

FlexPod Datacenter with VMware vSphere 5.1, Cisco Nexus 7000 Series Switches, and IP-Based Storage

The IT industry today faces the challenge of transitioning to virtualized and cloud-based data center infrastructure for improved efficiency, agility, and cost effectiveness. To enable this migration with reduced risk and cost, Cisco, in partnership with NetApp, has developed the FlexPod data center solution. FlexPod is predesigned unified computing, storage, and network infrastructure composed of Cisco Unified Computing System™ (Cisco UCS®) servers, Cisco UCS Manager, the Cisco Nexus® Family of switches, and NetApp FAS storage arrays. FlexPod provides a standard, flexible data center building block that can be used to build an optimized data center to support a variety of workloads and applications.

Cisco, through its Cisco® Validated Designs, offers a comprehensive suite of pretested FlexPod solutions, developed using various system components, configurations, and hypervisor and application software. Using a solution based on the Cisco Validated Design for FlexPod as the baseline platform, IT customers can deploy a virtualized and cloud-enabled data center quickly, with low risk and cost. The FlexPod solution described in this document implements a storage system based on IP storage protocols, eliminating the cost and complexity associated with traditional Fibre Channel-based data center storage infrastructure.

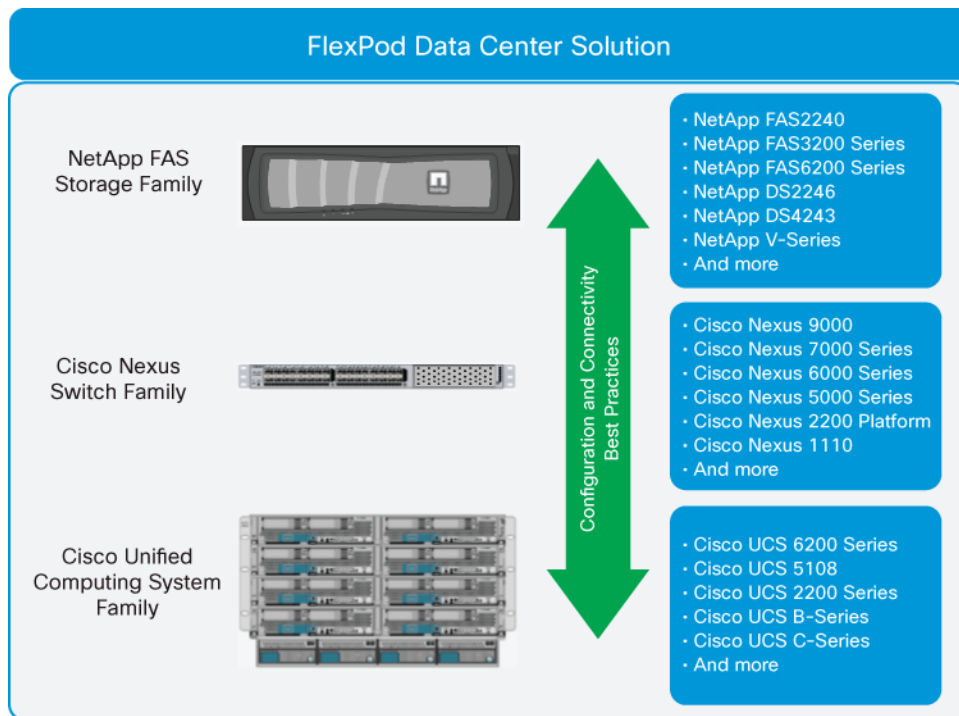
Benefits of Cisco Validated Design for FlexPod with Cisco Nexus 7000 Series Switches and IP-Based Storage

- **Reduced risk:** Prevalidated configurations help ensure proper deployment of the current applications on the new infrastructure.
- **Accelerated deployment:** Unified and standard architecture reduces transition downtime and management overhead.
- **Flexibility:** A wide variety of applications and workloads are supported through proven hardware and software combinations.
- **Scalability:** Modular architecture supports future expansion through scale-up and scale-out strategies.
- **Lower total cost of ownership (TCO):**
 - IP storage protocols provide simple and cost-effective storage solutions.
 - Standardized architecture reduces management and training overhead.
 - Modular infrastructure enables IT to build a right-sized data center and avoid underutilization of resources.
 - Pretested solutions reduce deployment, procurement, and setup times.

