



Technical Report

# FlexPod Express Technical Specifications

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## Important

Before ordering a complete FlexPod® configuration, check the NetApp® [FlexPod Solutions](#) website for the latest version of these technical specifications.

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## 1 Overview

FlexPod Express is a predesigned, best practice architecture that is built on the Cisco Unified Computing System (Cisco UCS) and the Cisco Nexus family of switches, and the storage layer is built by using the NetApp fabric-attached storage (FAS) or the NetApp E-Series storage. FlexPod Express is a suitable platform for running a variety of virtualization hypervisors as well as bare metal operating systems (OSs) and enterprise workloads.

FlexPod Express delivers not only a baseline configuration, but also the flexibility to be sized and optimized to accommodate many different use cases and requirements. This document categorizes the FlexPod Express configurations based on the storage system used, FlexPod Express with NetApp FAS and FlexPod Express with E-Series.

## 2 FlexPod Platforms

There are three FlexPod platforms:

- **FlexPod Datacenter.** This platform is a massively scalable virtual data center infrastructure suited for workload enterprise applications, virtualization, VDI, and public and private cloud. FlexPod Datacenter has its own specifications, which are documented in [TR-4036: FlexPod Datacenter Technical Specifications](#).
- **FlexPod Express.** This platform is a compact converged infrastructure that is targeted for remote office and edge use cases.
- **FlexPod Select.** This platform is a purpose-built architecture for high-performance applications, such as [FlexPod Select for High-Performance Oracle RAC](#).

This document provides the technical specifications for the FlexPod Express platform.

## 3 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 in this document are the minimum requirements for FlexPod; they can be expanded in the included product families as required for different environments and use cases.

## 4 Supported Versus Validated FlexPod Configurations

The FlexPod architecture is defined by the set of rules described in this document. The hardware components and software configurations must be supported by the Cisco Hardware Compatibility List (HCL) and the NetApp [Interoperability Matrix Tool \(IMT\)](#).

Each Cisco Validated Design (CVD) or NetApp Verified Architecture (NVA) is a possible FlexPod configuration. Cisco and NetApp document these configuration combinations and validate them with extensive end-to-end testing. The FlexPod deployments that deviate from these configurations are fully supported if they follow the guidelines in this document and all the components are listed as compatible in the Cisco HCL and NetApp [IMT](#).

For example, adding additional storage controllers or Cisco UCS servers and upgrading software to newer versions is fully supported if the software, hardware, and configurations meet the guidelines defined in this document.

## 5 Storage Operating System

The storage operating systems listed in this section are supported in the FlexPod Express platform.

### 5.1 NetApp ONTAP

The NetApp ONTAP® OS is the common OS 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 ONTAP: Scale-Out Storage to Achieve Nondisruptive Operations](#).

### 5.2 E-Series SANtricity Software

E-Series SANtricity® software is the OS that runs on every E-Series storage system. The SANtricity OS provides a highly flexible system that meets varying application needs and offers built-in high availability (HA) and a wide variety of data protection features. For more information, see the [NetApp SANtricity Operating System Software](#) webpage.

## 6 Minimum Hardware Requirements

This section describes the minimum hardware requirements for the different versions of FlexPod Express.

### 6.1 FlexPod Express with NetApp FAS

The hardware requirements for FlexPod Express solutions that use NetApp FAS controllers for underlying storage include these configurations.

#### CIMC-Based Configuration (Standalone Rack Servers)

The Cisco Integrated Management Controller (CIMC) configuration includes the following hardware components:

- Two 10 gigabits per second (10Gbps) standard Ethernet switches in a redundant configuration (Cisco Nexus 31108 is recommended, with Cisco Nexus 3000 and 9000 models supported)
- Cisco UCS C-Series standalone rack servers
- Two FAS2600 series controllers in an HA pair configuration deployed as a two-node cluster

#### Cisco UCS–Managed Configuration

The Cisco UCS–managed configuration includes the following hardware components:

- Two 10Gbps standard Ethernet switches in a redundant configuration (Cisco Nexus 3524 is recommended)
- One Cisco UCS 5108 alternating current (AC) blade server chassis
- Two Cisco UCS 6324 fabric interconnects
- Cisco UCS B-Series servers (at least four Cisco UCS B200 M3 blade servers)
- Two FAS2552, FAS2554, or FAS8020 controllers in an HA pair configuration (requires two available unified target adapter 2 [UTA2] ports per controller)
- One NetApp disk shelf with any supported disk type (when a FAS8020 controller is used)

## 6.2 FlexPod Express with E-Series

The hardware requirements for the FlexPod Express with E-Series starter configuration include:

- Two Cisco UCS 6324 fabric interconnects
- One Cisco UCS Mini chassis 5108 AC2 or DC2 (the Cisco UCS 6324 fabric interconnects are only supported in the AC2 and DC2 chassis)
- Cisco UCS B-Series servers (at least two Cisco UCS B200 M4 blade servers)
- One HA pair configuration of an E-Series E2824 storage system loaded with minimum 12 disk drives
- Two 10Gbps standard Ethernet switches in a redundant configuration (existing switches in the data center can be used)

These hardware components are required to build a starter configuration of the solution; additional blade servers and disk drives can be added as needed. The E-Series E2824 storage system can be replaced with a higher platform and can also be run as an all-flash system.

## 7 Minimum Software Requirements

This section describes the minimum software requirements for the different versions of FlexPod Express.

### 7.1 Software Requirements for FlexPod Express with NetApp FAS

The software requirements for the FlexPod Express with NetApp FAS include:

- Data ONTAP:
  - Data ONTAP 7-Mode requires 7.3.5 or later, including Data ONTAP 8.x
  - Clustered Data ONTAP requires Data ONTAP 8.1.1 or later**Note:** Clustered Data ONTAP is referred to as ONTAP as of version 9.0 and later
- Cisco NX-OS version 5.0(3)N1(1c) or later  
**Note:** All software must be listed and supported in the [NetApp IMT](#). Certain software features might require more recent versions of code than the minimums listed in previous architectures.
- In the Cisco UCS–managed configuration, Cisco UCS Manager 3.0(1c)  
**Note:** All software must be listed and supported in the [NetApp IMT](#) at <http://support.netapp.com/matrix/>.

### 7.2 Software Requirements for FlexPod Express with E-Series

The software requirements for the FlexPod Express with E-Series include:

- E-Series SANtricity software 11.30
- Cisco UCS Manager 3.1(1h)  
**Note:** All software must be listed and supported in the [NetApp IMT](#).

