FlexPod with VMware vSphere 5.1 and Cisco Nexus 7000 Series Switches

The IT industry today faces the challenge of transitioning toward 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 a 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.

Benefits of Cisco Validated Design for FlexPod with Cisco Nexus 7000 Series Switches

- **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):**
  - 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.

Cisco FlexPod Design Elements

FlexPod is a unified data center platform, composed of Cisco UCS servers, Cisco Nexus network switches, and NetApp storage arrays. Figure 1 shows the FlexPod base configuration and design elements. The FlexPod modules can be configured to match the application requirements by mixing and matching the component versions to achieve the optimum 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 a virtualized and nonvirtualized data center.

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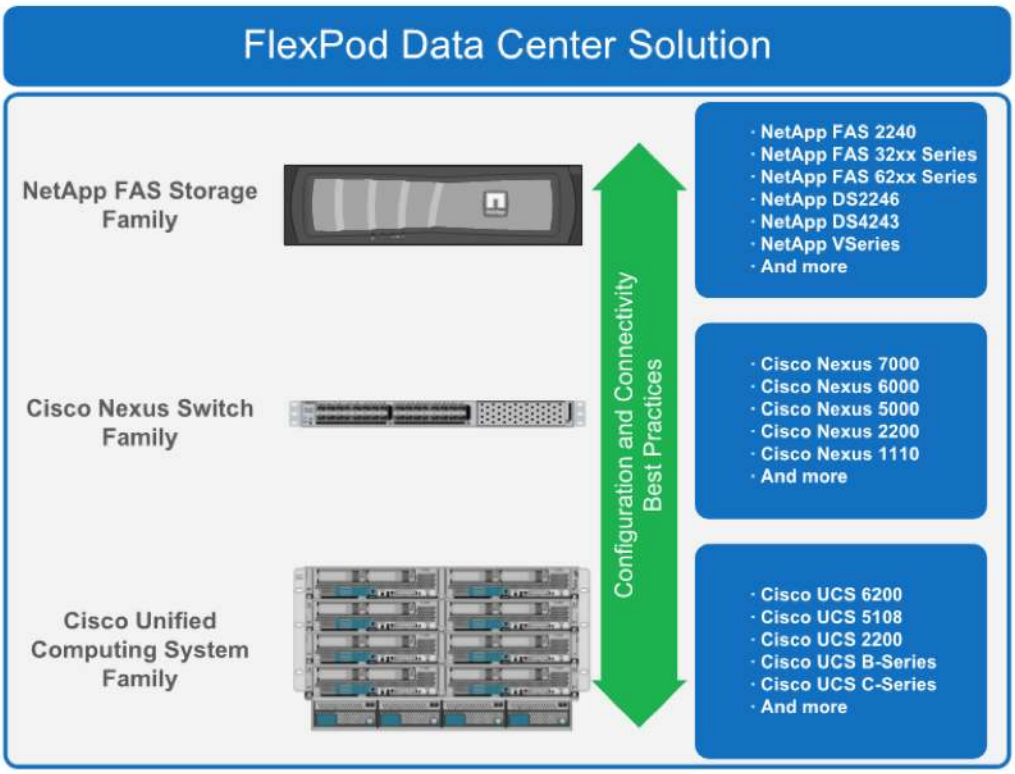
Figure 1. FlexPod Design Elements



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 and reduces 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. They 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 comprise an enterprise-class computing platform designed to deliver a broad range of IT workloads, ranging from web infrastructure to distributed databases, efficiently.

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The 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, refer to www.cisco.com/en/US/products/ps10265/index.html.

Cisco Nexus Switch Family

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 Layer 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.
- **Operational continuity:** The Cisco Nexus 7000 Series design integrates hardware, Cisco NX-OS features, and management to support zero-downtime environments.
- **Transport flexibility:** Transport flexibility enables incremental and cost-effective adoption of networking innovations and technologies.
- **Virtual device contexts (VDCs):** The Cisco NX-OS platform extends support for the VDC feature. A VDC virtualizes the physical switch as multiple unique logical devices.

In addition, the Cisco Nexus 7000 Series enables innovative technologies such as Cisco Overlay Transport Virtualization (OTV), Cisco FabricPath, Fibre Channel over Ethernet (FCoE), and Cisco Locator/ID Separation Protocol (LISP) for optimized data center deployments.

NetApp FAS Storage Family

The NetApp FAS storage system forms the scalable storage element in a FlexPod platform. It uses the NetApp Data ONTAP operating system. NetApp Data ONTAP 7-Mode and Clustered Data ONTAP Mode both are supported in this FlexPod design. Both operating systems provide SAN (FCoE, Fibre Channel, and Small Computer System Interface over IP [iSCSI]), network-attached storage (NAS) (Common Internet File System [CIFS] and Network File System [NFS]), and 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 supports midsize enterprises, and the NetApp FAS 6000 series supports large enterprises. NetApp FAS provides hot-swappable redundant components with fault tolerance through clustered storage controllers that offer scalability of up to several terabytes (TB).