FlexPod Design Elements

FlexPod is a unified data center platform composed of Cisco UCS servers, Cisco Nexus network switches, and NetApp storage array elements, as shown in Figure 1. The FlexPod modules can be configured to support a variety of applications by mixing and matching the component families and versions to achieve optimal capacity, price, and performance targets. The solution can be scaled by augmenting the elements of a single FlexPod instance and by adding multiple FlexPod instances to build numerous solutions for virtualized and nonvirtualized data centers.

Figure 1. FlexPod Design Elements



Cisco UCS Family

Cisco UCS is a next-generation data center platform that unites computing, networking, and storage access and virtualization into a cohesive server system for superior performance and cost effectiveness. All resources participate in a unified management domain in an integrated multi-chassis platform. This platform is composed of Cisco UCS B-Series Blade Servers and C-Series Rack Servers, fabric interconnects, blade server chassis, and adapter connectivity.

Cisco UCS Manager device management software enables unified management of the entire computing environment. It provides role-based and policy-based management by using the service profiles of the resources, reducing maintenance overhead.

Cisco UCS fabric interconnects are the communication and management backbone for the Cisco UCS solution, providing LAN and SAN connectivity to the server blades. The fabric interconnects connect the Cisco UCS B-Series and C-Series servers (connected through Cisco Nexus 2200 platform fabric extenders) and the blade server chassis to form a unified fabric, which becomes a single management domain, providing high availability and simplicity of management.

The Cisco UCS B-Series Blade Servers are an enterprise-class computing platform designed to efficiently deliver a broad range of IT workloads, from web infrastructure to distributed databases.

Cisco UCS C-Series Rack Servers extend the unified computing model to further increase scalability and business agility. The Cisco UCS C-Series implements innovative technologies, including a standards-based unified network fabric, support for Cisco Data Center Virtual Machine Fabric Extender (VM-FEX) virtualization, and Cisco Extended Memory Technology.

For more information about Cisco UCS servers, refer to www.cisco.com/en/US/products/ps10265/index.html.

Cisco Nexus Switches

The Cisco Nexus Family of switches forms the networking foundation for a FlexPod deployment. These switches support any transport over Ethernet, including Layer 2 and 3 traffic and storage traffic on a common data center–class platform, to transform the data center network into a standards-based, multipurpose, multiprotocol, Ethernet-based fabric. All switches in the Cisco Nexus Family use the Cisco NX-OS Software operating system.

The Cisco Nexus 7000 Series Switches offer a comprehensive, one-platform solution for the data center core network. They provide the high level of network availability needed to sustain nonstop operations. The main features of the Cisco Nexus 7000 Series include:

- **Infrastructure scalability:** Virtualization, efficient power and cooling, high density of 10 Gigabit Ethernet ports, and high performance support efficient data center infrastructure growth.
- **Operation continuity:** The Cisco Nexus 7000 Series design integrates hardware, Cisco NX-OS features, and management to support zero-downtime environments.
- **Transport flexibility:** The Cisco Nexus 7000 Series provides a foundation for unified fabrics with Cisco unified I/O and FCoE and enables incremental and cost-effective adoption of networking innovations and technologies. Virtual device contexts (VDCs) reduce software and hardware resource use.
- **Data center switching capability:** The Cisco Nexus 7000 Series implements advanced data center switching features such as Cisco Overlay Transport Virtualization (OTV), Cisco FabricPath, multihop Fibre Channel over Ethernet (FCoE), and Cisco Locator/ID Separation Protocol (LISP) for optimized data center deployments.

In addition, the Cisco Nexus 7000 Series provides critical high-availability features including Network File System (NFS) awareness, Layer 2 and 3 In-Service Software Upgrade (ISSU), and stateful supervisor switchover.