## 8 Connectivity Requirements

This section describes the connectivity requirements for the different versions of FlexPod Express.

### 8.1 Connectivity Requirements for FlexPod Express with NetApp FAS

The connectivity requirements for FlexPod Express with NetApp FAS include:

- NetApp FAS storage controllers must be directly connected to the Cisco Nexus switches, except in the Cisco UCS–managed configuration, where storage controllers are connected to the fabric interconnects.
- No additional equipment can be placed inline between the core FlexPod components.
- Virtual port channels (vPCs) are required to connect the Cisco Nexus 3000/9000 series switches to the NetApp storage controllers.
- Although it is not required, enabling jumbo frame support is recommended throughout the environment.

## 8.2 Connectivity Requirements for FlexPod Express with E-Series

The connectivity requirements for FlexPod Express with E-Series include:

- The E-Series storage controllers must be directly connected to the fabric interconnects.
- No additional equipment should be placed inline between the core FlexPod components.
- vPCs are required between the fabric interconnects and the Ethernet switches.

## 9 Other Requirements

Additional requirements for FlexPod Express include:

- All hardware components and software must be listed and supported on the [NetApp IMT](#).
- Valid support contracts are required for all equipment, including:
  - SMARTnet support for Cisco equipment
  - SupportEdge Premium support for NetApp equipment

## 10 Optional Features

This section describes the optional features for FlexPod Express.

### 10.1 iSCSI Boot Option

The FlexPod Express architecture uses iSCSI boot. The minimum requirements for the iSCSI boot option include:

- An iSCSI license/feature activated on the NetApp storage controller
- A two-port 10Gbps Ethernet adapter on each node in the NetApp storage controller HA pair

### 10.2 Configuration Options

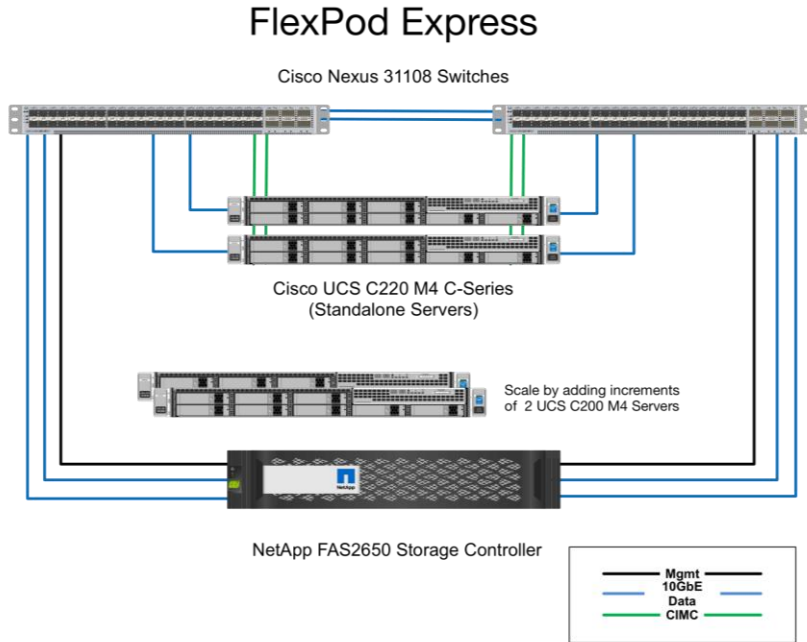
This section provides more information about the configuration required and validated in the FlexPod Express architecture.

### FlexPod Express with Cisco UCS C-Series and FAS2600 Series

Figure 1 illustrates the FlexPod Express with Cisco UCS C-Series and FAS2600 series solution. This solution supports both 10GbE and 1GbE uplinks.



Figure 1) FlexPod Express with Cisco UCS C-Series and FAS2600 series solution.

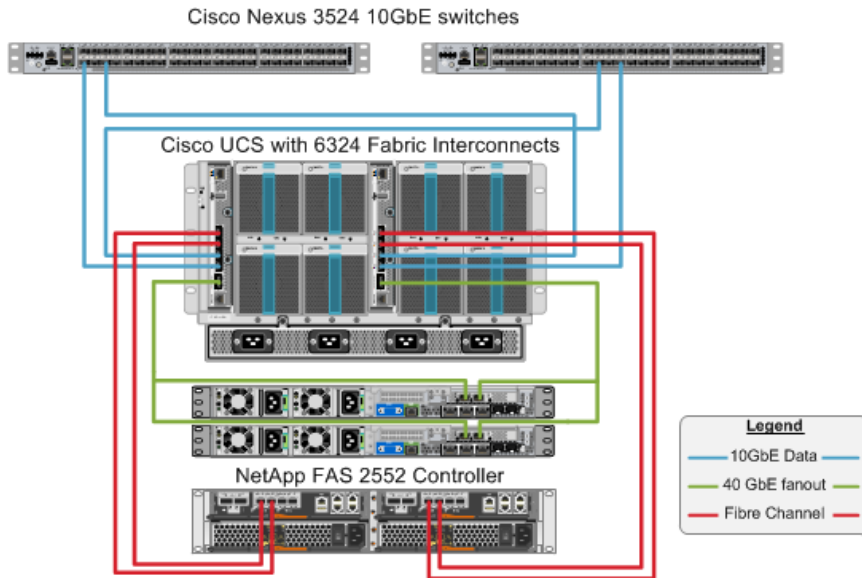


For more information about this configuration, see [NVA-0033-DESIGN: FlexPod Express with Cisco UCS C-Series and NetApp FAS2600 Series.](#)

### FlexPod Express with Cisco UCS Mini and FAS2552

Figure 2 illustrates the FlexPod Express Cisco UCS–managed configuration.

Figure 2) FlexPod Express Cisco UCS–managed configuration.

