



Technical Report

FlexPod Datacenter Technical Specifications

David Klem, Lindsey Street, John George, Chris Reno, NetApp
September 2015 | TR-4036

TABLE OF CONTENTS

1	FlexPod Datacenter Architecture	6
2	Definition of FlexPod Rules	6
3	NetApp Data ONTAP Modes of Operation	6
4	Modes of Operation for Cisco Nexus Switching	6
5	Minimum Hardware Requirements	7
6	Minimum Software Requirements	7
7	Connectivity Requirements	8
8	Other Requirements	8
9	Optional Features	9
9.1	Requirements for Classic FCP SAN Boot Option	9
9.2	Requirements for FCoE SAN Boot Option	9
9.3	Requirements for iSCSI Boot Option	9
9.4	Additional Configuration Information	10
10	Cisco Components	11
10.1	Cisco UCS B-Series Chassis Option	11
10.2	Cisco UCS B-Series Blade Server Options	11
10.3	Cisco UCS C-Series Rack-Mount Server Options	11
10.4	Cisco UCS Fabric Interconnect Options	12
10.5	Cisco Nexus 5000 Series Switch Options	12
10.6	Cisco Nexus 6000 Series Switch Options	13
10.7	Cisco Nexus 7000 Series Switch Options	13
10.8	Cisco Nexus 9000 Series Switch Options	13
10.9	Cisco APIC Options	14
10.10	Cisco Nexus Fabric Extender Options	14
10.11	Cisco Software Licensing Options	14
10.12	Cisco Support Licensing Options	15
11	NetApp Components	15
11.1	NetApp Storage Controller Options	15
11.2	Cluster Interconnect Switch Options	16
11.3	NetApp Ethernet Expansion Module Options	16
11.4	NetApp Disk Shelf and Disk Drive Options	17
11.5	NetApp Software Licensing Options	18

11.6 NetApp Support Licensing Options	18
12 Power and Cabling Requirements	18
12.1 Power Requirements	18
12.2 Minimum Cable Requirements	20
13 Legacy Equipment.....	22
14 Technical Specifications and References.....	23
14.1 Cisco UCS B-Series Blade Server Chassis	23
14.2 Cisco UCS B-Series Blade Servers	23
14.3 Cisco UCS C-Series Rack-Mount Servers.....	25
14.4 Cisco UCS VIC Adapters for Cisco UCS B-Series Blade Server	26
14.5 Cisco UCS Fabric Interconnects	27
14.6 Cisco Nexus 5000 Series Switches	27
14.7 Cisco Nexus 6000 Series Switches	28
14.8 Cisco Nexus 7000 Series Switches	29
14.9 Cisco Nexus 9000 Series Switches	29
14.10 Cisco Application Policy Infrastructure Controller	30
14.11 Cisco Nexus Fabric Extender Details	31
14.12 Small Form-Factor Pluggable Modules	31
14.13 NetApp Storage Controllers.....	32
14.14 Legacy Equipment.....	35
14.15 NetApp Ethernet Adapters.....	36
14.16 NetApp Disk Shelves.....	36
14.17 NetApp Disk Drives	36
15 Additional Validated Connectivity Options.....	37
Version History	38

LIST OF TABLES

Table 1) Cisco UCS B-Series chassis option.	11
Table 2) Cisco UCS B-Series blade server options.....	11
Table 3) Cisco UCS C-Series rack-mount server options.....	11
Table 4) Cisco UCS fabric interconnect options.	12
Table 5) Cisco Nexus 5000 series switch options.	12
Table 6) Cisco Nexus 6000 series switch options.	13
Table 7) Cisco Nexus 7000 series switch options.	13

Table 8) Cisco Nexus 9000 series switch options.	13
Table 9) Cisco APIC sizes.	14
Table 10) Cisco Nexus FEX option.	14
Table 11) Cisco software licensing options.	15
Table 12) Cisco support licensing options.	15
Table 13) NetApp storage controller options.	16
Table 14) Cluster interconnect switch options.	16
Table 15) Ethernet expansion module options.	17
Table 16) NetApp disk shelf options.	17
Table 17) NetApp software licensing options.	18
Table 18) NetApp support licensing options.	18
Table 19) Required power ports.	19
Table 20) Minimum cable requirements.	20
Table 21) Legacy equipment.	22
Table 22) Cisco UCS B-Series blade server chassis options.	23
Table 23) Cisco UCS B-Series blade server options.	23
Table 24) Cisco UCS B-Series blade server options.	24
Table 25) Cisco UCS B-Series blade server datasheets.	24
Table 26) Cisco UCS C-Series rack-mount server options (1).	25
Table 27) Cisco UCS C-Series rack-mount server options (2).	25
Table 28) Cisco UCS C-Series rack-mount server datasheets.	25
Table 29) Cisco UCS VIC adapters (1).	26
Table 30) Cisco UCS VIC adapters (2).	26
Table 31) Cisco UCS VIC adapter datasheets.	26
Table 32) Cisco UCS fabric interconnect options.	27
Table 33) Cisco UCS fabric interconnect datasheets.	27
Table 34) Cisco Nexus 5000 series switch options.	27
Table 35) Cisco Nexus 5000 series switch datasheets.	28
Table 36) Cisco Nexus 6000 series switch options.	28
Table 37) Cisco Nexus 6000 series switch datasheets.	28
Table 38) Cisco Nexus 7000 series switch options.	29
Table 39) Cisco Nexus 7000 series switch options continued.	29
Table 40) Cisco Nexus 6000 series switch datasheets.	29
Table 41) Cisco Nexus 9000 series switch options.	30
Table 42) Cisco Nexus 9000 series switch datasheets.	30
Table 43) Cisco APIC specifications.	30
Table 44) Cisco Nexus 9000 series switch datasheets.	31
Table 45) Ethernet SFP modules.	31
Table 46) FC SFP modules.	31
Table 47) FAS8000 series controller options.	32

Table 48) AFF8000 series controller options.....	32
Table 49) FAS6000 series controller options.....	33
Table 50) FAS3000 series controller options.....	34
Table 51) FAS2500 series controller options.....	34
Table 52) FAS2200 series controller options.....	35
Table 53) Legacy equipment.....	35
Table 54) NetApp 10GbE adapters.....	36
Table 55) NetApp disk shelves.....	36
Table 56) NetApp disk drives.....	36

LIST OF FIGURES

Figure 1) FCoE boot scenario.....	10
Figure 2) iSCSI boot scenario.....	37
Figure 3) FC boot scenario.....	38

1 FlexPod Datacenter Architecture

FlexPod[®] is a predesigned, best-practice data center architecture that is built on the Cisco[®] Unified Computing System[™] (Cisco UCS[®]), the Cisco Nexus[®] family of switches, and NetApp[®] fabric-attached storage (FAS) or V-Series systems.

FlexPod is a suitable platform for running a variety of virtualization hypervisors as well as bare metal operating systems and enterprise workloads. FlexPod delivers not only a baseline configuration but also the flexibility to be sized and optimized to accommodate many different use cases and requirements.

Note: Before ordering a complete FlexPod configuration, refer to the [NetApp FlexPod Solutions](#) page for the latest version of these technical specifications.

Note: For an overview of FlexPod reference architectures, refer to the [FlexPod Solutions Guide](#).

Note: For an overview of FlexPod reference architectures with Cisco Application Centric Infrastructure, refer to the [FlexPod Datacenter with ACI Solutions Guide](#).

2 Definition of FlexPod Rules

The FlexPod design allows a flexible infrastructure that encompasses many different components and software versions.

Use the rule sets as a guide for building or assembling a valid FlexPod configuration. The numbers and rules listed are the minimum requirements for FlexPod; they can be expanded in the included product families as required for different environments and use cases.

3 NetApp Data ONTAP Modes of Operation

The NetApp Data ONTAP[®] operating system is the common operating system that is installed on every NetApp storage system and is configured to operate as clustered Data ONTAP or in 7-Mode.

FlexPod is validated with both modes of operation, with clustered Data ONTAP providing a highly scalable storage architecture that enables nondisruptive operations, nondisruptive upgrades, and an agile data infrastructure. For more information about clustered Data ONTAP, refer to [NetApp Data ONTAP: Scale-out Storage to Achieve Nondisruptive Operations](#).

4 Modes of Operation for Cisco Nexus Switching

A variety of Cisco Nexus products can be used as the switching component of a given FlexPod deployment. The majority of these options leverage the traditional Cisco Nexus OX or NX-OS software. The Cisco Nexus family of switches offers varying capabilities within its product lines. These capabilities are detailed later in this document.

Cisco's offering in the software-defined networking (SDN) space is called Application Centric Infrastructure (ACI). The Cisco Nexus product line that supports the ACI mode, also called fabric mode, is the 9300 series. These switches can also be deployed in NX-OS or standalone mode.

Cisco ACI is targeted at data center deployments that focus on the requirements of a specific application. Applications are instantiated through a series of profiles and contracts that allow for connectivity from the host or virtual machine all the way through the network to the storage.

FlexPod is validated with both modes of operation of the Cisco Nexus switches. For more information about the ACI and the NX-OS modes, refer to the following Cisco pages:

- [Cisco Application Centric Infrastructure](http://www.cisco.com/c/en/us/solutions/data-center-virtualization/application-centric-infrastructure/index.html)<http://www.cisco.com/c/en/us/solutions/data-center-virtualization/application-centric-infrastructure/index.html>

- [Cisco NX-OS Software](#)

5 Minimum Hardware Requirements

A FlexPod configuration has minimum hardware requirements including, but not limited to, switches, fabric interconnects, servers, and FAS controllers.

You must use Cisco Unified Computing System (UCS) servers. Both C-Series and B-Series servers have been used in the validated designs. You can choose B-Series servers, which require chassis and blades, or the C-Series servers, which require rack-mount servers. Cisco Nexus Fabric Extenders (FEXs) are optional with C-Series servers.

A FlexPod configuration has the following minimum hardware requirements:

- Two Cisco Nexus switches in a redundant configuration. This configuration can consist of two redundant switches from the Cisco Nexus 5000, 6000, 7000, or 9000 series. The two switches should be of the same model and be configured in the same mode of operation.

Note: If you are deploying an ACI architecture, you must observe the following additional requirements:

- Deploy the Cisco Nexus 9000 series switches in a spine-leaf topology.
- Use three Cisco Application Policy Infrastructure Controllers (APICs).
- Two Cisco UCS 6100, 6200, or 6300 series fabric interconnects in a redundant configuration.
- Cisco UCS servers:
 - If the solution uses B-Series servers, one Cisco UCS 5000 B-Series blade chassis plus two Cisco UCS B-Series blade servers plus two 2104, 2204, or 2208 FEX modules.
 - If the solution uses C-Series servers, two Cisco UCS C-Series rack-mount servers.

Note: For larger deployments of Cisco UCS C-Series rack-mount servers, a pair of 2232PP FEX modules may be desirable. However, the 2232PP is not a hardware requirement.

- Two NetApp FAS controllers in a high-availability (HA) pair configuration.

