

FlexPod Datacenter with VMware vSphere 5.5 Update 1 and Cisco Nexus 9000 Series Switches

Overview

The IT industry today faces the challenge of transitioning to shared, 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 Datacenter solution. FlexPod Datacenter is predesigned unified computing, storage, and network infrastructure composed of Cisco Unified Computing System™ (Cisco UCS®) servers, Cisco UCS Manager, Cisco Nexus® switches, and NetApp fabric-attached storage (FAS) arrays. It provides a standard, flexible 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 Datacenter solutions, developed using various system components, configurations, and hypervisor and application software. Using a solution based on the Cisco Validated Design for FlexPod Datacenter as the baseline platform, IT customers can deploy a virtualized and cloud-enabled data center quickly, with low risk and cost. The FlexPod Datacenter 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.

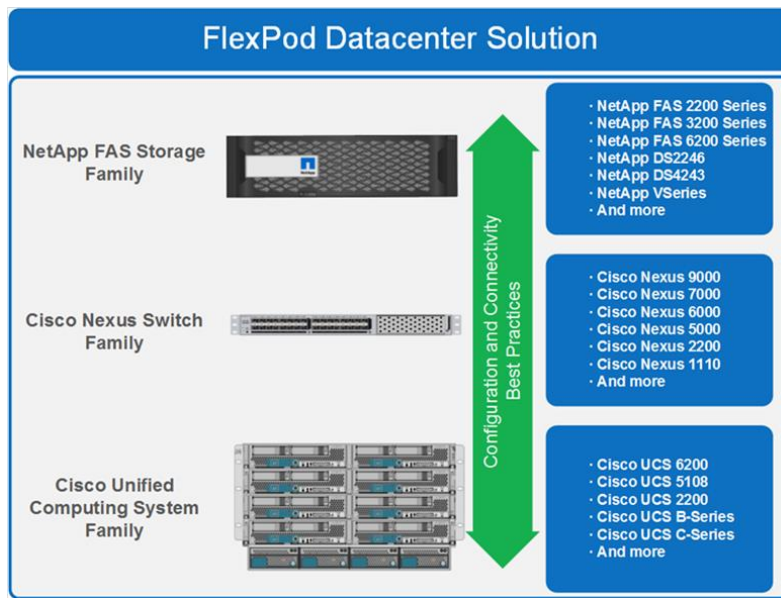
Benefits of Cisco Validated Design for FlexPod Datacenter with Cisco Nexus 9000 Series Switches and IP-Based Storage:

- **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
- **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 Datacenter 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 Datacenter instance and by adding multiple FlexPod Datacenter instances to build numerous solutions for virtualized and nonvirtualized data centers.

Figure 1. FlexPod Datacenter 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 multichassis platform. The system integrates a low-latency, lossless 10 Gigabit Ethernet unified network fabric with enterprise-class, x86-based servers. 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 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 (optionally connected through Cisco Nexus 2200 platform fabric extenders or directly to the fabric interconnects) and the blade server chassis to form a unified fabric, which becomes a single management domain, providing high availability and simplicity of management.

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.

Cisco Data Center Virtual Machine Fabric Extender (VM-FEX) virtualization and Cisco Extended Memory Technology are supported by the Cisco UCS B-Series and C-Series.

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 Central Software supports multiple data centers by centrally managing multiple Cisco UCS domains and resources.

Cisco UCS Director for FlexPod Datacenter simplifies management through centralized automation from a unified, single view.

For more information about Cisco UCS servers, refer to <http://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 Datacenter deployment. These switch platforms consist of Layer 2 and 3 nonblocking Ethernet switches with the capability to support Fibre Channel over Ethernet (FCoE) and enable a unified data center-class platform. They help 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 9000 Series Switches used in this FlexPod Datacenter validation are Cisco's state-of-the-art switches that form the foundation for Cisco Application Centric Infrastructure (ACI). ACI is a holistic architecture with centralized automation and policy-based application profiles. It offers a comprehensive, one-platform solution for the next-generation virtualized, scalable data center core network with centralized management.