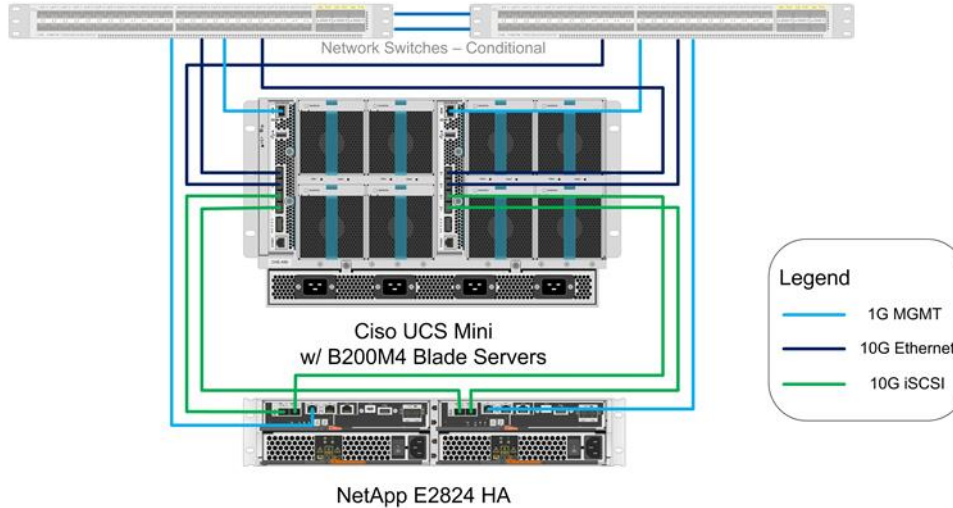


For more information about this configuration, see [FlexPod with Cisco UCS Mini Design Guide.](#)

## FlexPod Express with E-Series

Figure 3 illustrates the FlexPod Express with VMware vSphere 6.0U2, E-Series storage system, and Cisco UCS Mini.

Figure 3) FlexPod Express with VMware vSphere 6.0U2, E-Series storage system, and Cisco UCS Mini.



For more information about this configuration, see [NVA-0032: FlexPod Express with VMware vSphere 6.0U2, NetApp E-Series, and Cisco UCS Mini](#).

## 11 Cisco Components

Cisco is a substantial contributor to the FlexPod Express design and architecture; it contributes the compute and networking layers of the solution. This section describes the Cisco UCS and Cisco Nexus components that are available for FlexPod Express.

### 11.1 Cisco UCS B-Series Blade Server Options

Cisco UCS B-Series blades currently supported in the Cisco UCS Mini platform are B200 M4 and B420 M4. Other blades will be listed in Table 1 as they become supported in the Cisco UCS Mini platform.

Table 1) Cisco UCS B-Series servers.

Cisco UCS B-Series Server	Part Number	Technical Specifications
Cisco UCS B200 M4	UCSB-B200-M4	<a href="http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b200m4-specsheet.pdf">http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b200m4-specsheet.pdf</a>
Cisco UCS B420 M4	UCSB-B420-M4	<a href="http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b420m4-spec-sheet.pdf">http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b420m4-spec-sheet.pdf</a>

### 11.2 Cisco UCS C-Series Rack Server Options

Cisco UCS C-Series blades are available in one- and two-rack unit (RU) 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

CPUs, memory, disk drives, PCIe cards, or the Cisco FEX. Multiple configuration options are available and supported in FlexPod.

Table 2) Cisco UCS C-Series rack options.

Cisco UCS C-Series Rack Server	Part Number	Technical Specifications
Cisco UCS C220 M4	UCSC-C220-M4S	<a href="http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m4-sff-spec-sheet.pdf">http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m4-sff-spec-sheet.pdf</a>
Cisco UCS C240 M4	UCSC-C240-M4S	<a href="http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c240m4-sff-spec-sheet.pdf">http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c240m4-sff-spec-sheet.pdf</a>
Cisco UCS C460 M4	UCSC-C460-M4	<a href="http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c460m4_specsheet.pdf">http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c460m4_specsheet.pdf</a>

### 11.3 Cisco Nexus Switches

Redundant switches are required for all FlexPod Express architectures.

The FlexPod Express with NetApp FAS architecture is built with the Cisco Nexus 31108 switch. FlexPod Express with the Cisco UCS Mini (Cisco UCS–managed) architecture is validated using the Cisco Nexus 3524 switch. This configuration can also be deployed with a standard switch.

The FlexPod Express with E-Series can be deployed with a standard switch.

Table 3 lists the part numbers for the Cisco Nexus series chassis; they do not include additional SFP or add-on modules.

Table 3) Cisco Nexus switches.

Cisco Nexus Series Switch	Part Number	Technical Specifications
Cisco Nexus 3048	N3K-C3048TP-1GE	<a href="http://www.cisco.com/c/en/us/products/collateral/switches/nexus-3000-series-switches/data_sheet_c78-685363.html">www.cisco.com/c/en/us/products/collateral/switches/nexus-3000-series-switches/data_sheet_c78-685363.html</a>
Cisco Nexus 31108	N3K-C31108PC-B	<a href="http://www.cisco.com/c/en/us/products/switches/nexus-31108pc-v-switch/index.html">http://www.cisco.com/c/en/us/products/switches/nexus-31108pc-v-switch/index.html</a>
Cisco Nexus 9396	N9K-C9396PX	<a href="http://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-729405.html">www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-729405.html</a>

### 11.4 Cisco Support Licensing Options

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

**Note:** The licenses required and the part numbers for those licenses should be verified by your sales representative because they can differ for different products.

Table 4 lists the Cisco support licensing options.

Table 4) Cisco support licensing options.

Cisco Support Licensing	License Guide
SMARTnet 24x7x4	<a href="http://www.cisco.com/web/services/portfolio/product-technical-support/smartnet/index.html">www.cisco.com/web/services/portfolio/product-technical-support/smartnet/index.html</a>

## 12 NetApp Components

NetApp storage controllers provide the storage foundation in the FlexPod Express architecture for both boot and application data storage. This section lists the different NetApp options in the FlexPod Express architecture.

### 12.1 NetApp Storage Controller Options

#### NetApp FAS

Redundant FAS2200 or FAS2500 series controllers are required in the FlexPod Express architecture. The controllers run clustered Data ONTAP or Data ONTAP 7-Mode. When ordering the storage controllers, the preferred software version can be preloaded on the controllers. For clustered Data ONTAP, the cluster can be deployed either with a pair of cluster interconnect switches or in a switchless cluster configuration.

**Note:** The part numbers listed in Table 5 are for an empty controller. Different options and configurations are available based on the storage platform selected. Consult your sales representative for details about these additional components.

Table 5) NetApp storage controller options.

Storage Controller	FAS Part Number	Technical Specifications
FAS2620	Based on individual options chosen	<a href="http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx">http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx</a>
FAS2650	Based on individual options chosen	<a href="http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx">http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx</a>
FAS2520	Based on individual options chosen	<a href="http://www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx">www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx</a>
FAS2552	Based on individual options chosen	<a href="http://www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx">www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx</a>
FAS2554	Based on individual options chosen	<a href="http://www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx">www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx</a>
FAS8020	Based on individual options chosen	<a href="http://www.netapp.com/us/products/storage-systems/fas8000/fas8000-tech-specs.aspx">www.netapp.com/us/products/storage-systems/fas8000/fas8000-tech-specs.aspx</a>

#### E-Series Storage

An HA pair of NetApp E2800 series controllers is required in the FlexPod Express architecture. The controllers run the SANtricity OS.

