White Paper

Cisco Unified Computing System: Meet the Challenges of Virtualization with Microsoft Hyper-V

What You Will Learn

The modern virtualized data center is today's new IT service delivery foundation, with IT-as-a-service (ITaaS) giving business users direct control over computational resources while IT provides reliable, high-quality infrastructure and data protection services. However, traditional data centers built on disparate hardware and software components make virtualization inefficient and difficult to scale. Moreover, maintaining infrastructure security, performance, and reliability requires sophisticated technical insights beyond the skill sets of most IT departments.

To truly achieve optimized virtualization quickly requires a new infrastructure approach, with the latest technology components integrated in pre-engineered solutions tailored to meet the specific needs of the virtualized data center. Working together, Cisco and Microsoft have merged their latest best-in-class hardware and software components to reinvent the virtualized data center, letting you deploy an installation as small as a data center in a rack running several hundred virtual machines or one that encompasses a room of 320 physical servers supporting thousands of virtual machines. The cohesive Microsoft System Center lets you transparently deploy and manage applications, database storage, and virtual machines, and the tightly integrated Cisco UCS™ Manager lets you configure and monitor the hardware layer.

Cisco's networking and server engineering provides an excellent technical vantage point for complex, highly integrated, optimally performing virtualized infrastructure. Microsoft Windows Server 2008 R2, which includes the Microsoft Hyper-V hypervisor, provides a reliable, high-performance 64-bit foundation on which you can deploy mission-critical business applications with the agility and scalability necessary to meet today's IT infrastructure demands.

Complexities of the Virtualized Data Center

As virtualized data centers have evolved into private and public cloud services, the importance of managing complexity has become of critical importance. Network efficiency, for example, requires careful calculation of node and link capacities throughout the infrastructure. SAN reliability demands that the network be lossless, and application performance requires the capability to allocate bandwidth and CPU capacity in a highly specific way. Operation stability depends on careful isolation of LAN, SAN, and management network fabrics while employing common backbone facilities to optimize resource costs.

You cannot achieve these goals with traditional off-the-shelf server, storage, and networking components, and you cannot achieve high-performance virtualization without a hypervisor closely attuned to application workload requirements. Cisco Unified Computing System™ (Cisco UCS) server infrastructure consists of high-density, yet cost-effective, CPU and memory components designed to mesh with the Cisco Unified Fabric network, integrating both Cisco and third-party storage systems. The Microsoft Hyper-V hypervisor is designed with detailed internal knowledge of Microsoft Windows Server 2008 as well as the full spectrum of Microsoft data center applications: Microsoft SQL Server, Exchange, and SharePoint.

© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.

It is clear that future application agility and scalability will require servers with truly massive memory and processor capacities. Cisco UCS servers are poised to provide that scalability with up to 1 terabyte (TB) of memory and 48 CPU cores per server.

Managing such large infrastructures can be daunting. Fortunately, Cisco UCS Manager, combined with Microsoft System Center, provides complete end-to-end management of physical hardware down to the smallest field-replaceable component, and the capability to manage virtual workloads based on application requirements rather than data center limitations. For instance, the Cisco VN-Link technology lets you use Microsoft System Center to move a workload and all its attendant virtual network resources without having to reconfigure the hardware fabric.

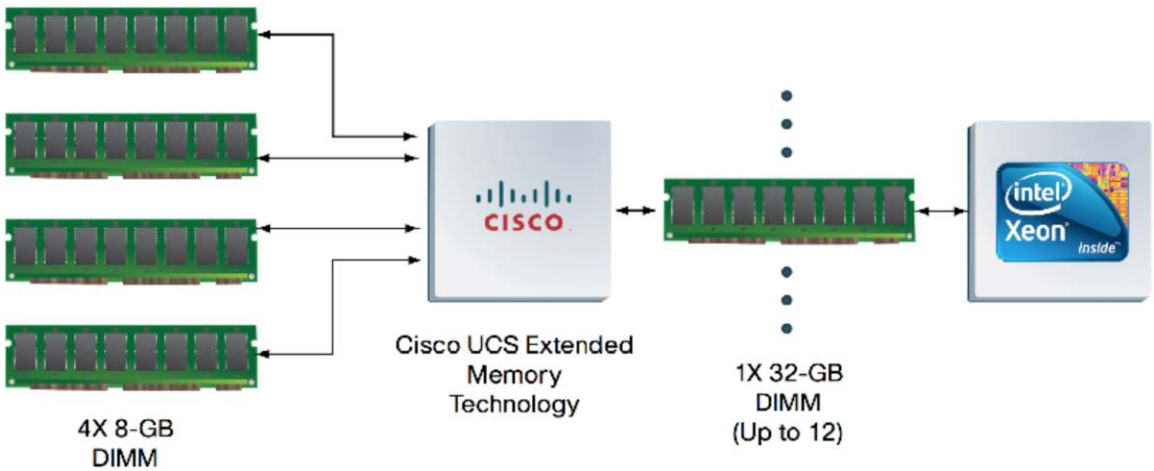
Addressing Critical Data Center Challenges