For more information about the Cisco Nexus 7000 Series, refer to <http://www.cisco.com/en/US/products/ps9402/index.html>.

NetApp FAS Storage

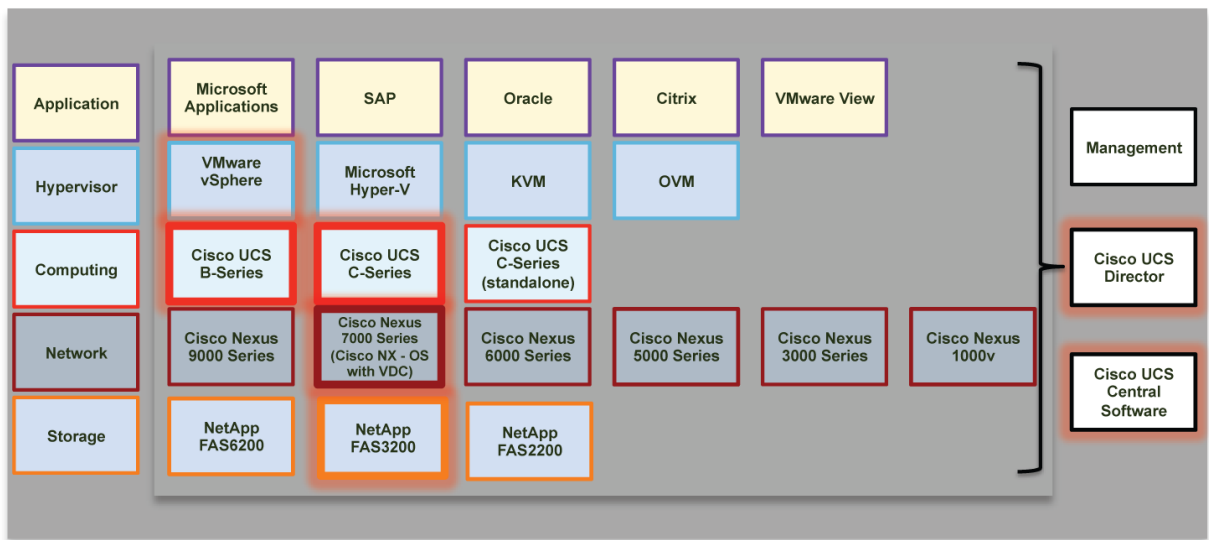
The NetApp FAS storage system forms the scalable storage element in a FlexPod platform. It uses the NetApp Data ONTAP operating system—both the Data ONTAP 7-Mode and the Clustered Data ONTAP Mode are supported in this FlexPod design. Both operating systems support SAN (Fibre Channel, and Small Computer System Interface over IP (iSCSI)), network-attached-storage (NAS), Common Internet File System (CIFS), Network File System (NFS), and enable primary and secondary storage in a single unified platform so that all virtual desktop data components can be hosted on the same storage array.

The NetApp FAS2000 Series and the NetApp FAS3000 Series support midsize enterprises, and the NetApp FAS6000 Series supports large enterprises. The NetApp FAS storage controllers provide hot-swappable redundant components with fault tolerance through clustered storage controllers that offer scalability of up to several terabytes (TB).

For additional information about NetApp storage systems, please refer to <http://www.netapp.com/us/products/storage-systems>

- Cisco Validated Design for FlexPod with Cisco Nexus 7000 Series Switches and IP-Based Storage: New Features**
- Through a single architecture, the solution supports IP protocols such as Small Computer System Interface over IP (iSCSI), NFS, and Common Internet File System (CIFS) to create an Ethernet-based, cost-efficient data center module.
 - Cisco UCS service profiles support iSCSI boot of native operating systems and, along with unified storage, deliver on-demand stateless computing resources to enable a highly scalable architecture.
 - Cisco Nexus 7000 Series Switches provide a high level of network availability for data-intensive storage applications. Along with Cisco NX-OS Software, the Cisco 7000 Series provides critical high-availability features including ISSU and NSF awareness.
 - NetApp FAS Storage Systems support flash memory and enterprise clustering to build agile, scalable, shared storage infrastructure.
 - NetApp Clustered Data ONTAP 8.1 offers unified scale-out storage deployment with up to tens of petabytes of storage.
 - VMware vSphere 5.1, coupled with NetApp Virtual Storage Console (VSC), offers an end-to-end virtual machine management system and enables awareness for VMware vSphere environments running on top of NetApp storage.