**Note:** The part numbers listed in Table 6 are for an empty controller. Different options and configurations are available based on the storage platform selected. Consult your sales representative for details about these additional components.

Table 6) E-Series storage controller options.

Storage Controller	Part Number	Technical Specifications
E2800	Based on individual options chosen	<a href="http://www.netapp.com/us/products/storage-systems/e2800/e2800-tech-specs.aspx">http://www.netapp.com/us/products/storage-systems/e2800/e2800-tech-specs.aspx</a>

## 12.2 NetApp Ethernet Expansion Modules

### NetApp FAS

Table 7 lists the NetApp FAS10GbE adapter options.

Table 7) NetApp 10GbE adapter options.

Component	Part Number	Technical Specifications
NetApp X1117A	X1117A-R6	<a href="https://library.netapp.com/ecm/ecm_download_file/ECM11280307">https://library.netapp.com/ecm/ecm_download_file/ECM11280307</a>

**Note:** The FAS2500 and 2600 series storage systems have onboard 10GbE ports.

**Note:** The NetApp X1117A adapter is for FAS8020 storage systems.

### E-Series Storage

Table 8 lists the E-Series 10GbE adapter options.

Table 8) E-Series 10GbE adapter options.

Component	Part Number
10GbE iSCSI/16Gb FC 4-port	X-56025-00-0E-C
10GbE iSCSI/16Gb FC 2-port	X-56024-00-0E-C

**Note:** The E2824 series storage systems have onboard 10GbE ports.

**Note:** The 10GbE iSCSI/16Gb FC 4-port host interface card (HIC) can be used for additional port density.

The onboard ports and the HIC can function as iSCSI adapters or FC adapters depending on the feature activated in SANtricity.

## 12.3 NetApp Disk Shelves and Disks

### NetApp FAS

A minimum of one NetApp disk shelf is required for storage controllers. The NetApp shelf type selected determines which drive types are available within that shelf.

**Note:** The FAS2500 and FAS2600 series of controllers are 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 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 you intend to purchase. Consult your sales representative for additional part numbers.

Table 9 lists the NetApp disk shelf options, along with the drives supported for each shelf type, which can be found on NetApp Hardware Universe. Follow the Hardware Universe link, select the version of ONTAP you are using, then select the shelf type. Under the shelf image, click Supported Drives to see the drives supported for specific versions of ONTAP and the disk shelves.

**Table 9) NetApp disk shelf options for NetApp FAS.**

Disk Shelf	Part Number	Technical Specifications
DS212C	DS212C-0-12	<a href="#">Disk Shelves and Storage Media Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>
DS224C	DS224C-0-24	<a href="#">Disk Shelves and Storage Media Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>
DS460C	DS460C-0-60	<a href="#">Disk Shelves and Storage Media Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>
DS2246	X559A-R6	<a href="#">Disk Shelves and Storage Media Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>
DS4246	X24M-R6	<a href="#">Disk Shelves and Storage Media Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>

## E-Series Storage

A minimum of one NetApp disk shelf is required for storage controllers that do not house any drives in their chassis. The NetApp shelf type selected determines which drive types are available within that shelf.

**Note:** The E2800 series of controllers are offered as a configuration that includes dual storage controllers plus disks housed within a supported disk shelf. This configuration is offered with SSD or SAS drives.

**Note:** Disk drive part numbers vary according to the size and form factor of the disk you intend to purchase. Consult your sales representative for additional part numbers.

Table 10 lists the NetApp disk shelf option, along with the drives supported for each shelf type, which can be found on NetApp Hardware Universe. Follow the Hardware Universe link, select the version of ONTAP you are using, then select the shelf type. Under the shelf image, click Supported Drives to see the drives supported for specific versions of ONTAP and the disk shelves.

**Table 10) NetApp disk shelf options for E-Series storage.**

Disk Shelf	Part Number	Technical Specifications
DE460C	E-X5730A-DM-0E-C	<a href="#">Disk Shelves Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>

Disk Shelf	Part Number	Technical Specifications
DE224C	E-X5721A-DM-0E-C	<a href="#">Disk Shelves Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>
DE212C	E-X5723A-DM-0E-C	<a href="#">Disk Shelves Technical Specifications</a> <a href="#">Supported Drives on NetApp Hardware Universe</a>

## 12.4 NetApp Software Licensing Options

### NetApp FAS

Table 11 lists the NetApp FAS software licensing options.

Table 11) NetApp FAS software licensing options.

NetApp Software Licensing	Part Number	Technical Specifications
Base cluster license	Consult your NetApp sales team for more licensing information.	

### E-Series Storage

Table 12 lists the E-Series software licensing options.

Table 12) E-Series software licensing options.

NetApp Software Licensing	Part Number	Technical Specifications
Standard features	Consult your NetApp sales team for more licensing information.	
Premium features		

## 12.5 NetApp Support Licensing Options

SupportEdge Premium licenses are required, and the part numbers for those licenses vary based on the options selected in the FlexPod Express design.

### NetApp FAS

Table 13 lists the NetApp support licensing options for NetApp FAS.

Table 13) NetApp FAS support licensing options.

NetApp Support Licensing	Part Number	Technical Specifications
SupportEdge Premium 4 hours onsite; months: 36	CS-O2-4HR	<a href="http://www.netapp.com/us/support/supportedge.html">www.netapp.com/us/support/supportedge.html</a>

### E-Series Storage

Table 14 lists the NetApp support licensing options for E-Series storage.

Table 14) E-Series storage support licensing options.

NetApp Support Licensing	Part Number	Technical Specifications
Hardware Support Premium 4 hours onsite; months: 36	SVC-O2-4HR-E	<a href="http://www.netapp.com/us/support/supportededge.html">www.netapp.com/us/support/supportededge.html</a>
Software Support	SW-SSP-O2-4HR-E	
Initial installation	SVC-INST-O2-4HR-E	

## 13 Power and Cabling Requirements

This section describes the power and minimum cabling requirements for a FlexPod Express design.

### 13.1 Power Requirements

The power requirements are based on U.S. specifications and assume the use of AC power. Other countries might have different power requirements. Direct current (DC) power options are also available for most components. For additional data about the maximum power required as well as other detailed power information, consult the detailed technical specifications for each hardware component.