As data centers have grown to support new mission-critical applications, new problems have arisen, requiring new technological solutions. Cisco UCS and Microsoft Windows Server 2008 R2 directly address these challenges to help ensure smooth performance and scalability of the Cisco UCS and Microsoft Hyper-V data center.

One problem that must be resolved with the rapid increase in virtualization is a memory bottleneck that caps per-application and per-server performance. The latest CPU architectures can address a fixed number of memory devices, or DIMMs, which today are popularly available in 2-, 4-, an 8-GB increments. the Intel Xeon series 5500 processor, for instance, addresses up to 12 DIMMs, yielding a maximum per-socket memory capacity of 96 GB—a serious restriction when a single high-performance virtual machine may require 16 GB of memory or more. Microsoft Windows Server 2008 R2 Standard Edition can readily exploit 32 GB, and Microsoft Windows Server 2008 R2 Data Center Edition supports up to 2 TB of memory. The only way to increase available memory is to increase the number of sockets. Because sockets must be added in pairs, this means nearly twice the capital expense as well as a doubling of ongoing power and cooling operational costs.

The patented Cisco Extended Memory Technology addresses this problem by enabling four times the memory capacity per socket, letting you achieve memory capacities of up to 512 GB (in a 2-socket Cisco UCS B440 M1 or M2 High-Performance Blade Server). Cisco Extended Memory Technology achieves this capacity by aggregating four physical DIMMS into a single logical DIMM, so that the processor's memory controller sees, for example, four 8-GB DIMMs as a single 32-GB DIMM (Figure 1).

Figure 1. Cisco Extended Memory Technology Makes Four 8-GB DIMMs Appear to the CPU as a Single 32-GB DIMM



© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.

This features results in a cost savings of up to 60 percent compared to typical system memory costs for high-socket-count servers (Table 1). Further savings are achieved through lower power and cooling costs across the life of the server.

Table 1. Capital Expenditures Savings with Cisco Extended Memory Technology Compared to Typical Memory Costs

Memory Capacity	Typical System Memory Cost (US$)	Cisco Unified Computing System Memory Cost (US$)	Cost Savings (US$)	Savings (Percent)
96	11,880	4800	7080	60
144	17,820	7200	10,620	60
192	Not available	9600		
384	Not available	47,520		

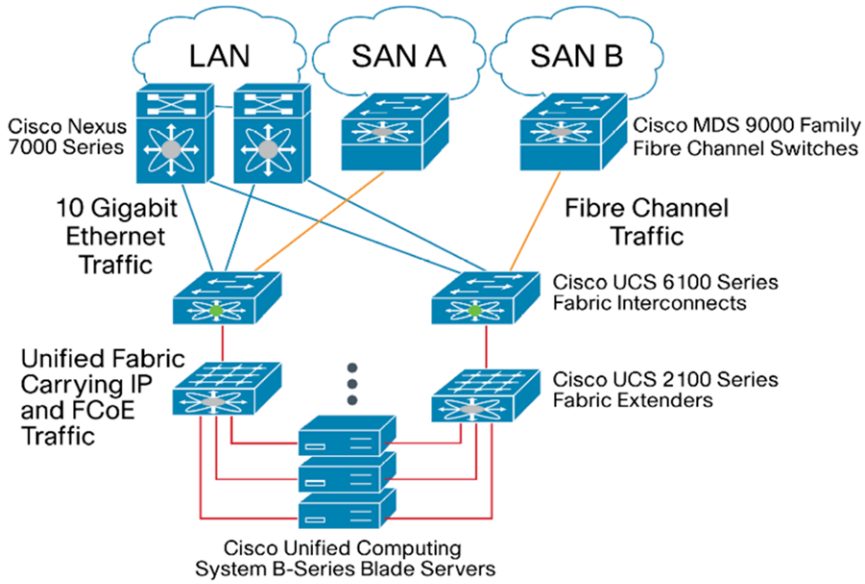
Another challenge that traditional data centers face is network reliability and its attendant management complexity. A traditional virtualized data center uses two separate networks—LAN and SAN—with the LAN serving double-duty as the management network. These networks typically employ off-the-shelf Ethernet and Fibre Channel switches, resulting in two disparate hardware platforms to support, spare, and administer. In the trend to migrate to a single network technology, many data centers are merging these networks into a common 10 Gigabit Ethernet infrastructure, but they still employ off-the-shelf Ethernet switches that must coexist with traditional Fibre Channel SANs.