Cisco Validated Design for FlexPod

The Cisco Validated Design validates the cohesive operation of industry-standard hypervisors and applications running on various FlexPod configurations. The comprehensive list of supported hypervisors, management, and FlexPod design elements and versions is illustrated in Figure 2.

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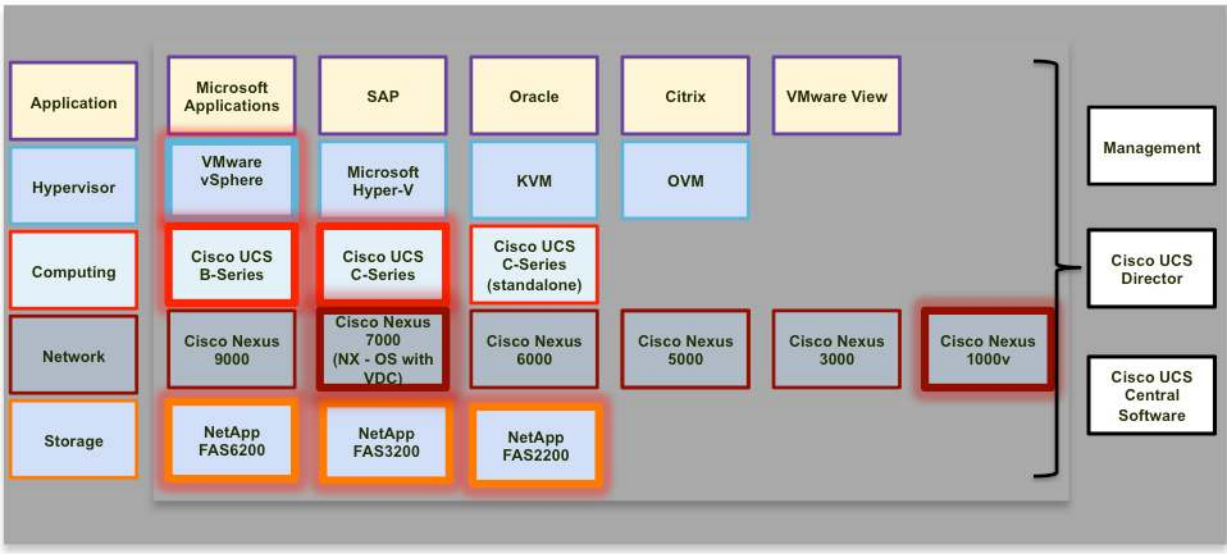
The highlighted components compose the Cisco Validated Design for FlexPod described in this document. The objective of this verification is to functionally validate VMware vSphere 5.1 on the latest FlexPod architecture for various hardware and software combinations and provide extendable infrastructure based on VMware vSphere for mixed workloads and applications. This Cisco Validated Design illustrates a typical FlexPod use case for a data center supporting diverse data-intensive, mission-critical applications and analytics. The data center interconnect (DCI) capability and high port density that the Cisco Nexus 7000 Series offers enable scalability for multidata center deployments. The VDC feature allows the switches to be virtualized at the device level.

Figure 2. Components of the Cisco Validated Design for FlexPod with Cisco Nexus 7000



Cisco Validated Design for FlexPod: New Features

- Cisco Nexus 7000 Series Switches provide the highest level of network availability for data-intensive applications. The Cisco Nexus 7000 Series chassis and line-card combinations support both low- and high-density deployment requirements.
- VDC support allows switches to be virtualized at the device level and achieves superior fault isolation, data traffic separation, and VDC-level administration and enhanced security.
- Multihop FCoE uses Fibre Channel uplinks and creates a unified Ethernet fabric, eliminating the need for Fibre Channel switches.
- Converged fabric supports multiple protocols: 10 Gigabit Ethernet, Fibre Channel, and FCoE.
- Single-wire management enables Cisco UCS Manager to manage the Cisco C-Series M3 servers using a single wire for both management and data traffic, doubling the server density and reducing cabling cost.
- Cisco Data Center VM-FEX technology unifies virtual and physical switching infrastructure to form a single virtual environment for simplicity of management and superior network utilization.
- NetApp Clustered Data ONTAP 8 offers scale-out deployment, to tens of petabytes of storage.
- VMware vSphere 5.1 provides enterprise-class hypervisor services with single sign-on (SSO) capabilities.