Note: This configuration can consist of products from the NetApp FAS2000, 3000, 6000, or 8000 family of controllers.

 - The HA configuration requires two redundant interfaces per controller for data access; the interfaces can be Fibre Channel over Ethernet (FCoE), Fibre Channel (FC), or 10 Gigabit Ethernet (10GbE).
 - If the solution uses clustered Data ONTAP, a cluster interconnect topology approved by NetApp is required. For more information, refer to [Cluster Management and Interconnect Switches](#).
 - If the solution uses clustered Data ONTAP, at least two additional 10GbE ports per controller are required for data access.
 - For clusters with two nodes, a two-node switchless cluster can be configured.
 - For clusters with more than two nodes, a cluster interconnect is required.
- One NetApp disk shelf with any supported disk type.

6 Minimum Software Requirements

A FlexPod configuration has the following minimum software requirements:

- NetApp Data ONTAP:
 - 7-Mode requires Data ONTAP 7.3.5 or later, including Data ONTAP 8.X
 - Clustered Data ONTAP requires Data ONTAP 8.1.1 or later

- Cisco UCS Manager 1.3 or later, including Cisco UCS 2.X
- For Cisco Nexus 5000 series switches, Cisco NX-OS software release 5.0(3)N1(1c) or later, including NX-OS 5.1.X
- For Cisco Nexus 6000 series switches, Cisco NX-OS software release 6.0(2)N2(3) or later
- For Cisco Nexus 7000 series switches:
 - The 4-slot chassis requires Cisco NX-OS software release 6.1(2) or later
 - The 9-slot chassis requires Cisco NX-OS software release 5.2 or later
 - The 10-slot chassis requires Cisco NX-OS software release 4.0 or later
 - The 18-slot chassis requires Cisco NX-OS software release 4.1 or later
- For Cisco Nexus 9000 series switches, Cisco NX-OS software release 6.1(2) or later

Note: All software used in a FlexPod configuration must be listed and supported in the NetApp [Interoperability Matrix Tool \(IMT\)](#). Some features may require more recent releases of the software than the ones listed.

7 Connectivity Requirements

A FlexPod configuration has the following connectivity requirements:

- The port-channel ports on the NetApp storage controllers must be directly connected to the Cisco Nexus 5000, 6000, 7000, or 9000 series switches because the Cisco UCS fabric interconnects do not support virtual port channels (vPCs).
- vPCs are required from the Cisco Nexus 5000, 6000, 7000, or 9000 series switches to the NetApp storage controllers.
- The Cisco UCS fabric interconnect appliance ports are recommended only for SAN protocols (FC, FCoE, and iSCSI). FCoE port channels between the fabric interconnects and the Cisco Nexus switches are recommended for end-to-end FCoE designs.
- No additional equipment can be placed inline between the core FlexPod components.
- vPCs are required from the Cisco Nexus 5000, 6000, 7000, or 9000 series switches to the fabric interconnects.
- FCoE port channels are recommended for end-to-end FCoE designs.
- Jumbo frame support must be enabled throughout the environment.
- A separate 100MbE/GbE out-of-band management network is required.

8 Other Requirements

FlexPod has the following additional interoperability and support-related requirements:

- All hardware and software components must be listed and supported on the [Interoperability Matrix Tool \(IMT\)](#), the Cisco UCS Hardware Compatibility List (HCL), and the Cisco UCS Hardware and Software Interoperability Matrix.
- If V-Series components are used with Data ONTAP 7-Mode, they must be listed and supported in the V-Series/gFile Gateway Support Matrix. In clustered Data ONTAP 8.2 and later, this feature is called NetApp FlexArray, and the compatibility information is detailed in the NetApp [IMT](#).
- Valid support contracts are required for all equipment, including:
 - SMARTnet® support for Cisco equipment
 - SupportEdge Premium support for NetApp equipment

For more information, refer to the NetApp [IMT](#) and the [V-Series/gFile Gateway Support Matrix](#).

9 Optional Features

For FlexPod architectures, NetApp recommends leveraging SAN technologies to allow stateless computing of Cisco UCS servers and data access. Multiple SAN options are available and valid in a FlexPod configuration, and each has different requirements.

9.1 Requirements for Classic FCP SAN Boot Option

The classic Fibre Channel Protocol (FCP) SAN boot option has the following licensing and hardware requirements:

- When Fibre Channel zoning is done in the Cisco Nexus 5000 series switch, a Storage Protocols Service Package license for the Cisco Nexus 5000 series switches (FC_FEATURES_PKG) is required.
- When Fibre Channel zoning is done in the Cisco Nexus 5000 series switch, SAN links are required between the fabric interconnect and the Cisco Nexus 5000 series switch. For additional redundancy, SAN port channels are recommended between the links.
- The Cisco Nexus 5010, 5020, and 5548P model switches require a separate FC or universal port (UP) module for connectivity into the Cisco UCS fabric interconnect and into the NetApp storage controller.
- Each NetApp storage controller requires a minimum of two 2/4/8Gb FC ports for connectivity.
- Requires an FCP license on the NetApp storage controller.

Note: The use of the Cisco Nexus 6000, 7000, or 9000 family of switches precludes the use of classic FC unless Fibre Channel zoning is done in the fabric interconnect. In this case, SAN uplinks to the switch are not supported.

9.2 Requirements for FCoE SAN Boot Option

The FCoE SAN boot option has licensing and hardware requirements.

- When Fibre Channel zoning is done in the switch, a Storage Protocols Service Package license for the Cisco Nexus 5000, 6000, or 7000 series switches (FC_FEATURES_PKG) is required.
- When Fibre Channel zoning is done in the switch, FCoE uplinks are required between the fabric interconnect and the Cisco Nexus 5000, 6000, or 7000 series switches, and FCoE port channels are recommended between the links for additional redundancy.
- Each NetApp storage controller requires at least one dual-port unified target adapter (UTA) add-on card for FCoE connectivity unless onboard unified target adapter 2 (UTA2) ports are present.
- The option requires an FCP license on the NetApp storage controller.
- If you use the Cisco Nexus 7000 series switches or the Cisco Nexus 6004 switch and Fibre Channel zoning is done in the switch, a line card capable of supporting FCoE is required.

Note: The use of the Cisco Nexus 9000 series switches precludes the use of FCoE unless Fibre Channel zoning is done in the fabric interconnect and storage is connected to the fabric interconnects with appliance ports. In this case, FCoE uplinks to the switch are not supported.

9.3 Requirements for iSCSI Boot Option

The iSCSI boot option has the following licensing and hardware requirements:

- An iSCSI license on the NetApp storage controller is required.
- An adapter in the Cisco UCS server capable of iSCSI boot is required.
- A two-port 10Gb/sec Ethernet adapter on the NetApp storage controller is required.

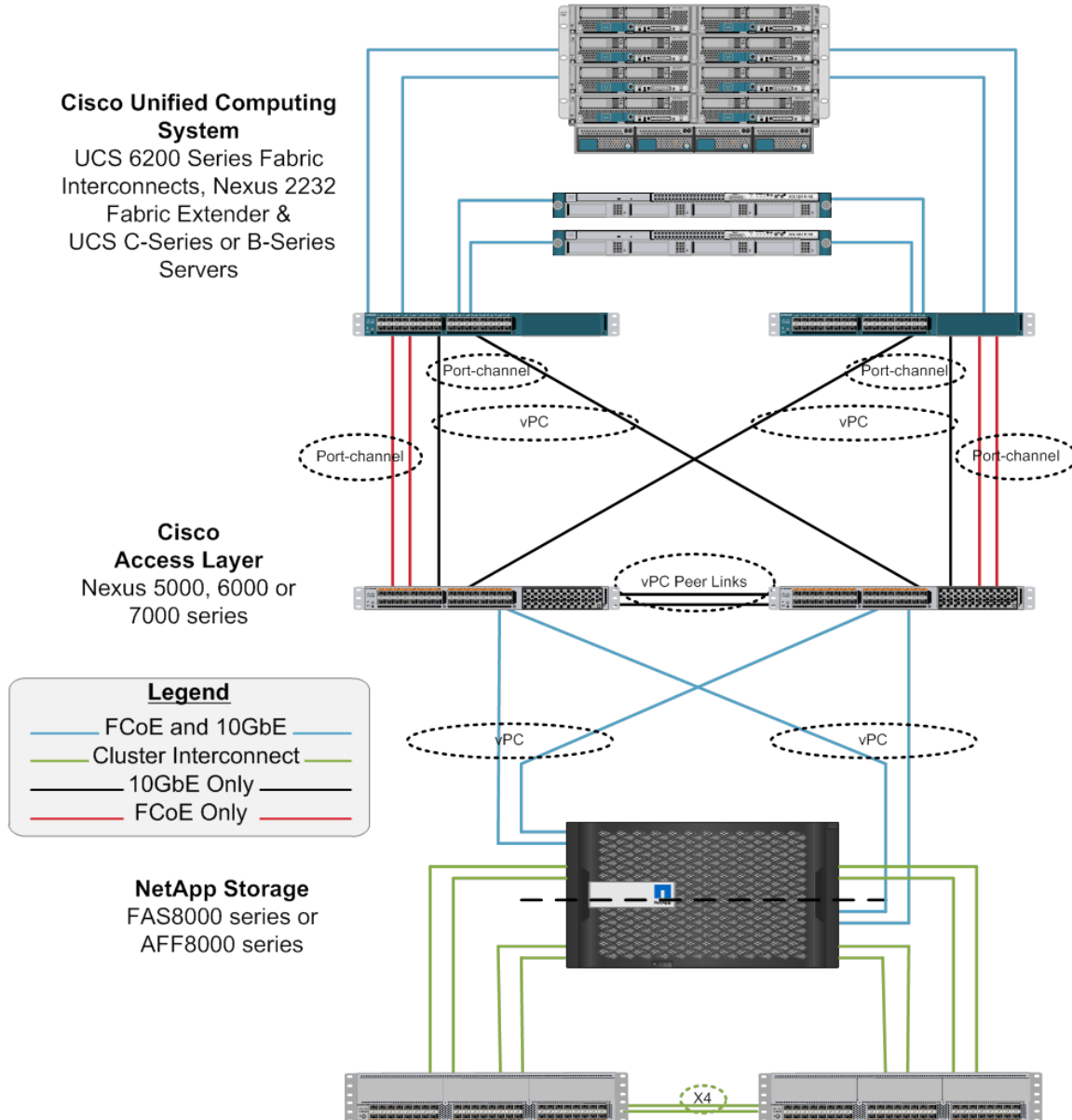
9.4 Additional Configuration Information

For the deployment of a system running clustered Data ONTAP, a pair of cluster interconnect switches is required. Supported cluster interconnect switches include the Cisco Nexus 5596 and the NetApp CN1610.

Figure 1 illustrates the connectivity deployed for the FCoE SAN boot scenario.

Note: For a system running clustered Data ONTAP, a pair of cluster interconnect switches, shown in the purple circle, is required. For a system running Data ONTAP 7-Mode, none of the connections or cluster interconnect switches shown in the purple circle are required.