For detailed Cisco UCS power data, see the [Cisco UCS Power Calculator](#).

Table 15 lists the power ports required per device.

Table 15) Power ports required per device.

Cisco Nexus Switches	Power Cables Required
Cisco Nexus 3048	2 x C13/C14 power cables for each Cisco Nexus 3000 series switch
Cisco Nexus 3524	2 x C13/C14 power cables for each Cisco Nexus 3000 series switch
Cisco Nexus 9396	2 x C13/C14 power cables for each Cisco Nexus 9000 series switch
Cisco UCS Chassis	Power Cables Required
Cisco UCS 5108	2 CAB-US515P-C19-US/CAB-US520-C19-US for each Cisco UCS chassis
Cisco UCS B-Series Servers	Power Cables Required
Cisco UCS B200 M4	N/A; blade server is powered by chassis
Cisco UCS B420 M4	N/A; blade server is powered by chassis
Cisco UCS C-Series Servers	Power Ports Required
Cisco UCS C220 M4	2 x C13/C14 power cables for each Cisco UCS server
Cisco UCS C240 M4	
Cisco UCS C460 M4	



NetApp FAS Controllers	Power Ports Required (per HA Pair)
FAS2	2 x C13/C14
FAS2	2 x C13/C14
FAS2554	2 x C13/C14
FAS2552	2 x C13/C14
FAS2520	2 x C13/C14
FAS8020	2 x C13/C14
E-Series Controllers	Power Ports Required (per HA Pair)
E2824	2 x C14/C20
NetApp FAS Disk Shelves	Power Ports Required
DS212C	2 x C13/C14
DS224C	2 x C13/C14
DS460C	2 x C13/C14
DS2246	2 x C13/C14
DS4246	4 x C13/C14
E-Series Disk Shelves	Power Ports Required
DE460C	2 x C14/C20
DE224C	2 x C14/C20
DE212C	2 x C14/C20

## 13.2 Minimum Cable Requirements

This section describes the minimum cable requirements for a FlexPod Express design. Most FlexPod implementations require additional cables, but the number varies based on the deployment size and scope.

Table 16 lists the minimum number of cables required for each device.

**Table 16) Minimum number of cables required for each device.**

Cisco Nexus 3000 Series Switches	Cables Required
Cisco Nexus 3048	At least two 10GbE fiber or twinax cables per switch
Cisco Nexus 3524	
Cisco Nexus 9396	
NetApp FAS Controllers	Cables Required
FAS2620	<ul style="list-style-type: none"> <li>At least two 10GbE cables per controller</li> <li>At least one GbE cable for management per controller</li> <li>If deploying clustered Data ONTAP (not as a switchless cluster), eight short twinax cables are required per pair</li> </ul>
FAS2650	
FAS2554	

Cisco Nexus 3000 Series Switches	Cables Required
FAS2552	of cluster interconnect switches <ul style="list-style-type: none"> <li>For clustered Data ONTAP switchless cluster deployments, at least two 10GbE cables for one controller HA pair</li> <li>SAS cables are required to connect external disk shelves to NetApp FAS controllers; appropriate number depends on number of shelves to be connected and configuration</li> </ul>
FAS2520	
FAS8020	
NetApp FAS Disk Shelves	Cables Required
DS212C	Number of SAS cables depends on specific configuration of disk shelves
DS224C	
DS460C	
DS2246	
DS4246	
E-Series Controllers	Cables Required
E2800	<ul style="list-style-type: none"> <li>At least one GbE cable for management per controller</li> <li>At least two 10GbE cables per controller (for iSCSI) or two FC cables matching speed requirements</li> </ul>
E-Series Disk Shelves	Cables Required
DE460C	2 x mini-SAS HD cables per disk shelf
DE224C	2 x mini-SAS HD cables per disk shelf
DE212C	2 x mini-SAS HD cables per disk shelf

## 14 Technical Specifications and References

This section describes additional important technical specifications for each of the FlexPod Express components.

### Cisco UCS B-Series Blade Servers

Table 17 lists the Cisco UCS B-Series blade server options.

Table 17) Cisco UCS B-Series blade server options.

Component	Cisco UCS B200 M4	Cisco UCS B420 M4
Processor support	Intel Xeon E5-2600	Intel Xeon E5-4600
Maximum memory capacity	24 DIMMs for a maximum of 768GB	48 DIMMs for a maximum of 3TB
Memory size and speed	32GB DDR4; 2133MHz	64GB DDR4; 2400MHz
SAN boot support	Yes	Yes
Mezzanine I/O adapter slots	2	3

Component	Cisco UCS B200 M4	Cisco UCS B420 M4
I/O maximum throughput	80Gbps	160Gbps

## Cisco UCS C-Series Rack Servers

Table 18 lists Cisco UCS C-Series rack server options.

Table 18) Cisco UCS M4 servers.

Component	Cisco UCS C220 M4	Cisco UCS C240 M4	Cisco UCS C460 M4
Processor support	1 or 2 Intel E5-2600 series	1 or 2 Intel Xeon E5-2600 series	2 or 4 Intel Xeon E7-4800/8800 series
Maximum memory capacity	1.5GB	1.5TB	6TB
PCIe slots	2	6	10
Form factor	1RU	2RU	4RU

Table 19 lists the datasheets for the Cisco UCS C-Series rack server options.

Table 19) Datasheets for the Cisco UCS C-Series rack server options.

Component	Cisco UCS Datasheet
Cisco UCS C220 M4	<a href="http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m4-sff-spec-sheet.pdf">http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m4-sff-spec-sheet.pdf</a>
Cisco UCS C240 M4	<a href="http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c240-m4-rack-server/datasheet-c78-732455.html">http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c240-m4-rack-server/datasheet-c78-732455.html</a>
Cisco UCS C460 M4	<a href="http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c460-m4-rack-server/datasheet-c78-730907.html">http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c460-m4-rack-server/datasheet-c78-730907.html</a>

## Cisco Nexus 3000 Series Switches

Table 20 lists the Cisco Nexus 3000 series switch options.

Table 20) Cisco Nexus 3000 series switch options.

Component	Cisco Nexus 3048	Cisco Nexus 3524
Form factor	1RU	1RU
Maximum 1Gbps ports	48	24
Forwarding rate	132Mbps	360Mbps
Jumbo frame support	Yes	Yes

Table 21 lists the datasheets for the Cisco Nexus 3000 series switch options.