Figure 2. Components of the Cisco Validated Design for FlexPod



This FlexPod with IP-based storage reference architecture includes the Cisco UCS C-Series servers with the Cisco UCS virtual interface card (VIC), the Cisco UCS B-Series servers, the Cisco Nexus 7000 Series Switches, the Cisco Nexus 2232 10 Gigabit Ethernet fabric extenders, and the NetApp FAS3200 family of storage controllers. This infrastructure provides iSCSI-booted hosts with file-level and block-level access to shared storage data stores. It addresses the design considerations for an Ethernet storage system to increase the performance of servers for storage systems.

The reference architecture uses Cisco virtual PortChannel (vPC) technology for link aggregation across the two physical switches. The architecture also uses Cisco UCS service profiles to support iSCSI boot-up of the native operating system and enables iSCSI-booted hosts with file-level and block-level access to IP-based data stores. The reference design uses IP-based storage features such as iSCSI boot-up of Cisco UCS hosts; virtual machine data store provisioning through NFS; and application access through iSCSI, CIFS, or NFS while using NetApp FAS unified storage. Ethernet-based storage is achieved in a simple and unified manner by using features such as virtual interfaces (VIFs) and virtual LANs (VLANs), which provide superior performance compared to the traditional Fibre Channel-based storage.

VMware vSphere 5.1 features used in this validation include VMware ESXi and vCenter Server. VMware vSphere along with NetApp VSC provide end-to-end virtual machine management.

The hardware components used in the reference design for VMware vSphere 5.1 on FlexPod with IP-based storage include:

- Two Cisco Nexus 7000 Series Switches
- Two Cisco Nexus 2232 fabric extenders
- Two Cisco UCS 6248UP 48-Port Fabric Interconnects
- Cisco UCS C-Series Rack Servers
- Cisco UCS B-Series Blade Servers
- NetApp FAS3250-AE (high-availability pair)

Note: The reference design tested in this Cisco Validated Design can support 16 Cisco UCS C-Series servers without the need for additional networking components and 8 Cisco UCS B-Series servers without the need for any additional blade server chassis. Using fabric extenders, it can support hundreds of Cisco UCS C-Series or B-Series servers. This reference design uses the NetApp Target Adapter (UTA) storage connectivity; however, a standard 10 Gigabit Ethernet also can be used.

Cisco UCS Manager Release 2.1 introduced single-wire management, in which the connection between the Cisco UCS C-Series server and Cisco Nexus 2232 fabric extender supports both data and management traffic on the same cable. This new feature offers reduced cabling and denser server-to-FEX deployments. Single-wire management is the preferred mode of deployment. Please refer to the Cisco UCS configuration guides for hardware and software requirements.

The FlexPod storage configurations used in this validation effort are:

- FlexPod with NetApp Clustered Data ONTAP Mode
- FlexPod with NetApp Data ONTAP operating in 7-Mode

Figures 3 and 4 illustrate the FlexPod configurations for the iSCSI-over-Ethernet boot scenario in the NetApp Cluster Data ONTAP mode and the NetApp Data ONTAP 7-mode, respectively, and show the design elements used in each mode. Note that the configurations of Cisco UCS and Cisco Nexus elements are identical in both topologies. The FlexPod architecture uses an Ethernet VDC on each Cisco Nexus 7000 Series Switch to provide virtualization and operation efficiency to the data center infrastructure.

The NetApp FAS controller topology is different. In NetApp Clustered Data ONTAP Mode, Cisco Nexus 5596UP Switch cluster interconnects are used to network the NetApp FAS controllers and the disk storage to create a storage pool. These clustered storage pools can easily be scaled out to multiple petabytes. In NetApp Data ONTAP 7-Mode, the disk storage connects to the NetApp FAS controllers using dedicated links, as shown in Figure 4. The FlexPod design can support Cisco UCS C-Series Rack Servers using single-wire management, providing further consolidation of the infrastructure and improved rack-mount server density.