Figure 1) FCoE boot scenario.



10 Cisco Components

Cisco has contributed substantially to the FlexPod design and architecture, covering both the compute and networking layers of the solution. This section describes the Cisco UCS and Cisco Nexus options that are available for FlexPod. FlexPod supports both the Cisco UCS B-Series and C-Series servers.

10.1 Cisco UCS B-Series Chassis Option

To use Cisco UCS B-Series blades, you must have a Cisco UCS B-Series chassis. If you intend to use Cisco UCS C-Series rack-mount servers, a chassis is not required.

Table 1) Cisco UCS B-Series chassis option.

Cisco UCS Chassis	Part Number	Technical Specifications
Cisco UCS 5108	N20-C6508	Cisco UCS 5100 Series Blade Server Chassis

10.2 Cisco UCS B-Series Blade Server Options

Cisco UCS B-Series blade servers are available in half-width and full-width varieties, with various CPU, memory, and I/O options. The part numbers listed in Table 2 are for the base server; they do not include the CPU, memory, disk drives, or mezzanine adapter cards. Multiple configuration options are available and supported in FlexPod.

Table 2) Cisco UCS B-Series blade server options.

Cisco UCS Blade	Part Number	Technical Specifications
Cisco UCS B22 M3	UCSB-B22-M3	Cisco UCS B22 M3 Blade Server
Cisco UCS B200 M3	UCSB-B200-M3	Cisco UCS B200 M3 Blade Server
Cisco UCS B200 M4	UCSB-B200-M4	Cisco UCS B200 M4 Blade Server
Cisco UCS B420 M3	UCSB-B420-M3	Cisco UCS B420 M3 Blade Server
Cisco UCS B420 M4	UCSB-B420-M4	Cisco UCS B420 M4 Blade Server
Cisco UCS B260 M4	UCSB-EX-M4-1C	Cisco UCS B260 M4 Blade Server

10.3 Cisco UCS C-Series Rack-Mount Server Options

Cisco UCS C-Series rack-mount servers are available in one-, two-, and four-rack unit (RU) varieties, with various CPU, memory, and I/O options. The part numbers listed in Table 3 are for the base server; they do not include CPUs, memory, disk drives, PCIe cards, or the Cisco fabric extender. Multiple configuration options are available and supported in FlexPod.

Table 3) Cisco UCS C-Series rack-mount server options.

Cisco UCS C-Series Rack-Mount Server	Part Number	Technical Specifications
Cisco UCS C22 M3	UCSC-C22-M3S	Cisco UCS C22 M3 Rack Servers
Cisco UCS C220 M3	UCSC-C220-M3S	Cisco UCS C220 M3 High-Density Rack Server (Small Form Factor Disk Drive Model)
Cisco UCS C220 M4	UCSC-C220-M4S	Cisco UCS C220 M4 Rack Server

Cisco UCS C-Series Rack-Mount Server	Part Number	Technical Specifications
Cisco UCS C24 M3	UCSC-C24-M3S	Cisco UCS C24 M3 Rack Server
Cisco UCS C240 M3	UCSC-C240-M3S	Cisco UCS C240 M3 High-Density Rack Server (Small Form Factor Disk Drive Model)
Cisco UCS C240 M4	UCSC-C240-M4S	Cisco UCS C240 M4 Rack Server
Cisco UCS C260 M2	C260-BASE-2646	Cisco UCS C260 M2 High-Density Rack Server
Cisco UCS C420 M3	UCSC-BASE-M3-C420	Cisco UCS C420 M3 Rack Server
Cisco UCS C460 M2	UCSC-BASE-M2-C460	Cisco Spec Sheets: Cisco UCS C460 M2 High-Performance Rack-Mount Server
Cisco UCS C460 M4	UCSC-C460-M4	Cisco UCS C460 M4 Rack Server

10.4 Cisco UCS Fabric Interconnect Options

Redundant fabric interconnects are required in the FlexPod architecture. When adding multiple Cisco UCS chassis to a pair of fabric interconnects, remember that the maximum number of chassis in an environment is determined by both an architectural and a port limit.

The part numbers shown in Table 4 are for the base fabric interconnects; they do not include the power supply unit (PSU), small-form-factor pluggable plus (SFP+) modules, or expansion modules. For more information about the upper limits, refer to the [Cisco UCS 6100 Series Fabric Interconnect Technical Specifications](#).

Table 4) Cisco UCS fabric interconnect options.

Cisco UCS Fabric Interconnect	Part Number	Technical Specifications
Cisco UCS 6248UP	UCS-FI-6248UP	Cisco UCS 6248UP 48-Port Fabric Interconnect
Cisco UCS 6296UP	UCS-PSU-6296UP-AC	Cisco UCS 6296UP 96-Port Fabric Interconnect
Cisco UCS 6324	UCS-FI-M-6324	Cisco UCS 6324 Fabric Interconnect

10.5 Cisco Nexus 5000 Series Switch Options

Redundant Cisco Nexus 5000, 6000, 7000, or 9000 series switches are required in the FlexPod architecture. The part numbers listed in Table 5 are for the Cisco Nexus 5000 series chassis; they do not include SFP modules, add-on Fibre Channel (FC), or Ethernet modules.

Table 5) Cisco Nexus 5000 series switch options.

Cisco Nexus 5000 Series Switch	Part Number	Technical Specifications
Cisco Nexus 5548UP	N5K-C5548UP-FA	Cisco Nexus 5548UP Switch
Cisco Nexus 5548P	N5K-C5548P-FA	Cisco Nexus 5548P Switch
Cisco Nexus 5596UP	N5K-C5596UP-FA	Cisco Nexus 5596UP Switch
Cisco Nexus 56128P	N5K-C56128P	Cisco Nexus 56128P Switch

Cisco Nexus 5000 Series Switch	Part Number	Technical Specifications
Cisco Nexus 5672UP	N5K-C5672UP	Cisco Nexus 5672UP Switch

10.6 Cisco Nexus 6000 Series Switch Options

Redundant Cisco Nexus 5000, 6000, 7000, or 9000 series switches are required in the FlexPod architecture. The part numbers listed in Table 6 are for the Cisco Nexus 6000 series chassis; they do not include SFP modules, add-on FC, or Ethernet modules.

Table 6) Cisco Nexus 6000 series switch options.

Cisco Nexus 6000 Series Switch	Part Number	Technical Specifications
Cisco Nexus 6001	N6K-C6001-64P	Cisco Nexus 6001 Switch
Cisco Nexus 6004	N6004-B-24Q	Cisco Nexus 6004X VXLAN Switch

10.7 Cisco Nexus 7000 Series Switch Options

Redundant Cisco Nexus 5000, 6000, 7000, or 9000 series switches are required in the FlexPod architecture. The part numbers listed in Table 7 are for the Cisco Nexus 7000 series chassis; they do not include SFP modules, line cards, or power supplies, but they do include fan trays.

Table 7) Cisco Nexus 7000 series switch options.

Cisco Nexus 7000 Series Switch	Part Number	Technical Specifications
Cisco Nexus 7004	N7K-C7004	Cisco Nexus 7000 4-Slot Switch
Cisco Nexus 7009	N7K-C7009	Cisco Nexus 7000 9-Slot Switch
Cisco Nexus 7010	N7K-C7010	Cisco Nexus 7000 10-Slot Switch
Cisco Nexus 7018	N7K-C7018	Cisco Nexus 7000 18-Slot Switch
Cisco Nexus 7706	N77-C7706	Cisco Nexus 7700 6-Slot Switch
Cisco Nexus 7710	N77-C7710	Cisco Nexus 7700 10-Slot Switch
Cisco Nexus 7718	N77-C7718	Cisco Nexus 7700 18-Slot Switch

10.8 Cisco Nexus 9000 Series Switch Options

Redundant Cisco Nexus 5000, 6000, 7000, or 9000 series switches are required in the FlexPod architecture. The part numbers listed in Table 8 are for the Cisco Nexus 9000 series chassis; they do not include SFP modules, add-on FC, or Ethernet modules.

Table 8) Cisco Nexus 9000 series switch options.

Cisco Nexus 9000 Series Switch	Part Number	Technical Specifications
Cisco Nexus 9336PQ	N9K-C9336PQ	Cisco Nexus 9000 Series Switches Cisco Nexus 9300 Series Switches
Cisco Nexus 9372PX	N9K-M4PC-CFP2	
Cisco Nexus 9396PX	N9K-C9396PX	
Cisco Nexus 9504	N9K-C9504-B2	Cisco Nexus 9500 Series Switches

Cisco Nexus 9000 Series Switch	Part Number	Technical Specifications
Cisco Nexus 9508	N9K-C9508-B2	
Cisco Nexus 9516	N9K-C9516-B2	

10.9 Cisco APIC Options

When deploying Cisco ACI, you must configure the Cisco Application Policy Infrastructure Controller (APIC) in addition to the items in section 14.9, “Cisco Nexus 9000 Series Switches.” Table 9 lists the part numbers and details for the APICs.

Table 9) Cisco APIC sizes.

Cisco APIC Configuration	Part Number	Description
Medium cluster	APIC-CLUSTER-M1	Cluster of three Cisco APIC controllers with medium CPU, hard drive, and memory configurations (up to 1,000 edge ports)
Large cluster	APIC-CLUSTER-L1	Cluster of three Cisco APIC controllers with large CPU, hard drive, and memory configurations (more than 1,000 edge ports)
Medium	APIC-M1	Cisco APIC controller with medium CPU, hard drive, and memory configurations (up to 1,000 edge ports)
Large	APIC-L1	Cisco APIC controller with large CPU, hard drive, and memory configurations (more than 1,000 edge ports)
Medium (spare)	APIC-M1=	Cisco APIC controller with medium CPU, hard drive, and memory configurations (up to 1,000 edge ports)
Large (spare)	APIC-L1=	Cisco APIC controller with large CPU, hard drive, and memory configurations (more than 1,000 edge ports)

10.10 Cisco Nexus Fabric Extender Options

Redundant Cisco Nexus 2232 fabric extenders (FEXs) are recommended for large FlexPod architectures that use C-Series servers.

Table 10) Cisco Nexus FEX option.

Cisco Nexus 9000 Series Switch	Part Number	Technical Specifications
Cisco Nexus 2232PP	N2K-C2232PP-10GE	Cisco Nexus 2000 Series Fabric Extenders

10.11 Cisco Software Licensing Options

Licenses are required to enable storage protocols on the Cisco Nexus switches. The Cisco Nexus 5000, 6000, and 7000 series of switches all require a storage services license to enable the FC or FCoE protocol for SAN boot implementations. The Cisco Nexus 9000 series switches currently do not support FC or FCoE.

Note: The required licenses and the part numbers for those licenses vary depending on the options that you select for each component of the FlexPod solution. For example, software license part numbers vary depending on the number of ports and which Cisco Nexus 5000, 6000, or 7000 series switches you choose. Consult your sales representative for information about exact part numbers. Table 11 lists the Cisco software licensing options.