Table 21) Datasheets for Cisco Nexus 3000 series switch options.

Component	Cisco Nexus Datasheet
Cisco Nexus 3048	<a href="http://www.cisco.com/c/en/us/products/collateral/switches/nexus-3000-series-switches/data_sheet_c78-685363.html">http://www.cisco.com/c/en/us/products/collateral/switches/nexus-3000-series-switches/data_sheet_c78-685363.html</a>

Component	Cisco Nexus Datasheet
Cisco Nexus 31108	<a href="http://www.cisco.com/c/en/us/products/switches/nexus-31108pc-v-switch/index.html">http://www.cisco.com/c/en/us/products/switches/nexus-31108pc-v-switch/index.html</a>

Table 22 lists the Cisco Nexus 9000 series switch options.

Table 22) Cisco Nexus 9000 series switch options.

Component	Cisco Nexus 9396	Cisco Nexus 9372
Form factor	2RU	1RU
Maximum ports	60	54
10Gbps SFP+ uplink ports	48	48

Table 23 lists the Cisco Nexus 9000 series switch options datasheets.

Table 23) Cisco Nexus 9000 series switch options datasheets.

Component	Cisco Nexus Datasheet
Cisco Nexus 9396	<a href="http://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-736967.html">http://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-736967.html</a>
Cisco Nexus 9372	<a href="http://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-736967.html">http://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-736967.html</a>

## NetApp FAS Storage Controllers

Table 24 lists the current NetApp FAS storage controller options.

Table 24) NetApp storage controller options.

Current Component	FAS2620	FAS2650	FAS2554	FAS2552	FAS2520
Configuration	2 controllers in a 2U chassis	2 controllers in a 4U chassis	2 controllers in a 4U chassis	2 controllers in a 2U chassis	2 controllers in a 2U chassis
Maximum raw capacity	1440TB	1243TB	576TB	509TB	336TB
Internal drives	12	24	24	24	12
Maximum number of drives (internal plus external)	144	144	144	144	84
Maximum volume size	100TB		60TB		
Maximum aggregate size	4TB		120TB		
Maximum number of LUNs	2,048 per controller				
Storage networking supported	iSCSI, FC, FCoE, NFS, and CIFS				iSCSI, NFS, and CIFS

Current Component	FAS2620	FAS2650	FAS2554	FAS2552	FAS2520
Maximum number of NetApp FlexVol <sup>®</sup> volumes	1,000 per controller				
Maximum number of NetApp Snapshot <sup>®</sup> copies	255,000 per controller				
Maximum NetApp Flash Pool <sup>™</sup> intelligent data caching	24TB		64TB		32TB

Table 25 lists the characteristics of a FAS8020 controller system.

**Table 25) FAS8020 controller characteristics.**

Component	FAS8020
Configuration	2 x controllers in a 3U chassis
Maximum raw capacity	2880TB
Maximum number of drives	480
Maximum volume size	70TB
Maximum aggregate size	324TB
Maximum number of LUNs	8,192 per controller
Storage networking supported	iSCSI, FC, NFS, and CIFS
Maximum number of FlexVol volumes	1,000 per controller
Maximum number of Snapshot copies	255,000 per controller
Maximum NetApp Flash Cache <sup>™</sup> intelligent data caching	3TB
Maximum Flash Pool data caching	24TB

Table 26 lists the datasheets for the NetApp storage controller.

**Table 26) Datasheets for NetApp storage controller.**

Component	Storage Controller Datasheet
FAS2600 series	<a href="http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx">http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx</a>
FAS2500 series	<a href="http://www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx">http://www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx</a>
FAS8000 series	<a href="http://www.netapp.com/us/products/storage-systems/fas8000/fas8000-tech-specs.aspx">http://www.netapp.com/us/products/storage-systems/fas8000/fas8000-tech-specs.aspx</a>

## NetApp FAS Ethernet Adapters

Table 27 lists NetApp FAS 10GbE adapters.

Table 27) NetApp FAS 10GbE adapters.

Component	X1117A-R6
Port count	2
Adapter type	SFP+ with Fibre

**Note:** The X1117A-R6 SFP+ adapter is supported on FAS8000 series controllers.

**Note:** The FAS2600 and FAS2500 series storage systems have onboard 10GbE ports.

For more information, see the [NetApp 10GbE adapter datasheet](#).

## NetApp FAS Disk Shelves

Table 28 lists the current NetApp FAS disk shelf options.

Table 28) NetApp FAS disk shelf options.

Component	DS460C	DS224C	DS212C	DS2246	DS4246
Form factor	4RU	2RU	2RU	2RU	4RU
Drives per enclosure	60	24	12	24	24
Drive form factor	3.5" large form factor	2.5" small form factor	3.5" large form factor	2.5" small form factor	3.5" large form factor
Shelf I/O modules	Dual IOM12 modules	Dual IOM12 modules	Dual IOM12 modules	Dual IOM6 modules	Dual IOM6 modules

For more information, refer to the [NetApp disk shelves datasheet](#).

## NetApp FAS 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 and are located in the Drives section on [NetApp Hardware Universe](#).

## E-Series Storage Controllers

Table 29 lists the current E-Series storage controller options.

Table 29) E-Series storage controller options.

Current Component	E2812	E2824	E2860
Configuration	2 x controllers in a 2U chassis	2 x controllers in a 2U chassis	2 x controllers in a 4U chassis
Maximum raw capacity	1800TB	1756.8TB	1800TB
Internal drives	12	24	60

Current Component	E2812	E2824	E2860
Maximum number of drives (internal plus external)	180		
Maximum SSD drives	120		
Maximum volume size for disk pool volume	1024TB		
Maximum disk pools	20		
Storage networking supported	iSCSI and FC		
Maximum number of volumes	512		

Table 30 lists the datasheets for the current E-Series storage controller.

Table 30) Datasheets for E-Series storage controller.

Component	Storage Controller Datasheet
E2800	<a href="http://www.netapp.com/us/media/ds-3805.pdf">http://www.netapp.com/us/media/ds-3805.pdf</a>

## E-Series Adapters

Table 31 lists the E-Series adapters.

Table 31) E-Series adapters.

Component	X-56023-00-0E-C	X-56025-00-0E-C	X-56027-00-0E-C	X-56024-00-0E-C	X-56026-00-0E-C
Port count	2	4	4	2	2
Adapter type	10Gb Base-T	16G FC and 10GbE iSCSI	SAS	16G FC and 10GbE iSCSI	SAS

## E-Series Disk Shelves

Table 32 lists the E-Series disk shelf options.