The Cisco Nexus 9000 Series provides flexible support for existing traditional switches while offering a migration path to a Cisco ACI data center. It offers both modular (Cisco Nexus 9500 platform) and fixed (Cisco Nexus 9300 platform) switches to support two modes of operation: NX-OS standalone mode and ACI mode.

In NX-OS standalone mode, the Cisco Nexus 9000 Series provides state-of-the-art switch capabilities, including high port density, low latency, and 40 Gigabit Ethernet connectivity.

In ACI mode, the Cisco Nexus 9000 Series runs in fabric mode, which enables centralized automation and management through application-based policy profiles and multitenancy in hardware.

Note that this Cisco Validated Design uses only the NX-OS standalone mode of the Cisco Nexus 9000 Series.

The primary features of the Cisco Nexus 9000 Series include:

- **Modular and fixed-port switch configurations:** Enables cost-effective, high-performance, application-centric infrastructure
- **Nonblocking 10 and 40 Gigabit Ethernet configurations:** Helps provide a transparent transition to support the increased bandwidth demands of scale-out, multimode application environments
- **Predictable high performance:** Delivers up to 60 terabytes per second (TBps) with a latency of less than 5 microseconds to enable data centers that can be scaled to more than 200,000 server ports

-
- **Programmability:** Provides Cisco intelligent APIs, Linux shell access, and a command-line interface (CLI for Python scripting to simplify customized and remote management and monitoring
 - **Flexible and power efficient chassis:** Uses a superior airflow model that allows future expansion through the capability to add high-bandwidth line cards and fabric modules and power supplies
 - **Transparent migration to ACI:** Supports traditional switch mode operation (using the standalone configuration) with the flexibility to migrate to fabric mode operation through an ACI configuration
 - **Link aggregation and resiliency:** Along with Cisco UCS, supports active port channeling using Link Aggregation Control Protocol (LACP) and virtual PortChannel (vPC) technology and offers excellent link fault tolerance and load balancing
 - **Operational continuity:** Integrates hardware, Cisco NX-OS features, and management to support zero-downtime environments

For more information about the Cisco Nexus 9000 Series, refer to

<http://www.cisco.com/c/en/us/products/switches/nexus-9000-series-switches/index.html>.

NetApp FAS

NetApp FAS forms the scalable storage element in a FlexPod Datacenter platform. It uses the NetApp Data ONTAP operating system. NetApp Data ONTAP supports SAN (Fibre Channel and Small Computer System Interface over IP [iSCSI]), network-attached-storage (NAS), Common Internet File System (CIFS), and Network File System (NFS) protocols. It enables 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 FlexPod design described in this verification effort uses the clustered Data ONTAP mode of the NetApp Data ONTAP operating system.

This FlexPod Datacenter implementation uses the NetApp FAS8000 Series unified storage systems. The FAS8000 design is optimized for scale-out storage infrastructure. It supports business-critical workloads that need massive performance and scalability capabilities. It unifies SAN and NAS storage infrastructure and uses high-performance NVRAM memory modules to increase application throughput. It integrates unified target adapter (UTA2) ports for 16-Gbps Fibre Channel, 10 Gigabit Ethernet, and FCoE.

For additional information about NetApp storage systems, refer to

<http://www.netapp.com/us/products/storage-systems>.

Cisco Validated Design for FlexPod with Cisco Nexus 9000 Series Switches and NetApp FAS8000 Series Storage Arrays: New Features

- Through a single IP-based storage architecture, the solution supports both NAS data stores and iSCSI-based SAN logical unit numbers (LUNs) to create an Ethernet-based cost-effective 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.
- The solution includes Cisco Nexus 9000 Series Switches, which form the foundation for Cisco ACI and enable transparent, easy migration to future ACI data center architecture.
- The Cisco Nexus 9000 Series provides end-to-end IP-based storage, supporting SANs that use iSCSI.
- The NetApp FAS8000 Series offers a high-performance, unified scale-up or scale-out storage system that can be scaled easily to suit workload needs.
- The latest release of NetApp Data ONTAP 8.2 operating system in clustered Data ONTAP mode offers unified scale-out storage deployment with up to tens of petabytes of storage and supports midsize to large enterprises.
- VMware vSphere 5.5 Update 1 delivers high availability through VMware vSphere Fault Domain Manager (FDM) technology and offers dynamic workload distribution through VMware Distributed Resource Scheduler (DRS).
- VMware vSphere 5.5 Update 1 implements VMware Update Manager for patch management and vSphere Web Client for ease of management.