The Cisco Validated Design described in this document uses the FlexPod distinct uplink design architecture for validation. This is an end-to-end Ethernet transport system supporting multiple LAN and SAN protocols, including FCoE (which is used by the Cisco Nexus switches and NetApp FAS controllers). It provides a unified 10 Gigabit Ethernet–enabled fabric with dedicated FCoE uplinks and dedicated Ethernet uplinks between the Cisco UCS fabric interconnects and the Cisco Nexus switches, and converged connectivity between the NetApp storage devices and multipurpose Cisco Nexus 7000 Series platforms.

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The VMware vSphere 5.1 features used in this validation include VMware ESXi, vCenter Server, vSphere software development kits (SDKs), Virtual Machine File System (VMFS), High Availability (HA), and Distributed Resource Scheduler (DRS). 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 distinct uplink topologies for these configurations and highlight the design elements used in each mode. Note that the configurations of Cisco UCS and Cisco Nexus elements are identical in both topologies. The Cisco Nexus 7000 Series Switches, configured in N-Port ID Virtualization (NPIV) mode, provide storage services for the FCoE traffic and eliminate the need for a dedicated SAN switching environment. The FlexPod architecture uses a dedicated storage VDC on each Cisco Nexus 7000 Series Switch to allow isolation between the two SAN networks. The VDC creates the logical Ethernet and SAN switches on a single platform, delivering operational benefits for SAN and LAN teams (ownership) and the simplicity of management of a unified fabric.

The NetApp FAS controller topology is different. In Clustered Data ONTAP Mode, Cisco Nexus 5596 cluster interconnects are used to network the NetApp FAS controllers with the disk storage to create a storage pool, which can be easily scaled out to multiple petabytes. In NetApp Data ONTAP 7-Mode, the disk storage connects with 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. FlexPod Distinct Uplink Design: NetApp Clustered Data ONTAP Mode