Table 32) E-Series disk shelf options.

Component	DE212C	DE224C	DE460C
Form factor	2RU	2RU	4RU
Drives per enclosure	12	24	60
Drive form factor	2.5" small form factor 3.5"	2.5"	2.5" small form factor 3.5"
Shelf I/O modules	IOM12	IOM12	IOM12

## E-Series Disk Drives

The technical specifications for the NetApp disk drives include form factor size, disk capacity, disk RPM, supporting controllers, and SANtricity version requirements and are located in the Drives section on [NetApp Hardware Universe](#).

## 15 Previous Architectures and Equipment

FlexPod is a flexible solution allowing customers to leverage both existing and new equipment currently for sale by Cisco and NetApp. Occasionally, certain models of equipment from both Cisco and NetApp are designated end of life.

Even though these models of equipment are no longer available, customers who bought one of these models prior to the end-of-sale date can leverage that equipment in a FlexPod configuration.

Additionally, FlexPod Express architectures are periodically refreshed to introduce the latest hardware and software from Cisco and NetApp to the FlexPod Express solution. This section lists the previous FlexPod Express architectures and hardware used within them.

### 15.1 Previous FlexPod Express Architectures

This section describes the previous FlexPod Express architectures.

#### FlexPod Express Small and Medium Configurations

The FlexPod Express small and medium configurations include the following components:

- Two Cisco Nexus 3048 switches in a redundant configuration
- At least two Cisco UCS C-Series rack mount servers
- Two FAS2200 or FAS2500 series controllers in an HA pair configuration

Figure 4 illustrates the FlexPod Express small configuration.



Figure 4) FlexPod Express small configuration.

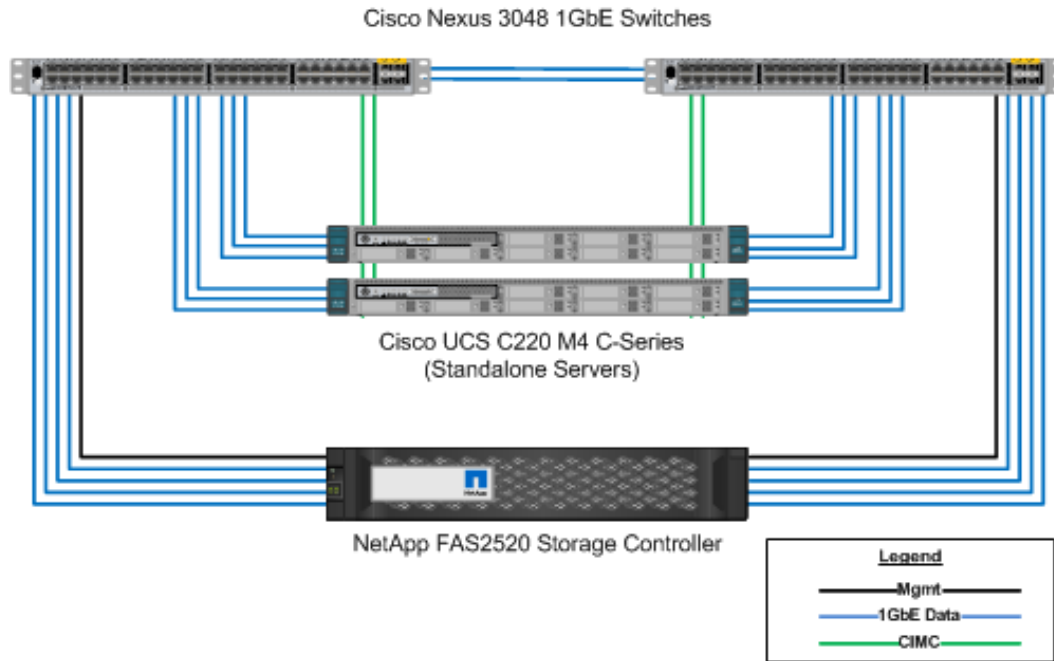
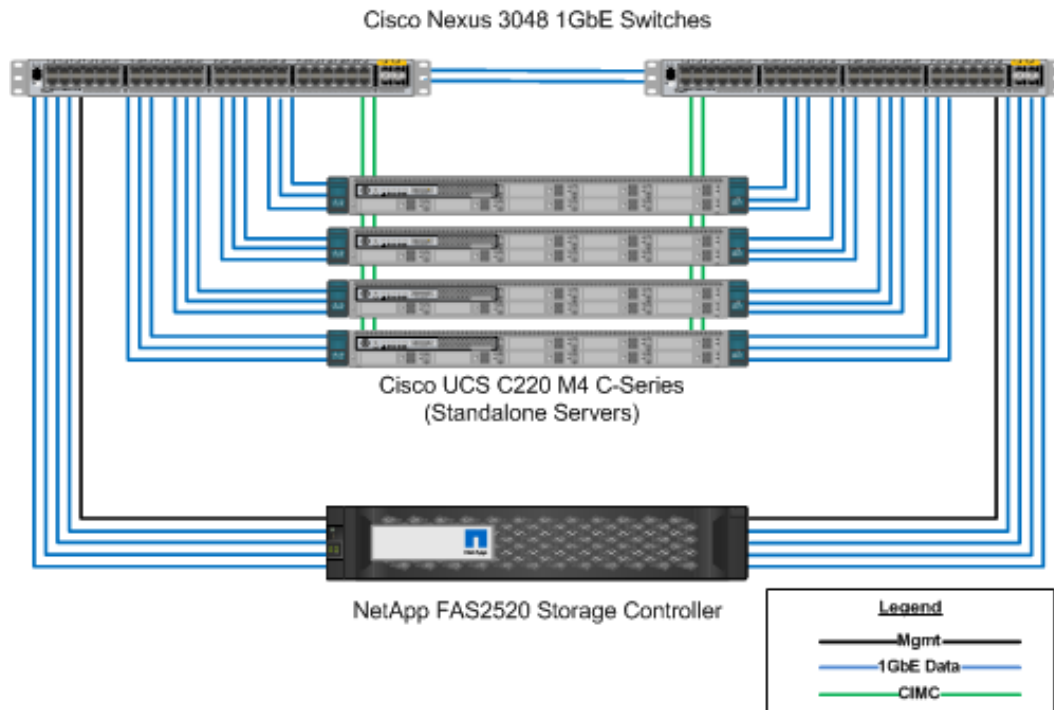


Figure 5 illustrates the FlexPod Express medium configuration.