As a result, IT staffs have encountered growth limits in their networks. Backbone congestion and network failures caused by traditional spanning-tree-based Layer 2 Ethernet switches can lose packets and sustain many minutes of convergence delay from a single link failure. Movement of virtual workloads within this inflexible infrastructure often requires disruptive hardware repositioning and network reconfiguration. Add to this complexity multiple layers of blade, top-of-rack, and core switches, and the task of managing this network becomes intractable.

The Cisco UCS unified fabric addresses these challenges with a single 40-GB network supporting 1-GB and 10-GB edge nodes. A single access-layer switch, the Cisco UCS 6100 Series Fabric Interconnect, carries all network traffic between virtual machines, creating a single point of control and management for both LAN and SAN traffic (Figure 2).

© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.

Figure 2. Cisco UCS Unified Fabric Carries Multiple Traffic Streams with Interconnects to Traditional Fibre Channel Networks When Needed



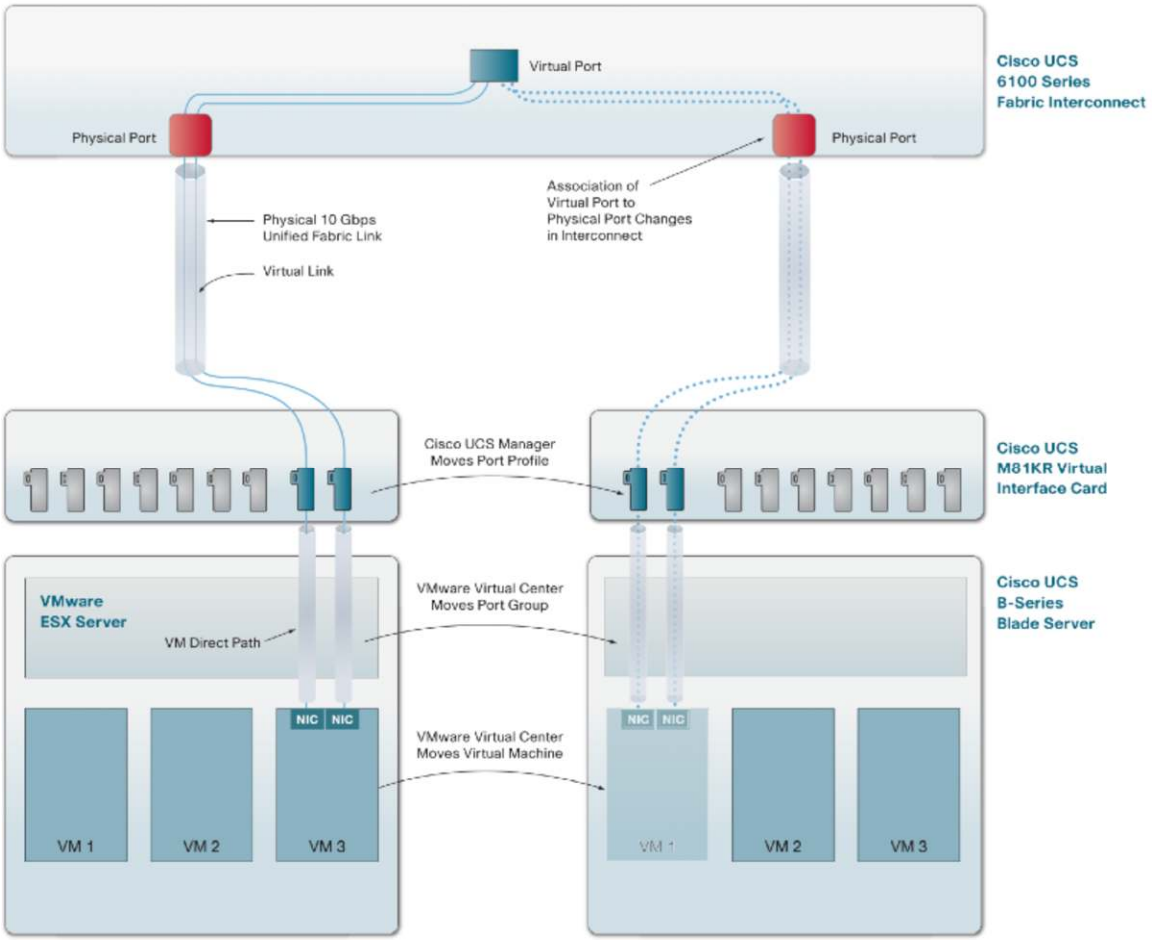
The fabric connects to server complexes using a single 40-GB redundant fabric interconnect cable. This approach eliminates blade-resident switches, because the fabric interconnects pass all traffic from blade servers to the upstream Cisco UCS 6100 Series interconnect. This architecture is compatible with migration from traditional Fibre Channel SANs such as Cisco MDS 9000 Family networks.

