



Technical Report

FlexPod Express Technical Specifications

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In partnership with



Important

Before ordering a complete FlexPod® configuration, check the NetApp® [FlexPod Converged Infrastructure](#) 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 FAS or the NetApp E-Series storage. FlexPod Express is a suitable platform for running various virtualization hypervisors and 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 Software

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

5.1 NetApp ONTAP

The NetApp ONTAP® software is installed on every NetApp storage system.

FlexPod is validated with ONTAP providing a highly scalable storage architecture that enables nondisruptive operations, nondisruptive upgrades, and an agile data infrastructure. For more information about ONTAP, see the [ONTAP Data Management Software product page](#).

5.2 E-Series SANtricity Software

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

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 the configurations describe in this section.

CIMC-Based Configuration (Standalone Rack Servers)

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

- Two 10Gbps standard Ethernet switches in a redundant configuration (Cisco Nexus 0808 is recommended, with Cisco Nexus 3000 and 9000 models supported)
- Cisco UCS C-Series standalone rack servers
- Two AFF C190, AFF A220, FAS2600, or FAS 2700 series controllers in a high-availability (HA) pair configuration deployed as a two-node cluster

Cisco UCS-Managed Configuration

The Cisco UCS-managed confirmation 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 M5 blade servers)
- Two AFF C190, AFF A220, FAS2750, or FAS2720 controllers in an HA pair configuration (requires two available unified target adapter 2 [UTA2] ports per controller)

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 AFF or FAS

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

- ONTAP 9.1 or later
- Cisco NX-OS version 7.0(3)I6(1) or later
- In the Cisco UCS-managed configuration, Cisco UCS Manager UCS 4.0(1b)

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.

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 or higher
- Cisco UCS Manager 4.0(1b).

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 NetApp 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.

8.3 Connectivity Requirements for FlexPod Express with NetApp AFF

The connectivity requirements for FlexPod Express with NetApp AFF include:

- NetApp AFF 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.

9 Other Requirements

Additional requirements for FlexPod Express include:

- Valid support contracts are required for all equipment, including:
 - SMARTnet support for Cisco equipment
 - SupportEdge Premium support for NetApp equipment

Note: All software components must be listed and supported in the [NetApp IMT](#).
All NetApp hardware components must be listed and supported on [NetApp Hardware Universe](#).
All Cisco hardware components must be listed and supported on [Cisco HCL](#).

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
- An adapter in the Cisco UCS server that is capable of iSCSI boot

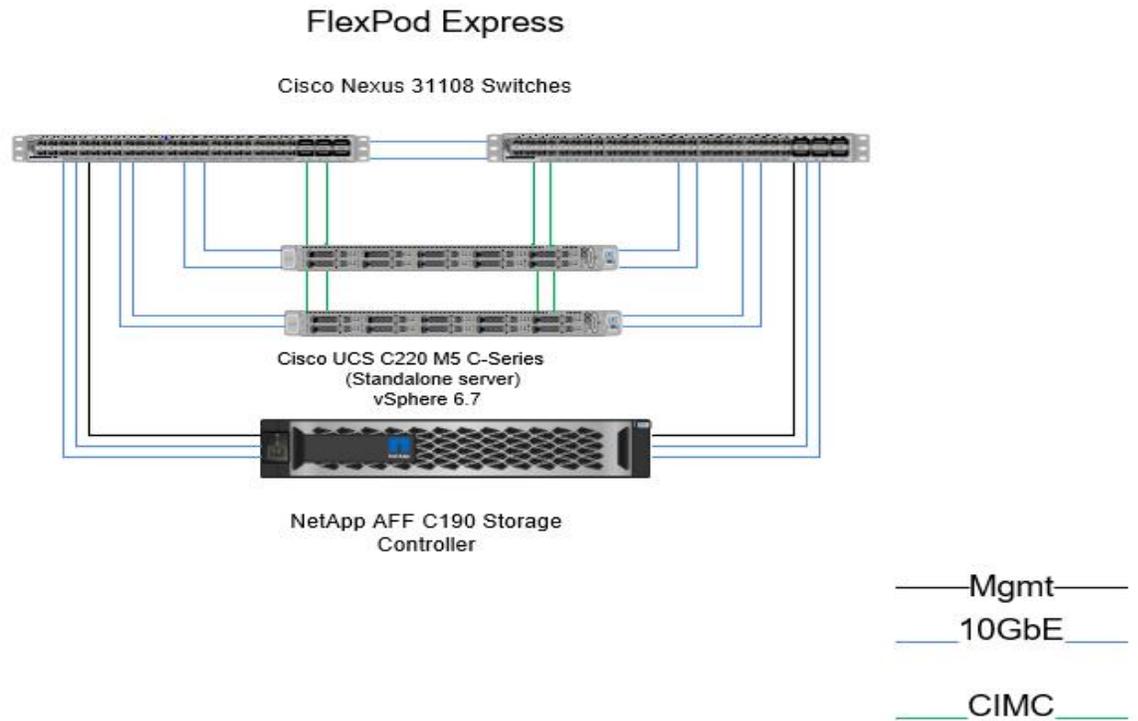
10.2 Configuration Options

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

FlexPod Express with Cisco UCS C-Series and AFF C190 Series

Figure 1 illustrates the FlexPod Express with Cisco UCS C-Series and AFF C190 series solution. This solution supports both 10GbE uplinks.

