White Paper

Creating a Best-of-Breed Private Cloud with Cisco and Windows Server 2012

What You Will Learn

Today, organizations are looking for ways to increase their business agility and efficiency. They want to be able to enable new business applications and services while reducing the time it takes to provision new environments and the complexity caused by having many disparate systems. In this paper, we'll introduce you to the Unified Computing System (UCS) platform. This platform, enabled by the latest Cisco technologies and Microsoft Windows Server 2012, provides state-of-the-art physical and virtual capabilities while simplifying manageability.

Cisco UCS complements Windows Server 2012 by enabling the features of Windows Server 2012 while adding capabilities based on Cisco's experience and innovations related to the UCS technology. The result is a compelling Private Cloud solution. We'll cover key Cisco complementary data center technologies, including

- The Cisco Unified Computing Systems (UCS) platform
- The Cisco Nexus 1000V, the Cisco Virtual Machine Fabric Extender (VM-FEX)
- The UCS Manager, UCS PowerTool and UCS System Center 2012 integration

With new features, manageability, and performance, Windows Server 2012 represents a step forward in Microsoft's server operating system. A major change, which has created an industry-leading solution, is the virtualization platform for on-premises private cloud and host-provided public clouds. Key Windows Server 2012 virtualization enhancements include:

- Virtualization for a heterogeneous environment with industry-leading capabilities for Windows and Linux workloads
- Improved manageability, enabling large-scale management with the same simplicity as single-server management
- Running any application in any cloud through a common capability set for both on- and off-premises deployments

We'll also explore the key capabilities of the joint Microsoft-Cisco solution and how those capabilities can enhance your IT infrastructure. Key focus areas include

- New scalability and performance possibilities that enable a virtual-first approach for all workloads
- Bare-metal network performance with VM-FEX and SR-IOV (Single Root I/O Virtualization)
- New virtual fibre channel capabilities that enable new virtual scenarios, including guest-level clustering
- New mobility technologies that allow virtual machines to move between any host with no downtime

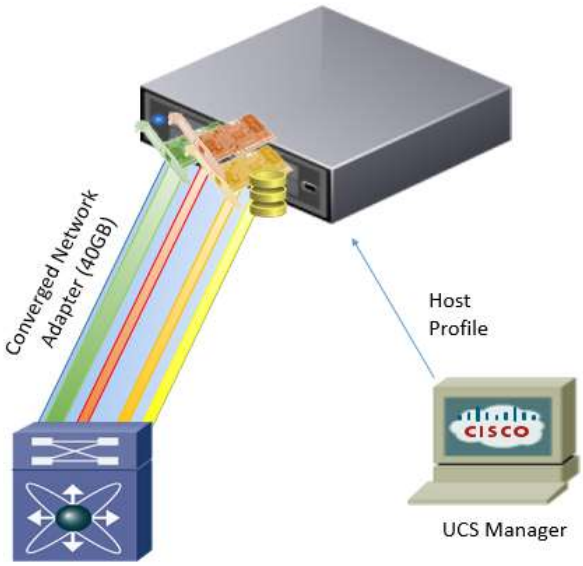
Windows 2012 and UCS let organizations break the tight bond that has existed between virtual machines and the physical network fabric, bringing even more options for organizations that are geographically distributed or that have multiple tenants through network virtualization and the extensible Hyper-V switch. Lastly, we'll focus on the integrated manageability of the Cisco-Microsoft solution which enables organizations to fully leverage the capabilities available to them.

Scalability and Performance

Today, many organizations are either highly virtualized or are currently planning a virtualization migration. Virtualization also enables other corporate initiatives, such as Bring Your Own Device (BYOD), by offering the platform for Virtual Desktop Infrastructure. Windows Server 2012 on UCS delivers a complete platform that provides industry-leading performance and feature sets, enabling the full capabilities and scale of the physical hardware to be employed without any compromise.

Virtualization is no longer seen as a technology used only for tier 2 and tier 3 applications. Organizations now strive to virtualize all applications in the datacenter, which includes tier 1 applications that traditionally may require very large amounts of processors, memory, network resources, and disk space. This allows organizations to standardize on how all systems are virtualized; no matter how large are the system's resource requirements. Windows Server 2012 provides support for the largest x86-based servers, including servers with 320 processor cores and 4 TB of memory. Support for very large environments is also reflected in the following new capabilities for virtual machine configurations which enables organizations to deploy any workload in a virtual environment where previously not possible due to scalability limitations. A Windows Server 2012 Hyper-V can be configured with up to 64 virtual CPUs with NUMA topology pass-through, 1TB of RAM and utilize the new 64TB VHDX format.