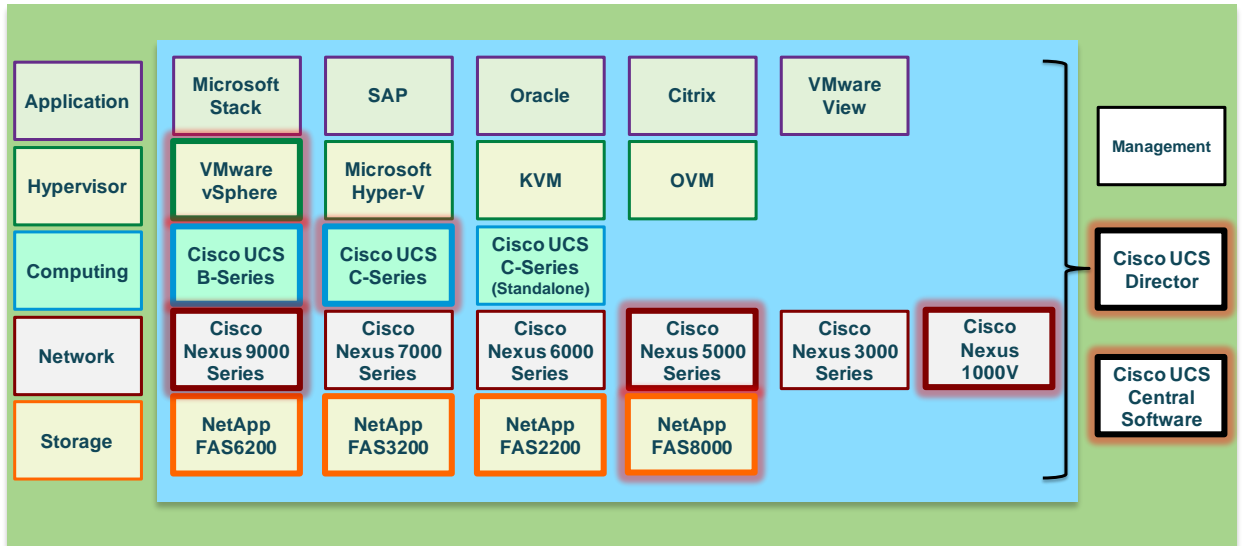
Cisco Validated Design for FlexPod Datacenter

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

The highlighted components make up the Cisco Validated Design for FlexPod described in this solution brief. This Cisco Validated Design illustrates a typical FlexPod Datacenter architecture with shared storage using IP storage protocols such as iSCSI, CIFS, and NFS and provides a simple, cost-effective solution compared to a traditional Fibre Channel SAN architecture. The objective of this verification is to functionally validate the FlexPod Datacenter solution with IP-based storage architecture that can support VMware vSphere 5.5 Update 1 (U1), VMware vCenter with NetApp plug-ins, and NetApp OnCommand.

This FlexPod Datacenter architecture serves as the foundation for an end-to-end IP-based storage solution that can migrate to an ACI data center in future. It supports SAN access using iSCSI. The solution provides 10 and 40 Gigabit Ethernet capable unlinks to the Cisco UCS fabric interconnects and NetApp FAS storage controllers and provides an extendable VMware vSphere solution for mixed workloads and applications.

Figure 2. Components of the Cisco Validated Design for FlexPod with Cisco Nexus 9000 Series Switches and IP-Based Storage



This FlexPod Datacenter with IP-based storage reference architecture includes Cisco UCS C-Series servers with Cisco UCS virtual interface cards (VICs), Cisco UCS B-Series servers, Cisco Nexus 9000 Series Switches, Cisco Nexus 5596UP Switch clustered interconnects, and NetApp FAS8040 storage controllers.