Figure 5) FlexPod Express medium configuration.



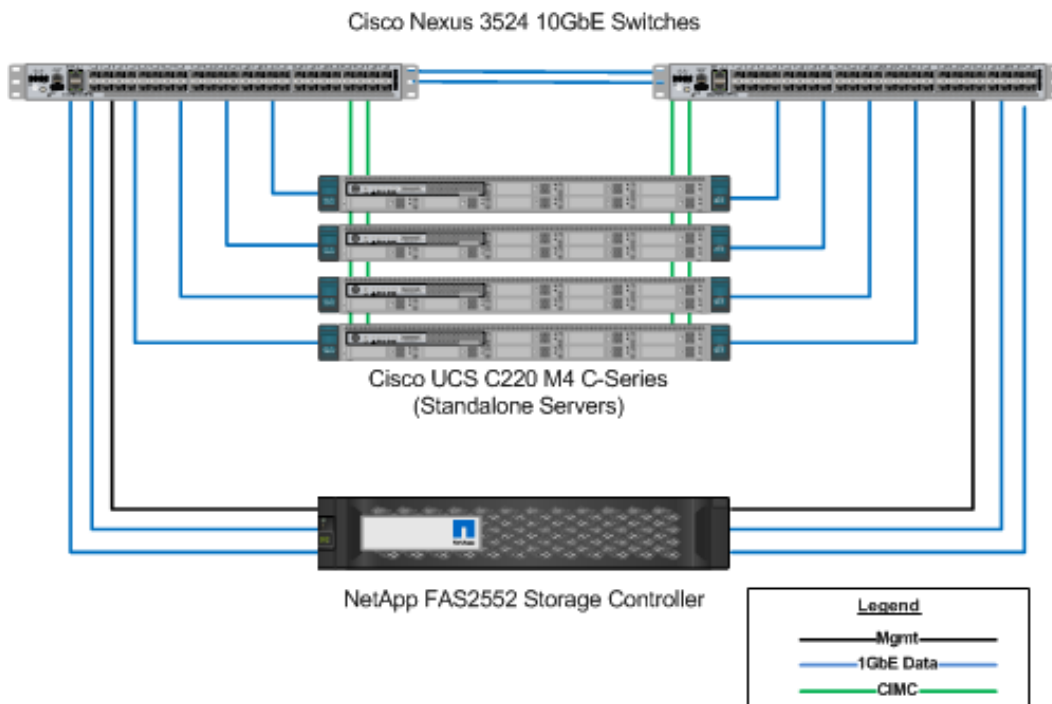
## FlexPod Express Large Configuration

The FlexPod Express large configuration includes the following components:

- Two Cisco Nexus 3500 series or Cisco Nexus 9300 series switches in a redundant configuration
- At least two Cisco UCS C-Series rack mount servers
- Two FAS2552, FAS2554, or FAS8020 controllers in an HA pair configuration (requires two 10GbE ports per controller)
- One NetApp disk shelf with any supported disk type (when the FAS8020 is used)

Figure 6 illustrates the FlexPod Express large configuration.

Figure 6) FlexPod Express large configuration.



## Previous FlexPod Express Verified Architectures

Previous FlexPod Express verified architectures are still supported. The architecture and deployment documents include:

- [FlexPod Express with Cisco UCS C-Series and NetApp FAS2500 Series](#)
- [FlexPod Express with VMware vSphere 6.0: Small and Medium Configurations](#)
- [FlexPod Express with VMware vSphere 6.0: Large Configuration](#)
- [FlexPod Express with Microsoft Windows Server 2012 R2 Hyper-V: Small and Medium Configurations](#)
- [FlexPod Express with Microsoft Windows Server 2012 R2 Hyper-V: Large Configuration](#)

## Previous Hardware

Table 33 lists the hardware used in previous FlexPod Express architectures.

**Table 33) Hardware used in previous FlexPod Express architectures.**

Hardware Used in Previous Architectures	Technical Specifications (If Available)
Cisco UCS C220 M3	<a href="http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c220-m3-rack-server/data_sheet_c78-700626.html">http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c220-m3-rack-server/data_sheet_c78-700626.html</a>
Cisco UCS C24 M3	<a href="http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/data_sheet_c78-706103.html">http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/data_sheet_c78-706103.html</a>
Cisco UCS C22 M3	<a href="http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/data_sheet_c78-706101.html">http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/data_sheet_c78-706101.html</a>
Cisco UCS C240 M3	<a href="http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c240-m3-rack-server/data_sheet_c78-700629.html">http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c240-m3-rack-server/data_sheet_c78-700629.html</a>
Cisco UCS C260 M2	<a href="http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/c260m2_specsheet.pdf">http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/c260m2_specsheet.pdf</a>
Cisco UCS C420 M3	<a href="http://www.cisco.com/en/US/products/ps12770/index.html">http://www.cisco.com/en/US/products/ps12770/index.html</a>
Cisco UCS C460 M2	<a href="http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/ps11587/spec_sheet_c17-662220.pdf">http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/ps11587/spec_sheet_c17-662220.pdf</a>
Cisco UCS B200 M3	<a href="http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-b200-m3-blade-server/data_sheet_c78-700625.html">http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-b200-m3-blade-server/data_sheet_c78-700625.html</a>
Cisco UCS B420 M3	N/A
Cisco UCS B22 M3	<a href="http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b22m3_specsheet.pdf">http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b22m3_specsheet.pdf</a>
Cisco Nexus 3524	<a href="http://www.cisco.com/c/en/us/products/switches/nexus-3524-switch/index.html">http://www.cisco.com/c/en/us/products/switches/nexus-3524-switch/index.html</a>
FAS2240	<a href="http://www.netapp.com/us/products/storage-systems/fas2000/fas2000-tech-specs.html">http://www.netapp.com/us/products/storage-systems/fas2000/fas2000-tech-specs.html</a>
FAS2220	<a href="http://www.netapp.com/us/products/storage-systems/fas2200/fas2200-tech-specs.aspx">http://www.netapp.com/us/products/storage-systems/fas2200/fas2200-tech-specs.aspx</a>
DS4243	N/A

## Version History

Version	Date	Document Version History
Version 1.4	March 2017	Added FAS2600 series, revised FlexPod Express architectures, and added E-Series controllers
Version 1.3	September 2015	Added Cisco M4 servers and NetApp FAS8000 series controllers
Version 1.2	April 2015	Added Cisco UCS–managed architecture
Version 1.1	December 2014	Added FAS2500
Version 1.0	April 2014	Initial release

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.

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