The Windows Server 2012 capabilities are enhanced through the Cisco UCS server platform which, as the figure below shows, features a Converged Network Adapter (CNA) that connects to a unified fabric. This, in turn, provides connectivity with a bandwidth between 40Gb and 160Gb for each blade. This connection can be divided into up to 256 virtual adapters using the UCS management framework. Each virtual adapter is seen by the operating system running on the UCS blade as either a physical network or fibre channel HBA device.



The ability to create this number of network and HBA devices separates the UCS platform from other blade-based solutions, which typically allow few adapter connections due to a limited number of physical slots. Many Microsoft best practices require numerous separate network and storage connections, especially when using virtualization and clustering. With this enhanced CNA, your platform investment is assured of meeting today's Microsoft best practices—and also safeguards for tomorrow's best practices—without sacrificing performance. The Cisco CNA provides manageability benefits because the PCI virtual devices can be added to servers without the need to open up the physical server. In the example shown, three network adapters with varying bandwidths and a fibre channel HBA have been created through a host profile applied via UCS Manager.

Fibre Channel Support

One of the adapter types supported by the previously mentioned unified fabric and CNA is fibre channel HBAs, which provide communication to storage. It is vital that the UCS blades integrate with storage of the UCS boot environment and storage for data and virtual machines. Windows Server 2012 opens up a new possibility for fibre channel access storage. Windows Server 2012 Hyper-V provides support for virtual fibre channel, allowing virtual

machines to have direct access to fibre channel-connected SANs, thus removing previous limitations for virtual machine access to SANs and allowing new shared storage scenarios within virtual machines (e.g., advanced guest clustering-based solutions and access to volumes greater than the 64TB VHDX limit).

Live Migration

The UCS platform allows for hundreds of blades to be managed by a single pane of glass, but even with the new Windows Server 2012 scalability improvements of 64-node clusters, it will still be very possible to have a greater number of blade servers than can be placed into a single Windows Server 2012 cluster. Windows Server 2012 supports a new type of virtual live migration (also known as “shared nothing” live migration), which allows a virtual machine to be moved between any two Windows Server 2012 Hyper-V hosts or clusters with no need for common storage or configuration and no downtime to the virtual machine. The UCS server family’s unique unified fabric provides a connectivity that virtual and traditional live migration can fully leverage, providing very fast migrations across the datacenter. Live Migration also supports multiple concurrent migrations, which dynamically adjusts the maximum number of concurrent live migrations based on available bandwidth, thus ensuring the best experience. Virtual machine storage can also be moved while the virtual machine continues to run, using the new Live Storage Move feature. This feature provides the ability to move between any supported storage—such as direct attached, SAN, and SMB—with no interruption to the VM.

Network Virtualization and Management

Network operators have experience in the management of the existing physical layers of network hardware and utilize a consistent management methodology. The introduction of virtualization into a datacenter introduces three problems for network operators:

- Difficulty in maintaining policies to virtual machines as they move between hosts
- A lack of visibility into traffic between virtual machines
- A lack of manageability, which forces virtualization administrators to manage the virtual networks; not an optimal solution

