:

• Eight HP Virtual Connect FlexFabric switches
• Eight HP Onboard Administrator modules
• Two ToR Fibre Channel switches
• Two ToR Ethernet switches for management
• Four ToR Ethernet switches for production networking

A single HP ConvergedSystem 700x has multiple layers of switching (blade server chassis and top of the rack) that add to the number of managed devices, as shown in Figure 6.

Figure 6. HP ConvergedSystem 700x Requires 3 Systems, 42 Switches, and 62 Management Points to Support 160 Blade Servers
Three separate networks—LAN, SAN, and management—add to the number of cables and upstream switches. To support 160 blade servers (equivalent to what each Cisco UCS domain can support), HP’s best practices recommend six to eight ToR switches, which increases latency compared to the single layer that Cisco UCS uses.

Conclusion
Cisco reinvented the server market five years ago when it delivered the Cisco Unified Computing System. It surpassed the capabilities of HP and IBM at the time. Although HP has attempted to incorporate some of the innovations that Cisco has brought to market, these attempts have been haphazard and have forced HP into many compromises that Cisco did not have to make. Although HP has made improvements to its management of blade servers with HP OneView, it costs customers money in licensing fees. The result is that even HP’s most recent offering is still far behind Cisco UCS.

Cisco has become the number—one x86—architecture blade vendor in the Americas and number two worldwide. Cisco UCS forms the basis of the some of the top integrated infrastructure solutions, according to IDC: Virtual Computing Environment (VCE) coalition Vblock™ System and FlexPod. This role is the result of the innovation used to design, build, and integrate the Cisco UCS hardware and management software. This integration radically simplifies the infrastructure, helping reduce both capital and operating costs, and delivers a solution with excellent agility, flexibility, scalability, resiliency, and manageability and greatly reduced total cost of ownership.

For More Information
• For more information about Cisco UCS, please visit http://www.cisco.com/go/ucs.
• For more information about Cisco UCS award—winning performance, please visit http://www.cisco.com/go/ucsatwork.