Table 11) Cisco software licensing options.

Cisco Software Licensing	Part Number	Technical Specifications
Cisco Nexus 5500 Storage License, 8-, 48-, and 96-port	N55-8P-SSK9/N55-48P-SSK9/N55-96P-SSK9	Licensing Cisco NX-OS Software Features Information About Licensing
Cisco Nexus 5010/5020 Storage Protocols License	N5010 -SSK9/N5020-SSK9	
Cisco Nexus 5600 Storage Protocols License	N56-16p-SSK9/N5672-72P-SSK9/N56128-128P-SSK9	
Cisco Nexus 6000 FC Features License	N6K-16P-10GE-SSK9/N6K-4P-40GE-SSK9	
Cisco Nexus 7000 Storage Enterprise License	N7K-SAN1K9	
Cisco Nexus 9000 Enterprise Services License	N95-LAN1K9/N93-LAN1K9	

10.12 Cisco Support Licensing Options

Valid SMARTnet support contracts are required on all Cisco equipment in the FlexPod architecture.

Note: The required licenses and the part numbers for those licenses must be verified by your sales representative because they can differ for different products. Table 12 lists the Cisco support licensing options.

Table 12) Cisco support licensing options.

Cisco Support Licensing	License Guide
SMARTnet 24x7x4	Cisco SMARTnet Service

11 NetApp Components

NetApp storage controllers provide the storage foundation in the FlexPod architecture for both boot and application data storage. NetApp components include storage controllers, Ethernet expansion modules, disks and disk shelves, and licensing options.

11.1 NetApp Storage Controller Options

Redundant NetApp FAS or V-Series controllers are required in the FlexPod architecture. The controllers run either clustered Data ONTAP or Data ONTAP 7-Mode. When the storage controllers are ordered, the preferred software version can be preloaded on the controllers. For clustered Data ONTAP, a complete cluster is ordered; a complete cluster includes a pair of storage controllers and a cluster interconnect.

The part numbers listed in Table 13 are for an empty controller. Different options and configurations are available depending on the selected storage platform. Consult your sales representative for details about these additional components.

Note: The controllers listed in Table 13 are appropriate for use in a FlexPod Datacenter solution because their connection to the Cisco Nexus switches is seamless.

Table 13) NetApp storage controller options.

Storage Controller	Part Number	Technical Specifications
FAS8080 EX	Contact your NetApp sales representative for the part number.	FAS8000 Series
FAS8060	FAS80X0-CHASSIS-INT-R6	
FAS8040	FAS80X0-CHASSIS-INT-R6	
FAS8020	FAS8020-CHASSIS-INT-R6	
AFF8080 EX	Contact your NetApp sales representative for the part numbers.	AFF8000 Series
AFF8060		
AFF8040		
AFF8020		
FAS6290/V6290	FAS-V62XX-CHASSIS-R6-C	FAS6200 Series
FAS6250/V6250	FAS-V62XX-CHASSIS-R6-C	
FAS6220/V6220	FAS-V62XX-CHASSIS-R6-C	
FAS3250/V3250	FAS-V32XX-CHASSIS-R6-C	FAS3200 Series
FAS3220/V3220	FAS-V32XX-CHASSIS-R6-C	
FAS2554	FAS2554-CHASSIS-R6	FAS2500 Series
FAS2552	FAS2552-CHASSIS-R6	

Note: For V-Series part numbers, refer to [NetApp V-Series Technical Specifications](#).

11.2 Cluster Interconnect Switch Options

Table 14 lists the NetApp and Cisco Nexus cluster interconnect switches available for FlexPod architectures.

Table 14) Cluster interconnect switch options.

Cluster Interconnect Switch	Part Number	Technical Specifications
NetApp CN1610	X1960-R6	NetApp Documentation: CN1610 switches
Cisco Nexus 5596UP	N5K-C5596UP-NFA	Cisco Product Information: Cisco Nexus 5596UP Switch

11.3 NetApp Ethernet Expansion Module Options

Table 15 lists the 10GbE and FCoE adapter options for FlexPod architectures.

Table 15) Ethernet expansion module options.

Ethernet Expansion Module	Part Number	Technical Specifications
NetApp X1160A	X1160A-R6	Adapter Card Support for Clustered Data ONTAP 8.2 Clustered Data ONTAP 8.2 SAN Administration Guide
NetApp X1117A	X1117A-R6	
NetApp X1139A	X1139A-R6	
NetApp X1140A	X1140A-R6	
NetApp X1143A	X1143A-R6	

11.4 NetApp Disk Shelf and Disk Drive Options

A minimum of one NetApp disk shelf is required for all storage controllers. V-Series controllers can also use third-party arrays, but their performance depends on the performance of those third-party drives.

The selected NetApp shelf type determines which drive types are available within that shelf. For example, the DS4243 shelf supports SAS, SATA, and SSD drives, but not Fibre Channel (FC) drives.

Note: The FAS2240 is offered as a configuration that includes dual storage controllers plus disks housed within the same chassis. This configuration is offered with SATA or SAS drives; therefore, additional external disk shelves are not needed unless performance or capacity requirements dictate more spindles.

Note: All disk shelf part numbers are for the empty shelf with two AC power supply units (PSUs). Consult your sales representative for additional part numbers.

Note: Disk drive part numbers vary according to the size and form factor of the disk that you intend to purchase. Consult your sales representative for additional part numbers. Table 16 lists the NetApp disk shelf options.

Table 16) NetApp disk shelf options.

Disk Shelf	Part Number	Technical Specifications
DS2246	X559A-R6	Disk Shelves and Storage Media
DS4243	X556A-R6	<ul style="list-style-type: none"> Disk Shelves and Storage Media Disk Shelves and Storage Media for FAS and V-Series Systems
DS4246	X24M-R6	Disk Shelves and Storage Media
DS4486	210-05399	Disk Shelves and Storage Media
900GB SAS	X417A-R6	<ul style="list-style-type: none"> Compare Storage Systems Drives
600GB SAS	X412A-R5	
450GB SAS	X411A-R5	
300GB SAS	X410A-R5	
200GB SSD	X446A-R6	
400GB SSD	X438A-R6	
800GB SSD	X447A-R6	

Disk Shelf	Part Number	Technical Specifications
1.6TB SSD	X439A-R6	
500GB SATA	X310A-R5	
1TB SATA	X302A-R5	
2TB SATA	X306A-R5	
3TB SATA	X308A-R5	

11.5 NetApp Software Licensing Options

Table 17 lists the NetApp software licensing options available for the FlexPod Datacenter architecture.

Table 17) NetApp software licensing options.

NetApp Software Licensing	Part Number	Technical Specifications
SW, Complete BNDL, 3240A, -C	SW-3240A-COMP-BNDL-C	Product Library A-Z
SW, Data ONTAP Essentials, 3240A, -C	SW-3240A-ONTAP8-C	

11.6 NetApp Support Licensing Options

SupportEdge premium licenses are required for the FlexPod architecture, but the part numbers for those licenses vary based on the options selected in the FlexPod design. For example, software license part numbers are different depending on which FAS controller you choose. Consult your sales representative for information about the exact part numbers of individual support licenses. Table 18 shows an example of a SupportEdge license.

Table 18) NetApp support licensing options.

NetApp Support Licensing	Part Number	Technical Specifications
SupportEdge Premium 4 hours onsite -months: 36	CS-O2-4HR	NetApp SupportEdge

12 Power and Cabling Requirements

A FlexPod design has minimum power and cabling requirements.

12.1 Power Requirements

The power requirements described in this section are based on U.S. specifications and assume the use of AC power. Other countries may have different power requirements. DC power options are also available for most components.

For additional data on the maximum power required and other detailed power information, consult the technical specifications for each hardware component. For detailed Cisco UCS power data, refer to the [Cisco Unified Computing System power calculator](#).

Table 19 lists the required power ports for each hardware component of the FlexPod architecture.

Table 19) Required power ports.

Hardware	Model Number	Power Ports Required
Cisco UCS chassis	Cisco UCS 5108	Four C19 power cables for each Cisco UCS 5000 series chassis
Cisco UCS fabric interconnects	Cisco UCS 6248UP	Two C13/C14 power cables for each fabric interconnect
	Cisco UCS 6296UP	
	Cisco UCS 6324	N/A; power is provided by chassis
Cisco Nexus 5000 series switches	Cisco Nexus 5548UP	Two C13/C14 power cables for each Cisco Nexus 5000 series switch
	Cisco Nexus 5548P	
	Cisco Nexus 5596UP	
	Cisco Nexus 5672UP	
	Cisco Nexus 56128P	Four C13/C14 power cables for each Cisco Nexus 56128P switch
Cisco Nexus 6000 series switches	Cisco Nexus 6001	Refer to the Cisco power supply datasheet because some installations require additional considerations: Cisco Nexus 6000 Series Technical Specifications
	Cisco Nexus 6004	
Cisco Nexus 7000 series switches	Cisco Nexus 7004	Refer to the Cisco power supply datasheet because some installations require additional considerations: Cisco Nexus 7000 Series DC Power Supply Modules
	Cisco Nexus 7009	
	Cisco Nexus 7010	
	Cisco Nexus 7018	
	Cisco Nexus 7706	
	Cisco Nexus 7710	
	Cisco Nexus 7718	
Cisco Nexus 9000 series switches	Cisco Nexus 9336PQ	Refer to the Cisco power supply data sheets because some installations required additional considerations: Cisco Nexus 9336PQ ACI Spine Switch Cisco Nexus 9300 Platform Switches Cisco Nexus 9500 Platform Switches
	Cisco Nexus 9372PX	
	Cisco Nexus 9396PX	
	Cisco Nexus 9504	
	Cisco Nexus 9508	
	Cisco Nexus 9516	
NetApp FAS controllers	FAS8080 EX	Two C13/C14 power cables
	FAS8060	Two C13/C14 power cables
	FAS8040	Two C13/C14 power cables
	FAS8020	Two C13/C14 power cables

Hardware	Model Number	Power Ports Required
	AFF8080 EX	Two C13/C14 power cables
	AFF8060	Two C13/C14 power cables
	AFF8040	Two C13/C14 power cables
	AFF8020	Two C13/C14 power cables
	FAS6290	Four C13/C14 power cables
	FAS6250	Four C13/C14 power cables
	FAS6220	Four C13/C14 power cables
	FAS3250	Four C13/C14 power cables
	FAS3220	Four C13/C14 power cables
	FAS2240	Four C13/C14 or 2 C13/C14 power cables, depending on the controller/chassis configuration
FAS2220	Two C13/C14 power cables	
NetApp disk shelves	DS2246	Two C13/C14 power cables
	DS4243	Four C13/C14 power cables
	DS4246	Four C13/C14 power cables
	DS4486	Four C13/C14 power cables

Note: Cisco UCS blades do not require individual power connections.

12.2 Minimum Cable Requirements

Most FlexPod implementations require additional cables, but the number varies based on the deployment size and scope.