Figure 3. VMware vSphere 5.1 Built on FlexPod with IP-Based Storage: NetApp Clustered Data ONTAP Mode

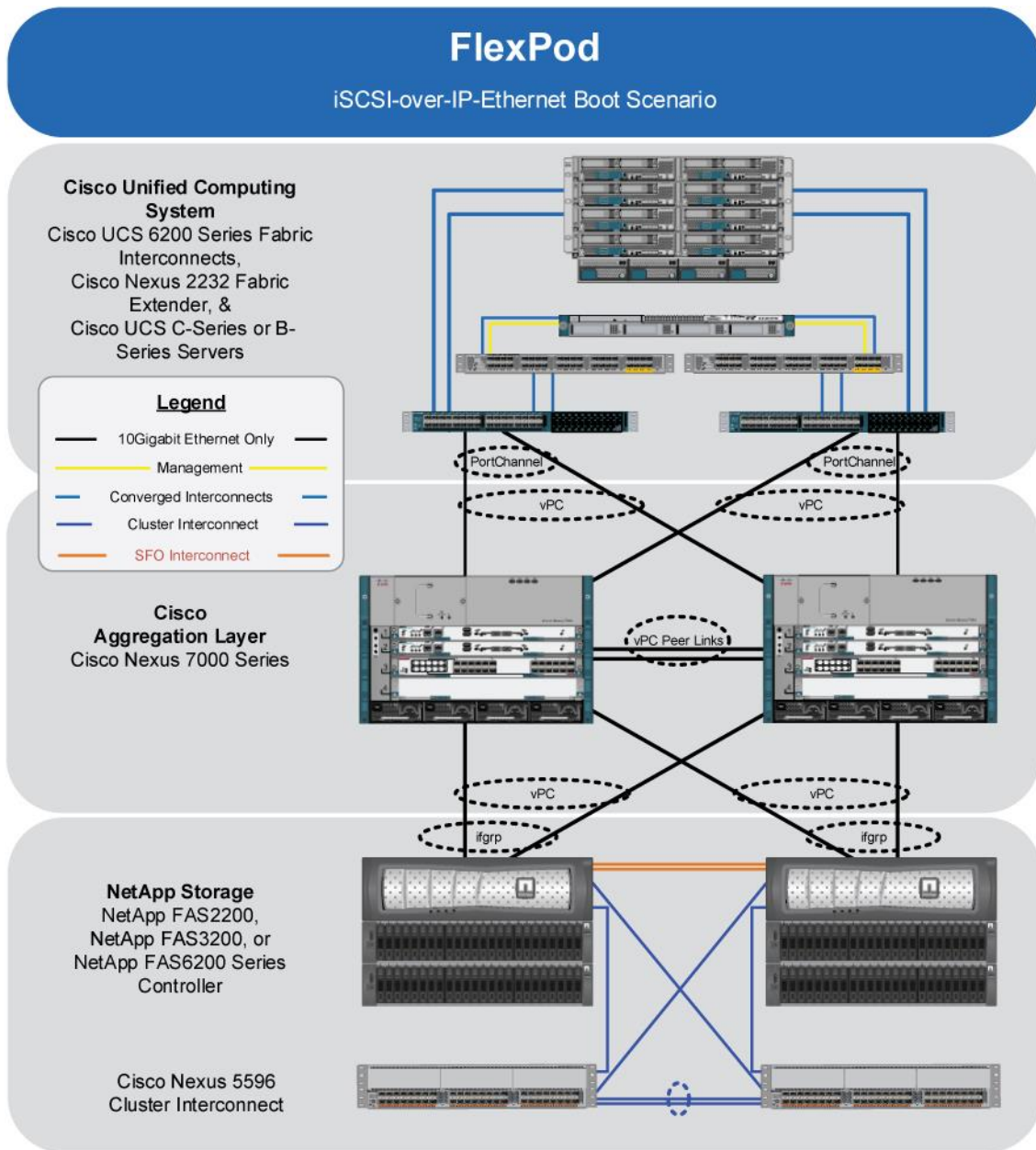
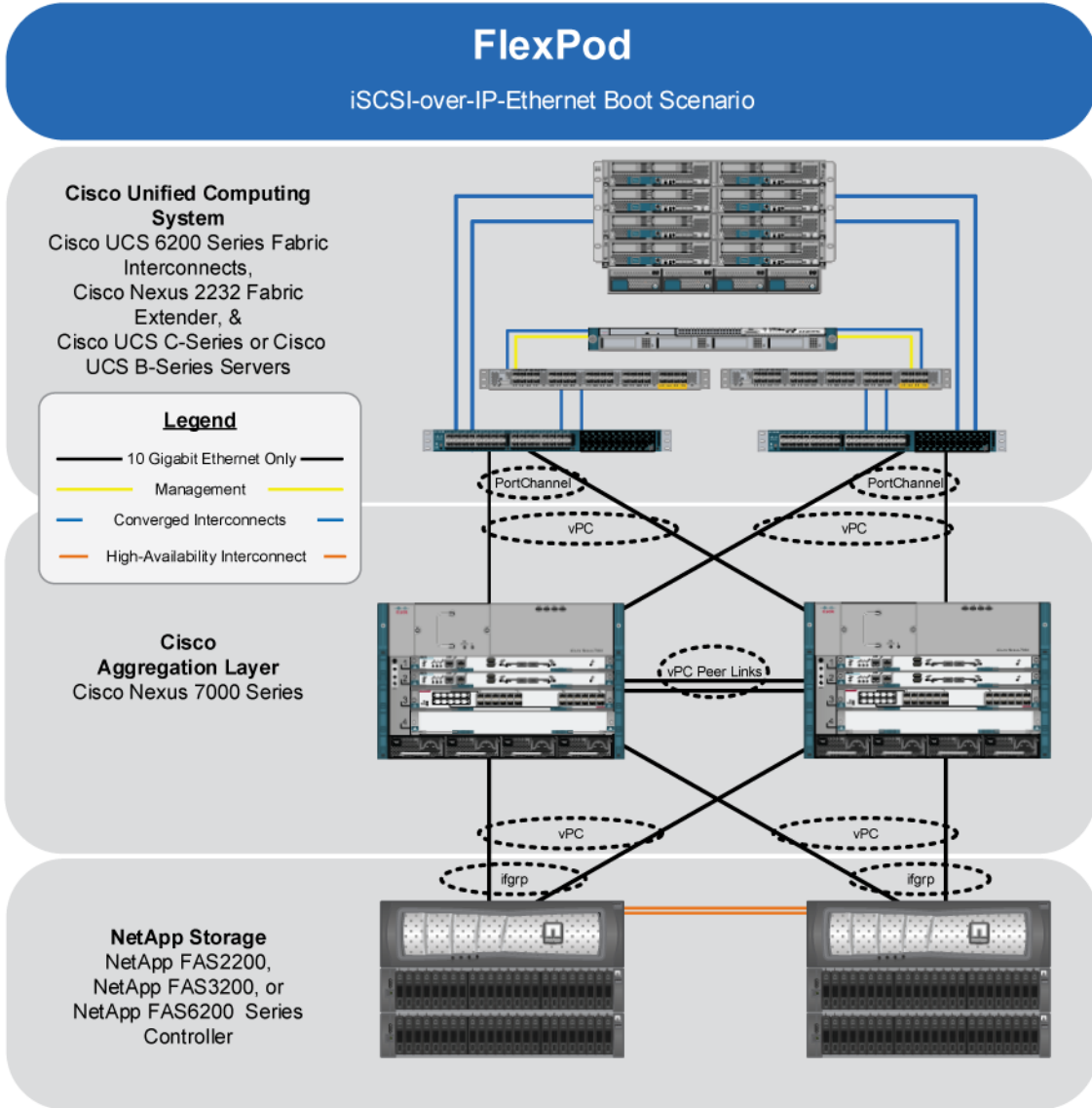