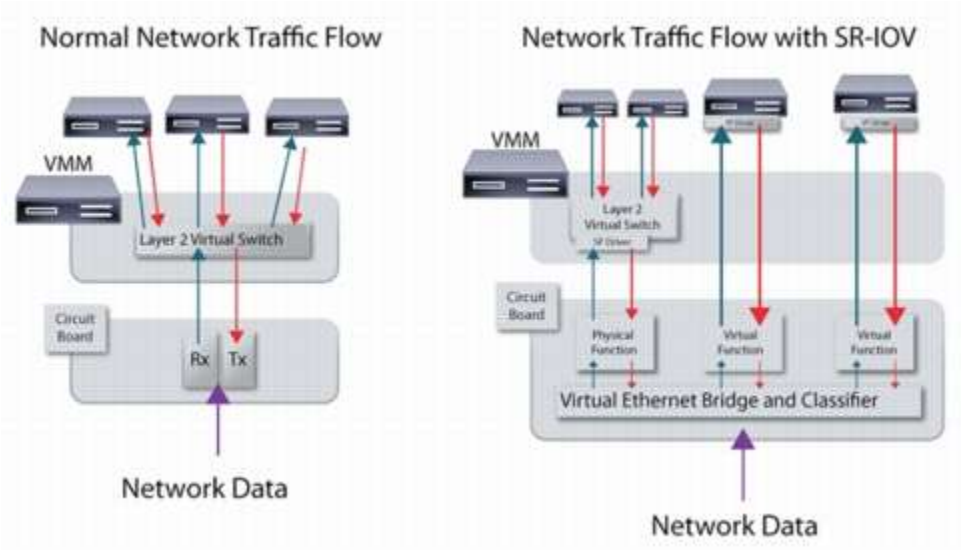
These problems are resolved by enabling the network infrastructure element of UCS to tightly integrate with the Hyper-V solution.

Extensibility for Hyper-V Network Switch

Windows Server 2012 Hyper-V introduces extensibility to the Hyper-V network switch. Third parties can plug into the Hyper-V network switch to extend functionality using existing. Cisco has leveraged the new Hyper-V extensible switch capability to enable the industry-leading Cisco Nexus 1000V to integrate with Hyper-V virtual switches. The Nexus 1000V provides full management of the new “virtual access layer” that virtualization introduces, solving the three challenges introduced by virtualization. Utilizing the Nexus 1000V brings the management and experience of the network for the Hyper-V virtual machines back to the network operators. This management is enabled in a consistent manner using the same methods used for the physical network infrastructure through the UCS management tools. The Nexus 1000V provides network virtualization capabilities in addition to advanced network policies, giving customers maximum flexibility and choice.

The UCS Virtual Machine Fabric Extender (VM-FEX) provides customers with the highest level of network performance, matching bare-metal network throughput for the most demanding workloads. VM-FEX extends the unified fabric technology and the CNA network adapters to provide support for another new Windows Server 2012 Hyper-V capability: Single Root I/O Virtualization (SR-IOV). Traditionally, virtual switches are created in Hyper-V.

The virtual switches, connected to a physical network adapter, provide external connectivity to the virtual machines connected to the virtual switch. The virtual switch provides many services to the virtual machines and supports extensibility from third parties. The switching does introduce some latency to communications because network traffic is processed through the virtual switch. SR-IOV allows virtual machines to communicate directly with virtual devices—called virtual functions—which are provided by the network adapter, directly bypassing the virtual switch and bare-metal performance.



SR-IOV-capable network adapters support a certain number of virtual functions. Each virtual function can be attached to a single virtual machine virtual network adapter at any one time. VM-FEX provides support for SR-IOV, and combined with the unified fabrics gives the highest levels of performance while still being managed and monitored through the standard UCS management framework. VM-FEX essentially extends the switch interface directly to a virtual machine. Windows Server 2012 Hyper-V enables full utilization of VM-FEX while still enabling full Live Migration of SR-IOV-enabled virtual machines.

Unified Manageability

Windows Server 2012 focuses on a management philosophy of “the power of many, the simplicity of one”—managing multiple servers as if managing only one. This philosophy is enabled in the operating system through several advancements. The Windows Server 2012 Server Manager has been re-architected to provide support for managing multiple servers simultaneously. Microsoft has substantially boosted the capability of PowerShell, providing more than 2300 intuitive cmdlets for managing almost every aspect of Windows Server 2012. Cisco builds on Microsoft PowerShell with UCS PowerTool. UCS PowerTool extends the PowerShell capability with a Cisco-built library that provides end to end UCS management through the common PowerShell interface. UCS PowerTool allows complete UCS infrastructure management for both physical and virtual environments and lets administrators quickly integrate with UCS.

Cisco and Microsoft Management Tools

Microsoft System Center 2012 is the Microsoft flagship management and monitoring portfolio for all aspects of an organization’s Microsoft environment, including desktop, servers, physical, virtual, hardware—all the way through to the application. UCS Manager is the Cisco management tool that provides end-to-end management of the UCS platform. And in addition to the PowerShell library for UCS, Cisco provides UCS Manager integration with two key

components of System Center 2012: Operations Manager and Orchestrator. The UCS Management Pack for System Center 2012 Operations Manager extends the monitoring and health insight of UCS components. System Center 2012 Orchestrator acts as an IT automation toolbox, providing connectivity to the many different IT systems in the datacenter. Sequences of actions can be defined in run books, which can be used either manually or by other systems, removing the need for manual processes that may have previously involved access to many different tools.