Table 20) Minimum cable requirements.

Hardware	Model Number	Cables Required
Cisco UCS chassis	Cisco UCS 5108	At least two twinax cables per Cisco UCS 2104XP/2204XP/2208XP module
Cisco UCS fabric interconnects	Cisco UCS 6248UP	<ul style="list-style-type: none"> Two Cat5e cables for management ports Two Cat5e cables for the L1, L2 interconnects, per pair of fabric interconnects At least four twinax cables per fabric interconnect At least four FC cables per fabric interconnect
	Cisco UCS 6296UP	
	Cisco UCS 6324	<ul style="list-style-type: none"> Two 10/100/1000Mbps management port At least two twinax cables per fabric

Hardware	Model Number	Cables Required
		interconnect
Cisco Nexus 5000 series switches	Cisco Nexus 5548UP	<ul style="list-style-type: none"> At least two 10GbE fiber or twinax cables per switch At least two FC cables per switch
	Cisco Nexus 5548P	
	Cisco Nexus 5596UP	
	Cisco Nexus 56128P	
	Cisco Nexus 5672UP	
Cisco Nexus 6000 series switches	Cisco Nexus 6001	<ul style="list-style-type: none"> At least two 10GbE fiber or twinax cables per switch At least two FC cables per switch for FCoE port channels
	Cisco Nexus 6004	
Cisco Nexus 7000 series switches	Cisco Nexus 7004	<ul style="list-style-type: none"> At least two 10GbE fiber or twinax cables per switch At least two FC cables per switch for FCoE port channels
	Cisco Nexus 7009	
	Cisco Nexus 7010	
	Cisco Nexus 7018	
	Cisco Nexus 7706	
	Cisco Nexus 7710	
	Cisco Nexus 7718	
Cisco Nexus 9000 series switches	Cisco Nexus 9336PQ	At least two 10GbE cables per switch
	Cisco Nexus 9372PX	
	Cisco Nexus 9396PX	
	Cisco Nexus 9504	
	Cisco Nexus 9508	
	Cisco Nexus 9516	
NetApp FAS controllers	FAS8080 EX	<ul style="list-style-type: none"> A pair of SAS or SATA cables per storage controller At least two FC cables per controller, if using legacy FC At least two 10GbE cables per controller At least one GbE cable for management per controller If deploying clustered Data ONTAP, eight short twinax cables are required per pair of cluster interconnect switches
	FAS8060	
	FAS8040	
	FAS8020	
	Two C13/C14 power cables	
	Two C13/C14 power cables	
	Two C13/C14 power cables	
	Two C13/C14 power cables	
	FAS6290	
	FAS6250	

Hardware	Model Number	Cables Required
	FAS6220	
	FAS3250	
	FAS3220	
	FAS2240	
	FAS2220	
NetApp disk shelves	DS2246	Two SAS, SATA, or FC cables per disk shelf
	DS4243	
	DS4246	
	DS4486	

13 Legacy Equipment

FlexPod is a flexible solution that allows the customer to leverage existing gear and new gear currently for sale by Cisco and NetApp. Occasionally, certain models of equipment from both Cisco and NetApp are designated end of life (EOL).

Even though these models of equipment are no longer available, customers who bought one of these models prior to the end of sale (EOS) date can leverage that equipment in a FlexPod configuration. The following table shows the equipment models that are supported in FlexPod but that are no longer for sale.

Table 21) Legacy equipment.

Legacy Equipment	
Cisco UCS B200 M1	Cisco UCS C250 M2 Extended Memory
Cisco UCS B250 M1 Extended Memory	Cisco UCS 6120XP
Cisco UCS B230 M1	Cisco UCS 6140XP
Cisco UCS B440 M1 High-Performance	Cisco Nexus 5010
Cisco UCS B230 M2	Cisco Nexus 5020
Cisco UCS B440 M2	NetApp FAS6280/V6280
Cisco UCS C200 M1	NetApp FAS6240/V6240
Cisco UCS C210 M1	NetApp FAS6220/V6220
Cisco UCS C250 M1	NetApp FAS6080/V6080
Cisco UCS B200 M2	NetApp FAS6040/V6040
Cisco UCS C200 M2	NetApp FAS3170/V3170
Cisco UCS C210 M2	NetApp FAS3160/V3160
Cisco UCS 2104XP FEX	NetApp FAS3140/V3140

For additional information, refer to the Cisco end-of-life and end-of-sale notices for [Cisco UCS C-Series rack servers](#) and [Cisco UCS B-Series blade servers](#).

14 Technical Specifications and References

Technical specifications provide details about the hardware components in a FlexPod solution, such as chassis, FEXs, servers, switches, controllers, and so on.

14.1 Cisco UCS B-Series Blade Server Chassis

The technical specifications for the Cisco UCS B-Series blade server chassis include number of rack units, maximum number of blades, unified fabric capability, midline I/O bandwidth per server, and number of I/O bays for FEXs.

Table 22) Cisco UCS B-Series blade server chassis options.

Component	Cisco UCS 5100 Series Blade Server Chassis
Rack units	6
Maximum full-width blades	4
Maximum half-width blades	8
Capable of unified fabric	Yes
Midplane I/O	Up to 80Gb/sec of I/O bandwidth per server
I/O bays for FEXs	Two bays for Cisco UCS 2104XP, 2204XP, and 2208XP FEXs

For more information, refer to the [Cisco UCS 5100 Series blade server chassis data sheet](#).

14.2 Cisco UCS B-Series Blade Servers

The technical specifications for the Cisco UCS B-Series blade server include number of processor sockets, processor support, memory capacity, size, and speed, SAN boot support, number of mezzanine adapter slots, I/O maximum throughput, form factor, and maximum number of servers per chassis.

Table 23) Cisco UCS B-Series blade server options.

Component	Cisco UCS B22-M3	Cisco UCS B200-M3	Cisco UCS B200-M4
Number of processor sockets	2	2	2
Processor support	Intel® Xeon® E5-2400	Intel Xeon E5-2600 v2	Intel Xeon E5-2600 v3
Memory capacity	12 DIMMs for a maximum of 384GB	24 DIMMs for a maximum of 768GB	24 DIMMs for a maximum of 768GB
Max memory size and speed	4, 8, 16, and 32GB DDR3; 1600MHz	4, 8, 16, and 32GB DDR3; 1333, 1600, or 1866MHz	8, 16, and 32GB DDR4; 2133MHz
SAN boot support	Yes	Yes	Yes

Component	Cisco UCS B22-M3	Cisco UCS B200-M3	Cisco UCS B200-M4
Mezzanine I/O adapter slots	1	1	1
I/O max throughput	80Gb/sec	80Gb/sec	80Gb/sec
Form factor	Half width	Half width	Half width
Max servers per chassis	8	8	8

Table 24) Cisco UCS B-Series blade server options.

Component	Cisco UCS B420-M3	Cisco UCS B420-M4	Cisco UCS B260-M4	Cisco UCS B460-M4
Number of processor sockets	4	4	2	4
Processor support	Intel Xeon E5-4600 v2 or E5-4600 series	Intel Xeon E5-4600	Intel Xeon E7-8800 v2, E7-4800 v2, or E7-2800 v2 series	Intel Xeon E7-4800 v2 and E7-8800 v2
Memory capacity	48 DIMMs for a maximum of 1.5TB	48 DIMMs for a maximum of 3TB	48 DIMMS for a maximum of 3TB	96 DIMMS for a maximum of 6TB
Memory size and speed	4, 8, 16, 32GB DDR3; 1600 or 1866Mhz	2133MHz DDR4	8, 16, 32, 64GB DDR3; 1600Mhz	8, 16, 32, 64GB DDR3; 1600Mhz
SAN boot support	Yes	Yes	Yes	Yes
Mezzanine I/O adapter slots	2	3	2	4
I/O max throughput	160Gb/sec	160Gb/sec	160Gb/sec	320Gb/sec
Form factor	Full width	Full width	Full width	Full-width double-high
Max servers per chassis	4	4	4	2

Table 25) Cisco UCS B-Series blade server datasheets.

Component	Cisco UCS Datasheet
Cisco UCS B22 M3	Cisco UCS B22 M3 blade server
Cisco UCS B200 M3	Cisco UCS B200 M3 blade server
Cisco UCS B200 M4	Cisco UCS B200 M4 blade server
Cisco UCS B420 M3 High-Performance	Cisco UCS B420 M3 blade server
Cisco UCS B420 M4	Cisco UCS B420 M4 blade server
Cisco UCS B260 M4	Cisco UCS B260 M4 blade server

Component	Cisco UCS Datasheet
Cisco UCS B460 M4	Cisco UCS B460 M4 blade server

14.3 Cisco UCS C-Series Rack-Mount Servers

The technical specifications for the Cisco UCS C-Series rack-mount servers include processor support, maximum memory capacity, number of PCIe slots, and size of the form factor.

Table 26) Cisco UCS C-Series rack-mount server options (1).

Component	Cisco UCS C22 M3	Cisco UCS C220 M3	Cisco UCS C220 M4	Cisco UCS C24 M3	Cisco UCS C240 M3
Processor support	1 or 2 Intel Xeon E5-2400	1 or 2 Intel E5-2600 series	1 or 2 Intel Xeon E5-2600 V3	2 Intel Xeon E5-2400	1 or 2 Intel E5-2600 series
Maximum memory capacity	192GB	256GB	768GB	192GB	384GB
PCIe slots	4	2	2	5	5
Form factor	1 RU	1 RU	1 RU	2 RU	2 RU

Table 27) Cisco UCS C-Series rack-mount server options (2).

Component	Cisco UCS C240 M4	Cisco UCS C260 M2	Cisco UCS C420 M3	Cisco UCS C460 M2	Cisco UCS C460 M4
Processor support	1 or 2 Intel Xeon E5-2600 v3 series	2 Intel Xeon E7-2800 series	2 or 4 Intel Xeon E5-4600 series	2 or 4 Intel Xeon E7-8800/4800	2 or 4 Intel Xeon E7-8800/4800
Maximum memory capacity	768GB	1TB	1.5TB	2TB	2 TB
PCIe slots	6	7	7	10	10
Form factor	2 RU	2 RU	2 RU	4 RU	4 RU

Table 28) Cisco UCS C-Series rack-mount server datasheets.

Component	Cisco UCS Datasheet
Cisco UCS C22 M3	Cisco UCS C22 M3 rack servers
Cisco UCS C220 M3	Cisco UCS C220 M3 rack server
Cisco UCS C220 M4	Cisco UCS C220 M4 rack server
Cisco UCS C24 M3	Cisco UCS C24 M3 rack server
Cisco UCS C240 M3	Cisco UCS C240 M3 rack server
Cisco UCS C240 M4	Cisco UCS C240 M4 rack server
Cisco UCS C260 M2	Cisco UCS C260 M2 rack-mount server
Cisco UCS C420 M3	Cisco UCS C420 M3 rack server

Component	Cisco UCS Datasheet
Cisco UCS C460 M2	Cisco UCS C460 M2 high-performance rack server
Cisco UCS C460 M4	Cisco UCS C460 M4 rack server

14.4 Cisco UCS VIC Adapters for Cisco UCS B-Series Blade Server

The technical specifications for the Cisco UCS virtual interface card (VIC) adapters for Cisco UCS B-Series blade servers include number of uplink ports, performance per port (IOPS), power, number of blade ports, hardware offload, and single root input/output virtualization (SR-IOV) support.