Figure 1) FlexPod Express with Cisco UCS C-Series and AFF C190 series solution.

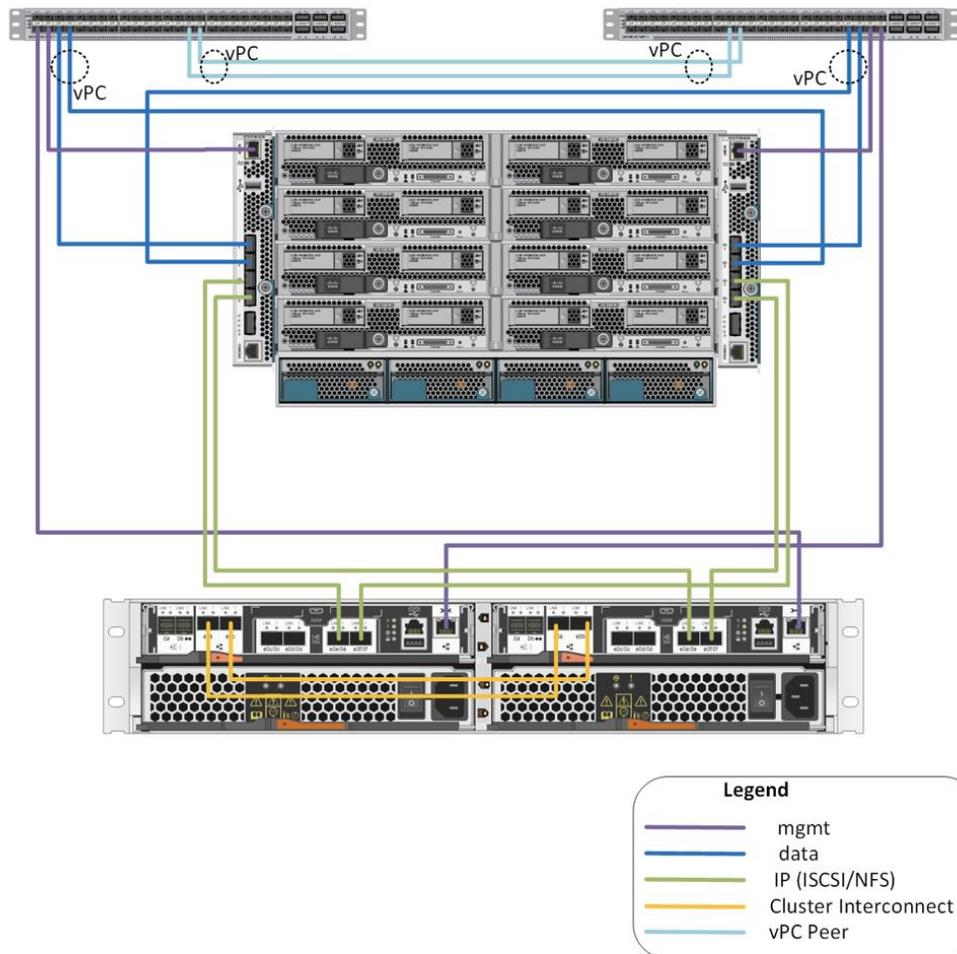


For more information about this configuration, see “FlexPod Express with VMware vSphere 6.7 and NetApp AFF C190 NVA Deployment Guide” (in progress).

FlexPod Express with Cisco UCS Mini and AFF A220 and FAS 2750/2720

Figure 2 illustrates the FlexPod Express with Cisco UCS-managed configuration.

Figure 2) FlexPod Express with VMware vSphere 6.7 U1 IP-based Direct Connect and Cisco UCS Mini.



For more information about this configuration, see [FlexPod Express with VMware vSphere 6.7U1 and NetApp AFF A220 with Direct - Attached IP - Based Storage](#).

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 M5 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 M5 | UCSB-B200-M5 | https://www.cisco.com/c/en/us/support/servers-unified-computing/ucs-b200-m5-blade-server/model.html |
| Cisco UCS B200 M4 | UCSB-B200-M4 | http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b200m4-specsheet.pdf |
| Cisco UCS B420 M4 | UCSB-B420-M4 | http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b420m4-spec-sheet.pdf |

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 | http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m4-sff-spec-sheet.pdf |
| Cisco UCS C240 M4 | UCSC-C240-M4S | http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c240m4-sff-spec-sheet.pdf |
| Cisco UCS C460 M4 | UCSC-C460-M4 | http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c460m4_specsheet.pdf |

11.3 Cisco Nexus Switches

Redundant switches are required for all FlexPod Express architectures.