The FlexPod Datacenter design elements support active port channeling using IEEE 802.3d standard LACP to achieve load balancing and fault tolerance. The reference architecture uses Cisco 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. It 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.

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 FlexPod Datacenter 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. The “wire-once” strategy eliminates the need for recabling between hosts to the Cisco UCS fabric interconnects as more storage is added to the architecture

The VMware vSphere 5.5 Update 1 features used in this validation include:

- VMware vSphere FDM technology, offering virtual machine resiliency in the event of physical server or guest OS failure
- VMware DRS, offering dynamic workload distribution to improve resource utilization
- VMware vSphere ESXi hypervisor, providing efficient virtual machine abstraction
- Virtual Machine File System (VMFS), supporting simultaneous memory access for multiple hosts

The hardware components used in the reference design for VMware vSphere 5.5 Update 1 on FlexPod Datacenter with IP-based storage include:

- Two Cisco Nexus 9000 Series Switches
- Two Cisco Nexus 5596UP clustered interconnects
- Two Cisco UCS 6248UP 48-Port Fabric Interconnects
- Cisco UCS C-Series Rack Servers
- Cisco UCS B-Series Blade Servers
- NetApp FAS8040 (high-availability pair) running the clustered Data ONTAP operating system

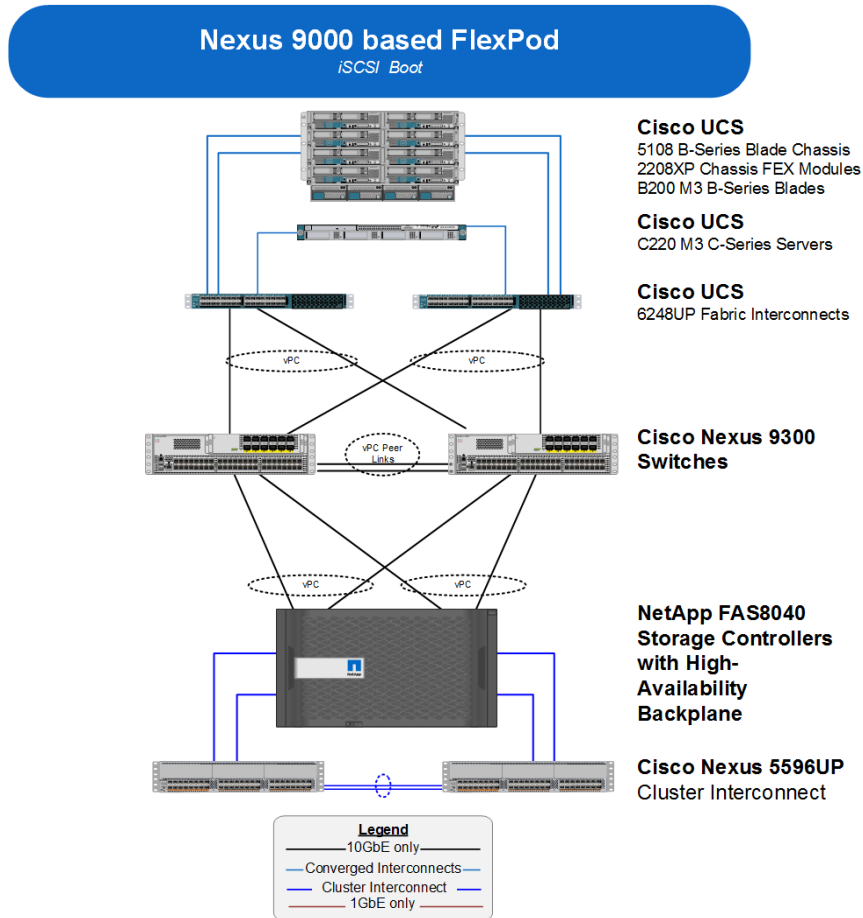
Note: This reference architecture provides support for 32 Cisco UCS C-Series servers with no requirement for any additional networking components. It also supports 8 Cisco UCS B-Series servers without any additional blade server chassis. By using additional fabric extenders and blade server chassis, 160 Cisco UCS C-Series and B-Series servers can be supported to increase the computing capacity.