All currently validated FlexPod architectures use a Cisco UCS VIC. Other adapters are supported if they are listed in the [NetApp Interoperability Matrix Tool](#) (IMT) and are compatible with your deployment of FlexPod, but they may not deliver all features outlined in corresponding reference architectures.

Table 29) Cisco UCS VIC adapters (1).

Component	Cisco UCS 1225 VIC	Cisco UCS 1227 VIC	Cisco UCS 1240 VIC	Cisco UCS 1280 VIC
Uplink ports	2 x 10Gb/sec FCoE	2 x 10Gb/sec FCoE	4 x 10Gb/sec FCoE	8 x 10Gb/sec FCoE
Performance (per port)	10Gb/sec line rate; >600,000 IOPS	10Gb/sec line rate; >600,000 IOPS	10Gb/sec line rate	10Gb/sec line rate
Power	12W	14W	12W	12W
Blade ports	256 virtual interfaces (Ethernet and FC)	256 virtual interfaces (Ethernet and FC)	256 virtual interfaces (8 reserved for internal use)	256 virtual interfaces (8 reserved for internal use)
Hardware offload	FCoE	FCoE	FCoE	FCoE
SR-IOV support	Yes	Yes	Yes	Yes

Table 30) Cisco UCS VIC adapters (2).

Component	Cisco UCS 1285VIC	Cisco UCS 1340 VIC	Cisco UCS 1380 VIC
Uplink ports	2 x 40Gb/sec FCoE	2 x 40Gb/sec or two sets of 4 x 10Gb/sec FCoE	2 x 40Gb/sec or two sets of 4 x 10Gb/sec FCoE
Performance (per port)	10Gb/sec line rate; >600,000 IOPS	10Gb/sec line rate; >900,000 IOPS	10Gb/sec line rate; >900,000 IOPS
Power	17 W	12 or 15W	12 W
Blade ports	256	256	256
Hardware offload	FCoE	FCoE	FCoE
SR-IOV support	Yes	Yes	SAN

Table 31) Cisco UCS VIC adapter datasheets.

Component	Cisco UCS Datasheet
Cisco UCS 1225 VIC	Cisco UCS VIC 1225

Component	Cisco UCS Datasheet
Cisco UCS 1227 VIC	Cisco UCS 1227 VIC
Cisco UCS 1240 VIC	Cisco UCS VIC 1240
Cisco UCS 1280 VIC	Cisco UCS VIC 1280
Cisco UCS 1285 VIC	Cisco UCS 1285 VIC
Cisco UCS 1340 VIC	Cisco UCS 1340 VIC
Cisco UCS 1380 VIC	Cisco UCS 1380 VIC

14.5 Cisco UCS Fabric Interconnects

The technical specifications for the Cisco UCS fabric interconnects include form factor size, total number of ports and expansion slots, and throughput capacity.

Table 32) Cisco UCS fabric interconnect options.

Component	Cisco UCS 6248UP	Cisco UCS 6296UP	Cisco UCS 6324
Form factor	1 RU	2 RU	Installed in Cisco UCS chassis
Total ports	48	96	<ul style="list-style-type: none"> • 4 unified ports • 1 scalability port • 16 server ports
Number of fixed SFP+ ports	32	48	N/A
Throughput	960Gb/sec	1.92Tb/sec	500Gb/sec
Expansion slots	1	3	N/A

Table 33) Cisco UCS fabric interconnect datasheets.

Component	Cisco UCS Datasheet
Cisco UCS 6248UP	Cisco UCS 6200 series fabric interconnects
Cisco UCS 6296UP	
Cisco UCS 6324	Cisco UCS 6324 fabric interconnect

14.6 Cisco Nexus 5000 Series Switches

The technical specifications for the Cisco Nexus 5000 series switches include form factor size, total number of ports, and layer 3 module and daughter card support.

Table 34) Cisco Nexus 5000 series switch options.

Component	Cisco Nexus 5548UP	Cisco Nexus 5548P	Cisco Nexus 5596UP	Cisco Nexus 5672UP	Cisco Nexus 56128P
Form factor	1 RU	1 RU	2 RU	1 RU	2 RU
Maximum ports	48	48	96	72	128

Component	Cisco Nexus 5548UP	Cisco Nexus 5548P	Cisco Nexus 5596UP	Cisco Nexus 5672UP	Cisco Nexus 56128P
Fixed ports 1/10Gb and FCoE	32	32	48	48	48
Maximum support for FEX modules	24	24	24	24	24
Maximum 1/10Gb and FCoE ports	48	48	96	72	128
Layer 3 daughter card supported	Yes	Yes	No	N/A	N/A
Layer 3 module supported	No	No	Yes	Yes	Yes

Table 35) Cisco Nexus 5000 series switch datasheets.

Component	Cisco Nexus Datasheet
Cisco Nexus 5548UP	Cisco Nexus 5548UP switch
Cisco Nexus 5548P	Cisco Nexus 5548P switch
Cisco Nexus 5596UP (2U)	Cisco Nexus 5596UP switch
Cisco Nexus 56128P	Cisco Nexus 56128P switch
Cisco Nexus 5672UP	Cisco Nexus 5672UP switch

14.7 Cisco Nexus 6000 Series Switches

The technical specifications for the Cisco Nexus 6000 series switches include form factor size and maximum number of ports.

Table 36) Cisco Nexus 6000 series switch options.

Component	Cisco Nexus 6001	Cisco Nexus 6004
Form factor	1 RU	4 RU
Maximum 1 or 10GbE ports	64	384
Maximum 40Gb ports	4	96

Table 37) Cisco Nexus 6000 series switch datasheets.

Component	Cisco Nexus Datasheet
Cisco Nexus 6001	Cisco Nexus 6001 switch
Cisco Nexus 6004	Cisco Nexus 6004X VXLAN switch

14.8 Cisco Nexus 7000 Series Switches

The technical specifications for the Cisco Nexus 7000 series switches include form factor size and maximum number of ports.

Table 38) Cisco Nexus 7000 series switch options.

Component	Cisco Nexus 7004	Cisco Nexus 7009	Cisco Nexus 7010	Cisco Nexus 7018
Form factor	7 RU	14 RU	21 RU	25 RU
Maximum 1 or 10GbE ports	96	336	384	768
Maximum 40GbE ports	12	42	48	96
Maximum 100GbE ports	4	14	16	32

Table 39) Cisco Nexus 7000 series switch options continued.

Component	Cisco Nexus 7706	Cisco Nexus 7710	Cisco Nexus 7718
Form factor	9 RU	14 RU	26 RU
Maximum 1 or 10GbE ports	192	384	768
Maximum 40GbE ports	96	192	384
Maximum 100GbE ports	48	96	192

Table 40) Cisco Nexus 6000 series switch datasheets.

Component	Cisco Nexus Datasheet
Cisco Nexus 7004	Cisco Nexus 7000 series switches
Cisco Nexus 7009	
Cisco Nexus 7010	
Cisco Nexus 7018	
Cisco Nexus 7706	Cisco Nexus 7700 switches
Cisco Nexus 7710	
Cisco Nexus 7718	

14.9 Cisco Nexus 9000 Series Switches

The technical specifications for the Cisco Nexus 9000 series switches include form factor size, number of supervisor, fabric module, and line card slots, and maximum number of 10GbE and 40GbE ports.

Table 41) Cisco Nexus 9000 series switch options.

Component	Cisco Nexus 9336PQ	Cisco Nexus 9372PX	Cisco Nexus 9396PX	Cisco Nexus 9504	Cisco Nexus 9508	Cisco Nexus 9516
Form factor	2 RU	1 RU	2 RU	7 RU	13 RU	21 RU
Supervisor slots	N/A	N/A	N/A	2	2	2
Fabric module slots	N/A	N/A	N/A	6	6	6
Line card slots	N/A	N/A	N/A	4	8	16
10GbE ports	0	48	48	Up to 576	Up to 1152	Up to 2304
40GbE ports	Up to 36	6	12	Up to 144	Up to 288	Up to 576

Table 42) Cisco Nexus 9000 series switch datasheets.

Component	Cisco Nexus Datasheet
Cisco Nexus 9336PQ	Cisco Nexus 9336PQ ACI spine switch
Cisco Nexus 9372PX	Cisco Nexus 9300 platform switches
Cisco Nexus 9396PX	
Cisco Nexus 9504	Cisco Nexus 9500 platform switches
Cisco Nexus 9508	
Cisco Nexus 9516	

14.10 Cisco Application Policy Infrastructure Controller

When deploying Cisco ACI, in addition to the items in section “Cisco Nexus 9000 Series Switches,” the Cisco Application Policy Infrastructure Controller (APIC) must be configured. Table 47 lists the technical specification for the APICs.

Table 43) Cisco APIC specifications.

Item	Cisco APIC Appliance—Medium Configuration		Cisco APIC Appliance—Large Configuration	
	Description	Default Quantity	Description	Default Quantity
Processors	Intel Xeon E5-2620 v2	2	Dual Intel Xeon E5-2630 v2	2
Memory	16GB DDR3	4	16GB DDR3	8
PCIe slots	Cisco VIC 1225 Or Cisco VIC 1225T	1	Cisco VIC 1225 Or Cisco VIC 1225T	1
Power supply	650 W power supply	1	650 W power supply	1
Datasheet	Cisco APIC			

14.11 Cisco Nexus Fabric Extender Details

The technical specifications for the Cisco Nexus FEX include speed, number of fixed ports and links, and form factor size.

Table 44) Cisco Nexus 9000 series switch datasheets.

Component	Cisco Nexus 2232PP
Speed	10GbE
Fixed 10GbE and FCoE ports	32
Fixed 10GbE and FCoE uplinks	8
Form factor	1 RU
Datasheet	Cisco Nexus 2000 series fabric extenders

14.12 Small Form-Factor Pluggable Modules

The technical specifications for the small form-factor pluggable (SFP) modules include bandwidth, maximum distance, wavelength, cable type, and part number.

Table 45 lists the Ethernet SFP modules for Cisco Nexus 5000, 6000, 7000, and 9000 series switches and Cisco UCS fabric interconnects.

Table 45) Ethernet SFP modules.

Component	Cisco SFP-10G-SR	Cisco SFP-10G-LR	Cisco SFP-10G-ER
Bandwidth	10Gb/sec	10Gb/sec	10Gb/sec
Maximum distance	26m	10km	40km
Wavelength	850nm	1310nm	1550nm
Cable type	MMF	SMF	SMF
Part number	SFP-10G-SR	SFP-10G-LR	SFP-10G-ER

Note: If you use a Cisco Nexus or Cisco UCS Universal Port (UP) model switch, no expansion modules are required.