The unified fabric goes beyond traditional networks to include a fully redundant out-of-band management channel that extends throughout the fabric to every device, helping ensure that management functions are not impaired by congestion in LAN or SAN pathways. The Cisco UCS 6100 Series interconnect runs redundant embedded instances of Cisco UCS Manager to control this management channel.

Integral to Cisco Unified Fabric is the Cisco VN-Link technology, which interoperates with Microsoft Hyper-V at the direct-memory-access (DMA) level to give virtual machines hardware-level access to all LAN resources. When combined with the Cisco UCS M81KR Virtual Interface Card (VIC), a single physical server can provision up to 128 virtual links. Microsoft Hyper-V interoperates with Cisco VN-Link to provide pass-through switching to individual virtual machines, eliminating the need for virtual switches and delivering the highest possible Small Computer System Interface over IP (iSCSI) and LAN network performance to each virtual machine (Figure 3).

© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.

Figure 3. Cisco VN-Link Enables Virtual Machine Links to Be Managed and Moved Independently of Physical Links



An important advantage of Cisco VN-Link is its transparent node-movement capability. When a virtual machine workload migrates to another physical host, Cisco VM-Link moves its virtual interface and the associated path to the new host, automatically associating the virtual port with the physical port of the new host. Thus, virtual machines move from server to server with their network characteristics intact, avoiding the disruption caused by reconfiguration of multiple switching layers. This feature provides complete mobility of network interface cards (NICs) to VLANs, letting Microsoft System Center move workloads between physical hosts without prerequisite network interconnect changes.

With all traffic to and from virtual machines traveling on separate virtual links, Cisco UCS Manager provides single-point administration of attributes such as quality of service (QoS), VLANs, bandwidth allocation, and access control lists (ACLs). Traffic engineering is essentially designed into the network fabric, letting you essentially guarantee performance and bandwidth requirements for mission-critical applications. Through its dedicated out-of-band management, the unified fabric helps ensure that Cisco UCS Manager has up-to-date instrumentation data, giving you real-time visibility into virtualized data center performance and fault states.

© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.

Cisco UCS and Microsoft Hyper-V Bring Essential Value to the Data Center

Cisco and Microsoft have pre-engineered specific virtualized data center capacity models, exploiting the following hardware and software capabilities:

- Up to 12 cores per 2-socket blade, and up to 32 cores per 4-socket rack-mount server: A main feature of Cisco UCS is dense computational capability in a small footprint. Cisco UCS B-Series Blade Servers can be configured in a single seven-rack-unit (7RU) Cisco UCS 5108 Blade Server Chassis to deliver up to 64 dual-threaded CPU cores.
- Memory capacities of up to 512 GB per blade and 1 TB per rack-mount server: Traditional server architectures add sockets to increase memory capacity, spreading available memory across the sockets. Cisco Extended Memory Technology avoids this unnecessary socket proliferation—which doubles power and cooling requirements—to deliver four times the traditional memory density in 2-socket server configurations.
- Unified network fabric with 40-Gbps lossless Ethernet: Traditional network technologies, such as spanning-tree-based Layer 2 switching and processor-based Layer 3 routing, cannot meet the performance requirements of the modern virtualized data center. Cisco VN-Link unified network fabric combines the traditionally separate LAN, SAN, and management networks into a single multilane physical network supporting up to 128 separate, individually manageable communications channels. The lossless nature of this fabric helps ensure that applications do not experience protocol- and contention-induced outages, exploiting all available network capacity. This feature ultimately lowers network costs and lets you increase network capacity transparently as you need it.
- High vertical growth rates supporting up to 320 physical servers in a single virtualized data center assembly: Traditional data center architectures face intrinsic network fabric interconnect limits long before the physical capacity of a data center is reached. Cisco UCS can grow to 320 physical servers—comprising more than 10 thousand CPU cores—in a single virtualized data center assembly. Cisco UCS Manager and Microsoft System Center can manage multiple VDCs, providing virtually unlimited data center growth.
- Cohesive management tool set in Cisco UCS Manager and Microsoft System Center: The lowest total cost of ownership (TCO) in its class is gained through low-cost management, best-in-class hardware and intrinsically capable Cisco and Microsoft management tools. Cisco UCS Manager manages the hardware infrastructure, while Microsoft System Center administers the efficient Microsoft Hyper-V hypervisor to optimize application performance through dynamic CPU and memory allocation and live workload migration. Together these tools enable turn-key “private cloud-in-a-box” deployments.
- Open management software interfaces supporting a broad partner tool ecosystem: Both Cisco UCS Manager and Microsoft System Center offer extensive open APIs to enable partner management tool development, and a thriving third-party tool ecosystem already exists.

Each of these capabilities represents the state of the art in their respective technology fields. They address specific virtualized data center challenges to ultimately lower TCO while simultaneously increasing reliability and simplifying management. Understanding these challenges will let you compare Cisco UCS and Microsoft Windows Server 2008 with other virtualized data center architectures, showing you the advantages that Cisco and Microsoft deliver.

© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.

Delivered As You Want It

Cisco UCS with Microsoft Windows Server 2008 R2 and Hyper-V create an outstanding combination for building rapid-deployment, highly scalable, virtualized data centers. Cisco UCS has proven itself as the next-generation data center architecture that delivers the lowest TCO among competitive approaches.[1] The comprehensive portfolio of Cisco UCS blade and rack server products, combined with Cisco Unified Fabric components and Microsoft Hyper-V, let you build both small- and large-scale virtualized data centers to meet any business objective.

Cisco UCS Manager and Microsoft System Center complement each other, giving you a simple and elegant hardware and software administrative interface. You save acquisition and operation costs by eliminating management blades, multiple management consoles, and license servers.

With the scalability of Cisco and Microsoft hardware and software components, you can size your initial Cisco UCS deployment to match the prospective workload, confident that you will be able to grow from that starting point to accommodate new application and business requirements. Even small and medium-size businesses (SMBs) with small IT staffs can roll out a Cisco UCS private cloud in a box using the Microsoft Hyper-V Cloud Fast Track offering, which combines Microsoft Windows Server 2008 and Hyper-V with Cisco UCS and NetApp SAN in packages as small as a half rack.

With the exceptional performance, reliability, and TCO achieved with the Cisco UCS and Microsoft Hyper-V partnership, you can easily justify deploying a new virtualized data center instead of trying to upgrade an existing installation.

For More Information

Visit the http://www.cisco.com/go/microsoft

[1] *Data Center Management: The Key Ingredient for Reducing Server Power While Increasing Data Center Capacity*, June 2010, Enterprise Management Associates (http://tinyurl.com/emaciscoucs)

© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at **www.cisco.com/go/offices.**

Cisco and the Cisco Logo are trademarks of Cisco Systems, Inc. and/or its affiliates in the U.S. and other countries. A listing of Cisco's trademarks can be found at www.cisco.com/go/trademarks. Third party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1005R)

Printed in USA C11-689370-00 10/11

© 2011 Cisco and/or its affiliates. All rights reserved. This document is Cisco Public Information.