Figure 4. VMware vSphere 5.1 Built on FlexPod with IP-Based Storage: NetApp Data ONTAP Operating in 7-Mode



Hardware and Software Versions Used in the Cisco Validated Design for VMware vSphere 5.1 on FlexPod with IP-Based Storage

Table 1. FlexPod Hardware and Software Design Elements Tested in This Validated Design

Layer	Hardware or Software	Version or Release	Details
Computing	Cisco UCS fabric interconnect	2.1(1b)	Embedded management
	Cisco UCS C200 M2 Rack Server	2.1(1b)	Software bundle release
	Cisco UCS C220 M3 Rack Server	2.1(1b)	Software bundle release
	Cisco UCS B200 M2 Blade Server	2.1(1b)	Software bundle release
	Cisco UCS B200 M3 Blade Server	2.1(1b)	Software bundle release
	Cisco Ethernet network interface card (eNIC)	2.1.2.38	Ethernet driver for Cisco VIC
Network	Cisco Nexus 7000 Series	6.1(2)	Operating system version
Storage	NetApp FAS3250-A	Clustered Data ONTAP 8.1.2	Operating system version
Software	Cisco UCS hosts	VMware vSphere ESXi™ 5.1	Operating system version
	Microsoft .NET Framework	3.5.1	Feature enabled within Microsoft Windows operating system
	Microsoft SQL Server	Microsoft SQL Server 2008 R2 SP1	Virtual machine (1 each): Microsoft SQL Server Database
	VMware vCenter	5.1	Virtual machine (1 each): VMware vCenter
	NetApp OnCommand	5.1	Virtual machine (1 each): NetApp OnCommand
	NetApp VSC	4.1	Plug-in within VMware vCenter
	Cisco Nexus 1110-X Virtual Services Appliance	4.2.1.SP1.5.1a	Virtual services appliance
	Cisco Nexus 1000V Switch	4.2.1.SV2.1.1a	Virtual services blade within the Cisco Nexus 1110-X
	NetApp NFS Plug-in for VMware vStorage APIs for Array Integration (VAAI)	1.0-018	Plug-in within VMware vCenter

In addition to the configurations discussed so far, FlexPod supports a wide range of other hardware and software versions. To verify support for a specific implementation of FlexPod and to identify compatible hardware and software configurations, refer to the following compatibility guides:

- NetApps Interoperability Matrix Tool: <http://support.netapp.com/matrix/>
- Cisco UCS Hardware and Software Interoperability Tool: www.cisco.com/web/techdoc/ucs/interoperability/matrix/matrix.html
- VMware Compatibility Guide: www.vmware.com/resources/compatibility/search.php

Note: The FlexPod Cooperative Support model applies to both the FlexPod architecture component versions validated in this Cisco Validated Design and the individual component versions listed as supported in the interoperability matrix. Cooperative support is available for all FlexPod components and versions so long as customers have purchased the appropriate levels of support contracts. This approach allows customization of the FlexPod solution according to the organizations' specific requirements.

Conclusion

FlexPod is an integrated, standardized, and prevalidated data center module that can be used to build a right-sized data center for a variety of IT applications. Its flexible architecture is composed of Cisco UCS servers, Cisco Nexus network switches, and NetApp FAS storage arrays. By selecting the appropriate versions of these design elements, the customer can deploy a flexible and scalable data center optimized to meet the customer's workload requirements. The Cisco Validated Design discussed in this document focuses on the case in which VMware vSphere 5.1 is run on FlexPod with IP-based shared storage. Using this Cisco Validated Design for FlexPod as the foundation, customer IT departments can transition to a scalable, virtualized data center implementing an IP-based shared storage system in a cost-effective manner.

For More Information

FlexPod Datacenter with VMware vSphere 5.1 and Cisco Nexus 7000 Series Switches deployment guide:
http://www.cisco.com/c/en/us/td/docs/unified_computing/ucs/UCS_CVDs/flexpod_esxi_N7k.html



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