The validation effort described in this document uses the FlexPod Datacenter storage configuration with a Cisco Nexus 9000 standalone design and NetApp Data ONTAP operating system running in clustered mode.

Figure 3 shows the design elements used in FlexPod Datacenter configuration for IP-based storage in NetApp clustered Data ONTAP mode. The FlexPod Datacenter architecture uses an Ethernet virtual device context (VDC) on each Cisco Nexus 9000 Series Switch to provide virtualization and operation efficiency to the data center infrastructure.

In this mode, the Cisco Nexus 5596UP clustered interconnects are used as shown in Figure 3, 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 by adding storage capacity to an existing high-availability pair or by adding storage clusters.

Figure 3. VMware vSphere 5.5 Update 1 Built on FlexPod Datacenter with IP-Based Storage and Cisco Nexus 9000 Series in Standalone Mode with NetApp Clustered Data ONTAP Mode



Software Versions Used in the Cisco Validated Design for VMware vSphere 5.5 Update 1 on FlexPod with IP-Based Storage

Table 1 lists the hardware and software versions used in the Cisco Validated Design FOR VMware vSphere 5.5 U1 on FlexPod with IP-Based Storage.

Table 1. Hardware and Software Versions

Layer	Device	Version or Release	Details
Computing	Cisco UCS fabric interconnect	2.2(2c)	Embedded management
	Cisco UCS C220 M3	2.2(2c)	Software bundle release
	Cisco UCS B200 M3	2.2(2c)	Software bundle release
	Cisco eNIC	2.1.2.42	Ethernet driver for Cisco VIC
Network	Cisco Nexus 9396PX Switch	6.1.(2)I2(1)	Operating system version
Storage	NetApp FAS8040	Clustered Data ONTAP 8.2.1	Operating system version
	Nexus 5596UP cluster interconnect	5.2(1)N1(1)	Operating system version
Software	Cisco UCS hosts	VMware vSphere ESXi 5.5u1	Operating system version
	Microsoft SQL Server	Microsoft SQL Server 2008 R2 SP1	Virtual machine (1 each): SQL Server database

Layer	Device	Version or Release	Details
	VMware vCenter	5.5u1	Virtual machine (1 each): vCenter
	NetApp OnCommand	6.1	Virtual machine (1 each): OnCommand
	NetApp Virtual Storage Console (VSC)	5	Plug-in for vCenter
	Cisco Nexus 1110-X Virtual Services Appliance	5.2(1)SP1(7.1)	Virtual services appliance
	Cisco Nexus 1000V	4.2.1.SV2(2.2)(Advanced Edition)	Virtual services blade in the Cisco Nexus 1110-X
	NetApp NFS plug-in for VMware vStorage APIs for array vStorage APIs for array integration (VAAI)	1.0-021	Plug-in for vCenter
	Cisco UCS Director	5	Cisco UCS Director virtual machine

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: <http://www.cisco.com/web/techdoc/ucs/interoperability/matrix/matrix.html>
- VMware Compatibility Guide: <http://www.vmware.com/resources/compatibility/search.php>

Note: The FlexPod Cooperative Support model applies to both the FlexPod Datacenter 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 Datacenter solution according to the organizations' specific requirements.

Conclusion

FlexPod Datacenter 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 use case running VMware vSphere 5.5 Update 1 on FlexPod Datacenter built using Cisco UCS M3 blade servers, Cisco Nexus 9000 Series Switches, and the NetApp FAS 8000 Series storage system to provide an end-to-end IP-based shared storage solution. By using this Cisco Validated Design for FlexPod Datacenter as the foundation, customer IT departments can transition to a Cisco ACI virtualized data center implementing an IP-based shared storage system in a cost-effective manner.

For More Information

See the FlexPod Datacenter with VMware vSphere 5.5 Update 1 and Cisco Nexus 9000 Series Switches deployment guide at

http://www.cisco.com/c/dam/en/us/td/docs/unified_computing/ucs/UCS_CVDs/flexpod_esxi55u1_n9k.pdf.



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 or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: 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. (1110R)