In addition to providing the basic management of the Cisco UCS, such as the configuration of the unified fabric, UCS Manager enables capabilities vital to multiserver environments where, even with the best hardware, failures still occur. Service Profile Templates enables templates to be defined, which, at a very granular level, detail the configuration of what a deployed blade server should be (e.g., the number of network adapters, number of fibre channel connections, and other hardware configuration options). The Service Profile Template can then be used to very quickly provision new blades to a desired configuration; however, in the event of a blade failure, a replacement blade can be identified. And, through the Service Template, the hardware configuration of the failed blade can be applied to the replacement blade, including which operating system on the shared storage to boot from. This capability essentially replaces the failed blade in minutes, but keeps the entire personality of the hardware intact so the network, storage, and software does not realize it moved; thus, no changes or human interaction are required to restore application services. These advanced capabilities of UCS manager are also exposed through UCS PowerTool and System Center Orchestrator.

The UCS Integration Pack for System Center 2012 Orchestrator allows Orchestrator to connect and perform actions on UCS Manager as part of multisystem workflows, extending the capabilities of automated actions. System Center Virtual Machine Manager (SCVMM) provides virtual machine management in data centers. SCVMM is platform agnostic and provides a unified experience across various hypervisors. The UCS User Interface (UI) extension add-in for SCVMM provides centralized management of Cisco UCS by allowing access to controls from within SCVMM. The add-in shows the UCS domain inventory, correlates Hyper-V instances to UCS servers and service profiles, controls power status of service profiles, and launches KVM consoles directly from SCVMM[1].

Together Cisco UCS and Microsoft Windows Server 2012 Offer a Step Forward

Windows Server 2012 provides a tremendous step forward in server virtualization—and as a cloud platform—with enhancements in the Windows Server 2012 operating system and many enhancements in the Hyper-V role. The UCS platform combined with the Nexus 1000V and VM-FEX provides the most complete platform for Windows Server 2012 Hyper-V, enabling organizations to not only take full advantage of the Windows Server 2012 Hyper-V capabilities, but extend them through Cisco innovations. When PowerShell and System Center 2012 integration is leveraged with UCS Manager, organizations gain a single, unified way to manage all aspects of the Microsoft and Cisco solution. It becomes very clear that together Windows Server 2012 and UCS provide the best and most complete solution in the market enabling organizations to embrace virtualization and the Private Cloud.

For organizations looking to implement a fully integrated and proven architecture that leverages the Cisco UCS and Windows Server 2012 capabilities then Cisco partners with both Netapp and EMC to offer complete converged infrastructure solutions in the form of FlexPod and VSPEX respectively. Having multiple storage options allows for our partners and customers to have the most choices when they look for integrated Microsoft Private Cloud solutions. FlexPod with Microsoft Private Cloud is an Integrated Netapp and Cisco reference implementation of

[1] SCVMM UI Extension for UCS is in beta as of February 2013.

Microsoft Private Cloud Fast Track, which delivers IT as a service (ITaaS) through a cost-effective, flexible, highly manageable, and automated infrastructure that will grow with your business. It is a combined infrastructure stack of Netapp, Microsoft, and Cisco® technologies that is available through channel partners and is validated by Microsoft through the Microsoft Private Cloud Fast Track program.

FlexPod with Microsoft Private Cloud has the flexibility to be sized and optimized to accommodate many different use cases, including application workloads such as Microsoft SQL Server®, Exchange Server, SharePoint® Server, and others. FlexPod with Microsoft Private Cloud enables simplified management with repeatable deployments.

For more information go to: www.cisco.com/go/flexpod

VSPEX™ Private Cloud for Microsoft Windows Server with Hyper-V is a complete virtualization solution, proven by Cisco and EMC to run Microsoft applications and delivered to you by your trusted partner. Designed for flexibility and validated to help facilitate interoperability and fast deployment, VSPEX works with your Microsoft-based environment while removing the complexity and risk that typically accompanies the design, integration, and deployment of a best-in-class solution.

For more information go to: www.cisco.com/go/vspex

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