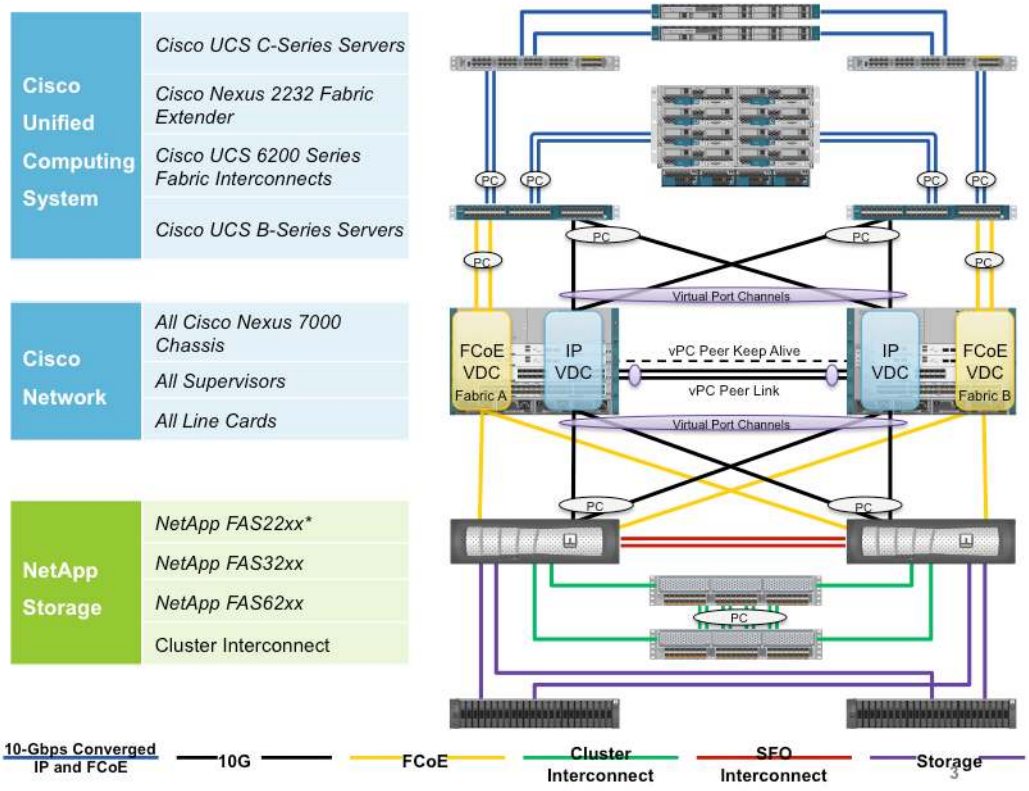

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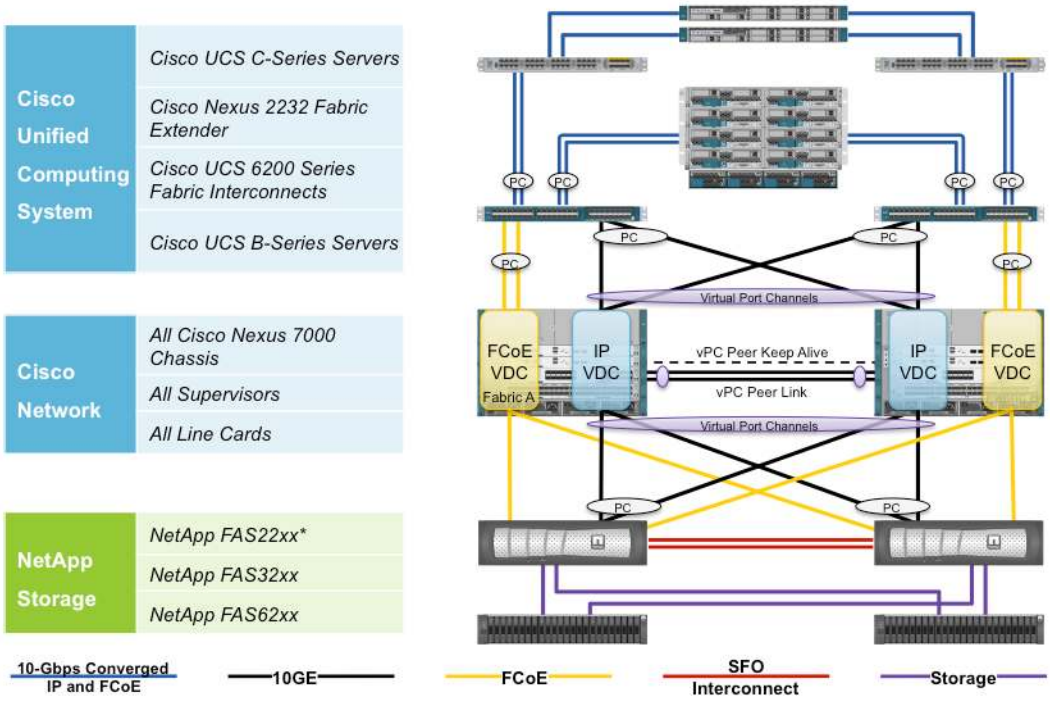
Figure 4. FlexPod Distinct Uplink Design: NetApp Data ONTAP 7-Mode



Hardware and Software Versions Used in the Cisco Validated Design

Table 1 lists the FlexPod hardware and software design elements tested in this validation effort.

Table 1. Hardware and Software Versions Used in the Cisco Validated Design for FlexPod with Cisco Nexus 7000 Series Switches

Layer	Device	Image
Computing	Cisco UCS 6200 Series Fabric Interconnects	Release 2.1(1e)
	Cisco UCS B-200 M2 Blade Servers	Release 2.1(1e)
	Cisco UCS B-200 M3 Blade Servers	Release 2.1(1e)
	Cisco UCS C-220 M2 Rack Servers	Release 2.1(1e)
	Cisco UCS C-220 M3 Rack Servers	Release 2.1(1e)
	Cisco Ethernet network interface card (E-NIC) driver	Release 2.1.2.38
	Cisco host bus adapter NIC (F-NIC) driver	Release 1.5.0.20
Network	Cisco Nexus 7000 Series	Release 6.1(2)
	(F-Series module required for FCoE support)	
Storage	NetApp FAS model 3250-AE	Clustered Data ONTAP Release 8.1.2
	Cisco Nexus 5596UP Switch cluster interconnect	Release 5.2(1)N1(1)
Software	Cisco UCS hosts	VMware vSphere ESXi Release 5.1
	Microsoft .NET Framework	Release 3.5.1
	Microsoft SQL Server	Microsoft SQL Server 2008 R2 SP1
	VMware vCenter	Release 5.1
	NetApp OnCommand System Manager	Release 5.1
	NetApp Virtual Storage Console (VSC)	Release 4.1

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	Cisco Nexus 1000V Switch	Release 4.2(1)SV2(1.1a)
	Cisco Nexus 1110-X Virtual Services Appliance	Release 4.2(1)SV1(5.1a)
	NetApp NFS Plug-in for VMware vStorage APIs for Array Integration (VAAI)	Release 1.0-018

In addition to the configurations discussed so far, FlexPod can be designed using a wide range of 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:

- NetApp 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 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. With the appropriate versions of these design elements, the customer can deploy a flexible and scalable data center optimized to meet workload requirements. The Cisco Validated Design described in this document focuses on the use case in which VMware vSphere 5.1 is run on FlexPod with Cisco Nexus 7000 Series Switches supporting VDC. Using this Cisco Validated Design for FlexPod as the foundation, customer IT departments can transition to a scalable, virtualized, high-availability data center with less cost and time.

For More Information

- Design guide for VMware vSphere 5.1 on FlexPod with Cisco Nexus 7000 Series Switches using FCoE
- NetApp Clustered Data ONTAP deployment guide
- NetApp Data ONTAP 7-Mode deployment guide

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