Table 46 lists the FC SFP modules for Cisco Nexus 5000 series switches and Cisco UCS fabric interconnects.

Table 46) FC SFP modules.

Component	Cisco DS-SFP-FC4G-SW	Cisco DS-SFP-FC4G-LW	Cisco DS-SFP-FC8G-SW	Cisco DS-SFP-FC8G-LW
Bandwidth	4Gb/sec	4Gb/sec	8Gb/sec	8Gb/sec
Maximum distance	860m	10km	520m	10km
Wavelength	850nm	1310nm	850nm	1310nm
Cable type	MMF	SMF	MMF	SMF
Part number	DS-SFP-FC4G-SW	DS-SFP-FC4G-LW	DS-SFP-FC8G-SW	DS-SFP-FC8G-LW

Note: If you use a Cisco Nexus or Cisco UCS UP model switch, no expansion modules are required.

For more information about SFP, refer to [Cisco SFP and SFP+ Transceiver Module Installation Notes](#) and [Cisco Transceiver Modules](#).

14.13 NetApp Storage Controllers

The technical specifications for the NetApp storage controllers include chassis configuration, number of rack units, amount of memory, Flash Cache™ caching, aggregate size, number of LUNs, supported network storage, maximum number of FlexVol® volumes, maximum number of supported SAN hosts, and maximum number of Snapshot® copies.

FAS8000 Series

Table 47 lists the NetApp FAS8000 series storage controller options.

Table 47) FAS8000 series controller options.

Component	FAS8080 EX	FAS8060	FAS8040	FAS8020
Configuration	Dual-chassis HA	Dual-chassis HA	Dual-chassis HA	Dual-chassis HA
Form factor	12 RU	6 RU	6 RU	3 RU
Memory	256GB	128GB	64GB	48GB
Flash Cache caching (maximum)	24TB	8TB	4TB	3TB
Maximum volume or aggregate size	400TB	324TB	180TB	150TB
Maximum number of LUNs	8,192			
Storage networking supported	FC, FCoE, IP SAN (iSCSI), NFS, CIFS, HTTP, and FTP			
Maximum number of FlexVol volumes	Up to 1,000 per controller (clustered Data ONTAP); up to 500 per controller (7-Mode)			
Maximum number of supported SAN hosts	Up to 512 hosts per high-availability pair			
Maximum number of Snapshot copies	127,000			

For more information about the FAS8000 series storage controllers, refer to [NetApp FAS8000 Series Technical Specifications](#).

AFF8000 Series

Table 48 lists the NetApp AFF8000 series storage controller options.

Table 48) AFF8000 series controller options.

Component	AFF8080 EX	AFF8060	AFF8040	AFF8020
Configuration	Dual-chassis HA	Dual-chassis HA	Dual-chassis HA	Dual-chassis HA
Form factor	12 RU	6 RU	6 RU	3 RU

Component	AFF8080 EX	AFF8060	AFF8040	AFF8020
Memory	256GB	128GB	64GB	48GB
Maximum volume or aggregate size	100TB	100TB	100TB	70TB
Maximum number of LUNs	12,000 per node			
Storage networking supported	FC, FCoE, IP SAN (iSCSI), NFS, CIFS, HTTP, and FTP			
Maximum number of FlexVol volumes	Up to 1,000 per controller (clustered Data ONTAP); up to 500 per controller (7-Mode)			
Maximum number of supported SAN hosts	Up to 512 hosts per high-availability pair			
Maximum number of Snapshot copies	127,000			

For more information about the AFF8000 series storage controllers, refer to [NetApp AFF8000 Series Technical Specifications](#).

FAS6000 Series

Table 49 lists the NetApp FAS6000 series storage controller options.

Table 49) FAS6000 series controller options.

Component	FAS6290/V6280	FAS6250/V6240	FAS6220/V6210
Configuration	Dual-chassis HA	Dual-chassis HA	Single-chassis HA
Form factor	12 RU	12 RU	6 RU
Memory	192GB	144GB	96GB
Flash Cache caching (maximum)	16TB	8TB	6TB
Maximum volume or aggregate size	100TB	100TB	70TB
Maximum number of LUNs	4,096		
Storage networking supported	FC, FCoE, IP SAN (iSCSI), NFS, CIFS, HTTP, and FTP		
Maximum number of FlexVol volumes	500 per controller		
Maximum number of supported SAN hosts	Up to 512 hosts per HA pair		
Maximum number of Snapshot copies	127,000		

For more information about the FAS6000 series storage controllers, refer to [NetApp FAS6200 Series Technical Specifications](#) and [NetApp V-Series Technical Specifications](#).

FAS3000 Series

Table 50 lists the NetApp FAS3000 series storage controller options.

Table 50) FAS3000 series controller options.

Component	FAS3250/V3250	FAS3220/V3220
Configuration	Dual-chassis HA	Single-chassis HA
Form factor	6 RU	3 RU
Memory	40GB	24GB
Flash Cache caching (maximum)	2TB	1TB
Maximum volume or aggregate size	70TB	60TB
Maximum number of LUNs	4,096	
Storage networking supported	FC, FCoE, IP SAN (iSCSI), NFS, CIFS, HTTP, and FTP	
Maximum number of FlexVol volumes	500 per controller	
Maximum number of supported SAN hosts	Up to 512 hosts per HA pair	
Maximum number of Snapshot copies	127,000	

FAS2000 Series

Table 51 lists the NetApp FAS2000 series storage controller options.

Table 51) FAS2500 series controller options.

Component	FAS2554	FAS2552	FAS2520
Configuration	Dual-chassis HA	Dual-chassis HA	Dual-chassis HA
Form factor	4 RU	2 RU	2 RU
ECC Memory	36GB	36GB	36GB
Maximum volume or aggregate size	120TB	120TB	120TB
Maximum number of LUNs	4,096		
Storage networking supported	FC, FCoE, IP SAN (iSCSI), NFS, CIFS, HTTP, and FTP		FC, IP SAN (iSCSI), NFS, CIFS
Maximum number of FlexVol volumes	500 per controller		
Maximum number of supported SAN hosts	Up to 512 hosts per HA pair		
Maximum number of Snapshot copies	127,000 per controller		

Table 52) FAS2200 series controller options.

Component	FAS2240-2	FAS2220
Configuration	Dual-chassis HA	Single-chassis HA
Form factor	2 RU	2 RU
Memory	12GB	12GB
Flash Cache caching (maximum)	1TB	512GB
Maximum volume or aggregate size	120TB	120TB
Maximum number of LUNs	1,024	
Storage networking supported	FC, IP SAN (iSCSI), NFS, CIFS	IP SAN (iSCSI), NFS, CIFS
Maximum number of FlexVol volumes	500 per controller	
Maximum number of supported SAN hosts	Up to 512 hosts per HA pair	
Maximum number of Snapshot copies	127,000	

Note: For the FAS2200 series product line, both FAS2220 and FAS2240 are supported options in FlexPod. However, configuration changes must be made with these products because of intentional product limitations. For example, to use a FAS2200 series with clustered Data ONTAP, your cluster network would only be 1GbE. To use a FAS2200 series with Data ONTAP operating in 7-Mode, you must use iSCSI boot to take advantage of 10GbE uplink ports. NetApp recommends FAS2240-2 if you use the FAS2200 series.

For more information about the FAS2000 series storage controllers, refer to [NetApp FAS2200 Series Technical Specifications](#) and [NetApp FAS2500 Series Technical Specifications](#).

14.14 Legacy Equipment

Table 53 lists the legacy equipment options. These legacy equipment options are no longer for sale because they have been announced as end of life (EOL) or end of sale (EOS) by their respective companies. Although these models are no longer sold, if you already own them, they are still supported in a FlexPod environment.

Table 53) Legacy equipment.

Legacy Equipment	
Cisco UCS B200 M1	Cisco UCS 6120XP
Cisco UCS B250 M1 Extended Memory	Cisco UCS 6140XP
Cisco UCS B230 M1	Cisco Nexus 5010
Cisco UCS B440 M1 High-Performance	Cisco Nexus 5020
Cisco UCS C200 M1	NetApp FAS6280/V6280
Cisco UCS C210 M1	NetApp FAS6240/V6240
Cisco UCS C250 M1	NetApp FAS6220/V6220
Cisco UCS B200 M2	NetApp FAS6080/V6080
Cisco UCS C200 M2	NetApp FAS6040/V6040

Legacy Equipment	
Cisco UCS C210 M2	NetApp FAS3170/V3170
Cisco UCS 2104XP FEX	NetApp FAS3160/V3160
Cisco UCS C250 M2 Extended Memory	NetApp FAS3140/V3140

For additional information, refer to the Cisco end-of-life and end-of-sale notices for [Cisco UCS C-Series rack servers](#) and [Cisco UCS B-Series blade servers](#).

14.15 NetApp Ethernet Adapters

The technical specifications for the NetApp Ethernet adapters include the port count and adapter type. For more information, refer to [Adapter card support for Clustered Data ONTAP 8.2](#).

Table 54) NetApp 10GbE adapters.

Component	X1160A-R6*	X1117A-R6	X1139A-R6	X1140A-R6
Port count	2	2	2	2
Adapter type	SFP+ with fiber	SFP+ or copper	UTA with fiber	UTA with copper

* X1160A-R6 SFP+ is only supported with FAS2200 series controllers.

14.16 NetApp Disk Shelves

The technical specifications for the NetApp disk shelves include form factor size, number of drives per enclosure, and shelf I/O modules. For more information, refer to [NetApp Disk Shelves and Storage Media Technical Specifications](#).

Table 55) NetApp disk shelves.

Component	DS2246	DS4243	DS4246	DS4486
Form factor	2 RU	4 RU	4 RU	4 RU
Drives per enclosure	24	24	24	48
Drive form factor	2.5" small form factor	3.5" large form factor	3.5" large form factor	3.5" large form factor
Shelf I/O modules	Dual IOM6 modules	Dual IOM3 modules	Dual IOM6 modules	Dual IOM6 modules

14.17 NetApp Disk Drives

The technical specifications for the NetApp disk drives include form factor size, disk capacity, disk RPM, supporting controllers, and Data ONTAP version requirements.

Table 56) NetApp disk drives.

Component	2.5" SAS	3.5" SAS	SSD	SATA
Form factor	2.5"	3.5"	3.5"	3.5"
Disk capacities	450GB, 600GB, 900GB	450GB, 600GB	200GB, 800GB	1TB, 2TB, 3TB

Component	2.5" SAS	3.5" SAS	SSD	SATA
Disk RPM	10k	15k	N/A	
Data ONTAP version	7.3.3P2 or later, 8.0P1 or later	7.3.3P2 or later, 8.0P1 or later	8.0.1 or later	7.2.2P2 or later, 8.0P1 or later; 3TB SATA requires 8.0.2 or later

15 Additional Validated Connectivity Options

Additional validated connectivity options include iSCSI and FC. Figure 2 shows an Ethernet-only configuration that is booted using iSCSI.

Figure 2) iSCSI boot scenario.

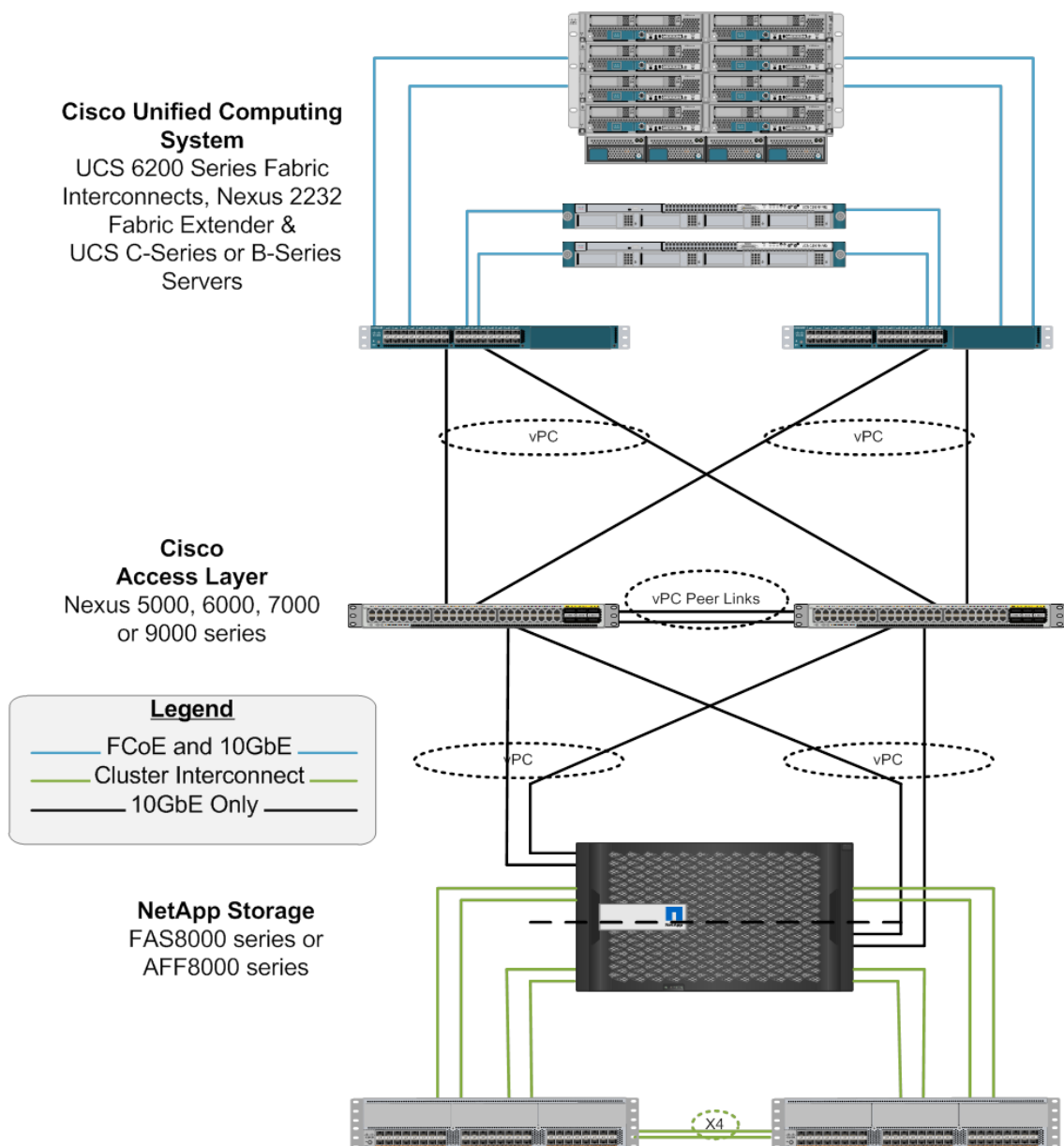
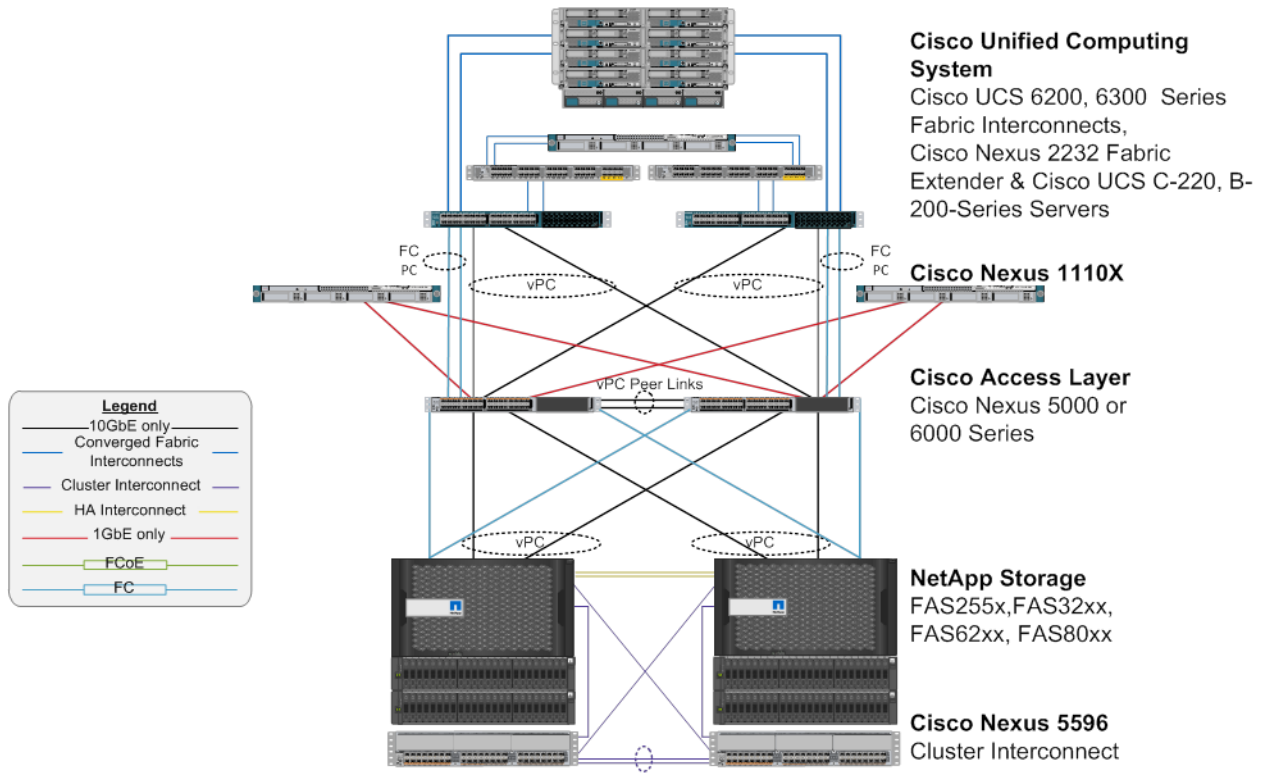


Figure 3 shows an FC connectivity configuration.

Figure 3) FC boot scenario.



Version History

Version	Date	Document Version History
Version 1.0	February 2012	Initial release.
Version 1.0.1	May 2012	Updated to include FAS2240 and Cisco UCS C-Series.
Version 1.0.2	July 2012	Minor updates.
Version 1.0.3	October 2012	Updated to include clustered Data ONTAP, Cisco UCS M3 servers, and EOL notices for Cisco UCS 6100 and 2100.
Version 1.0.4	April 2013	Updated to include FAS3250. Moved 6100 series FI and 50x0 series to legacy.
Version 1.0.5	January 2014	Includes the new FAS6200 and 3200 series, Cisco Nexus 6000, and the updated UCS gear.
Version 1.0.6	July 2014	Updated with Cisco Nexus 9000 series switches and NetApp FAS8000 series controllers.
Version 1.0.7	August 2014	Updated with NetApp FAS2500 series controllers.
Version 1.0.8	September 2014	Adjusted SAN boot for direct-connect topology.
Version 1.0.9	March 2015	Updated with Cisco M4 servers and UCS mini fabric interconnect.

Version	Date	Document Version History
Version 1.0.10	September 2015	Updated with New B-series servers and NetApp AFF8000

Refer to the [Interoperability Matrix Tool \(IMT\)](#) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.

Copyright Information

Copyright © 1994–2015 NetApp, Inc. All rights reserved. Printed in the U.S. No part of this document covered by copyright may be reproduced in any form or by any means—graphic, electronic, or mechanical, including photocopying, recording, taping, or storage in an electronic retrieval system—without prior written permission of the copyright owner.

Software derived from copyrighted NetApp material is subject to the following license and disclaimer:

THIS SOFTWARE IS PROVIDED BY NETAPP "AS IS" AND WITHOUT ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY DISCLAIMED. IN NO EVENT SHALL NETAPP BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

NetApp reserves the right to change any products described herein at any time, and without notice. NetApp assumes no responsibility or liability arising from the use of products described herein, except as expressly agreed to in writing by NetApp. The use or purchase of this product does not convey a license under any patent rights, trademark rights, or any other intellectual property rights of NetApp.

The product described in this manual may be protected by one or more U.S. patents, foreign patents, or pending applications.

RESTRICTED RIGHTS LEGEND: Use, duplication, or disclosure by the government is subject to restrictions as set forth in subparagraph (c)(1)(ii) of the Rights in Technical Data and Computer Software clause at DFARS 252.277-7103 (October 1988) and FAR 52-227-19 (June 1987).

Trademark Information

NetApp, the NetApp logo, Go Further, Faster, AltaVault, ASUP, AutoSupport, Campaign Express, Cloud ONTAP, Clustered Data ONTAP, Customer Fitness, Data ONTAP, DataMotion, Fitness, Flash Accel, Flash Cache, Flash Pool, FlashRay, FlexArray, FlexCache, FlexClone, FlexPod, FlexScale, FlexShare, FlexVol, FPolicy, GetSuccessful, LockVault, Manage ONTAP, Mars, MetroCluster, MultiStore, NetApp Insight, OnCommand, ONTAP, ONTAPI, RAID DP, RAID-TEC, SANtricity, SecureShare, Simplicity, Simulate ONTAP, SnapCenter, Snap Creator, SnapCopy, SnapDrive, SnapIntegrator, SnapLock, SnapManager, SnapMirror, SnapMover, SnapProtect, SnapRestore, Snapshot, SnapValidator, SnapVault, StorageGRID, Tech OnTap, Unbound Cloud, WAFL, and other names are trademarks or registered trademarks of NetApp Inc., in the United States and/or other countries. All other brands or products are trademarks or registered trademarks of their respective holders and should be treated as such. A current list of NetApp trademarks is available on the web at <http://www.netapp.com/us/legal/netapptmlist.aspx>.