The FlexPod Express with NetApp AFF or FAS architecture is built with the Cisco Nexus 31108 switch. FlexPod Express with the Cisco UCS Mini (Cisco UCS-managed) architecture is validated by 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 | www.cisco.com/c/en/us/products/collateral/switches/nexus-3000-series-switches/data_sheet_c78-685363.html |
| Cisco Nexus 31108 | N3K-C31108PC-V | http://www.cisco.com/c/en/us/products/switches/nexus-31108pc-v-switch/index.html |
| Cisco Nexus 9396 | N9K-C9396PX | www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-729405.html |
| Cisco Nexus 3172 | N3K-C3172 | https://www.cisco.com/c/en/us/products/collateral/switches/nexus-3000-series-switches/data_sheet_c78-729483.html |

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 | www.cisco.com/web/services/portfolio/product-technical-support/smartnet/index.html |

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 AFF C190, AFF A220, or FAS2750 series controllers are required in the FlexPod Express architecture. The controllers run ONTAP software. When ordering the storage controllers, the preferred software version can be preloaded on the controllers. For 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 |
|--------------------|------------------------------------|---|
| FAS2750 | Based on individual options chosen | https://www.netapp.com/us/products/storage-systems/hybrid-flash-array/fas2700.aspx |
| FAS2720 | Based on individual options chosen | https://www.netapp.com/us/products/storage-systems/hybrid-flash-array/fas2700.aspx |
| AFF C190 | Based on individual options chosen | https://www.netapp.com/us/products/entry-level-aff.aspx |
| AFF A220 | Based on individual options chosen | https://www.netapp.com/us/documentation/all-flash-fas.aspx |
| FAS2620 | Based on individual options chosen | http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx |
| FAS2650 | Based on individual options chosen | http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx |

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 | http://www.netapp.com/us/products/storage-systems/e2800/e2800-tech-specs.aspx |

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 | https://library.netapp.com/ecm/ecm_download_file/ECM11280307 |

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 OS.

For more information about supported adapter options, see the Adapter section of [NetApp Hardware Universe](#).

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 FAS2700 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 | Disk Shelves and Storage Media Technical Specifications Supported Drives on NetApp Hardware Universe |
| DS224C | DS224C-0-24 | Disk Shelves and Storage Media Technical Specifications Supported Drives on NetApp Hardware Universe |
| DS460C | DS460C-0-60 | Disk Shelves and Storage Media Technical Specifications Supported Drives on NetApp Hardware Universe |
| DS2246 | X559A-R6 | Disk Shelves and Storage Media Technical Specifications Supported Drives on NetApp Hardware Universe |

| Disk Shelf | Part Number | Technical Specifications |
|------------|-------------------|--|
| DS4246 | X24M-R6 | Disk Shelves and Storage Media Technical Specifications Supported Drives on NetApp Hardware Universe |
| DS4486 | DS4486-144TB-R5-C | Disk Shelves and Storage Media Technical Specifications Supported Drives on NetApp Hardware Universe |

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 options and 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 | Disk Shelves Technical Specifications Supported Drives on NetApp Hardware Universe |
| DE224C | E-X5721A-DM-0E-C | Disk Shelves Technical Specifications Supported Drives on NetApp Hardware Universe |
| DE212C | E-X5723A-DM-0E-C | Disk Shelves Technical Specifications Supported Drives on NetApp Hardware Universe |

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 | www.netapp.com/us/support/supportedge.html |

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 | www.netapp.com/us/support/supportedge.html |
| 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 | | 2x C13/C14 power cables for each Cisco Nexus 3000 series switch |
| Cisco Nexus 3524 | | 2x C13/C14 power cables for each Cisco Nexus 3000 series switch |
| Cisco Nexus 9396 | | 2x 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 B200 M5 | | N/A; blade server is powered by chassis |
| Cisco UCS B480 M5 | | 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 | | |
| Cisco UCS C220 M5 Cisco UCS C240 M5 Cisco UCS C480 M5 | | |
| NetApp FAS Controllers | | Power Ports Required (per HA Pair) |
| 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 31108 | At least two 10GbE fiber or Twinax cables per switch |
| Cisco Nexus 3172PQ | |
| Cisco Nexus 3048 | |
| Cisco Nexus 3524 | |
| Cisco Nexus 9396 | |
| DS212C | Number of SAS cables depends on specific configuration of disk shelves |
| DS224C | |
| DS460C | |
| DS2246 | |
| DS4246 | |
| E2800 | <ul style="list-style-type: none"> At least one Gigabit Ethernet (1GbE) cable for management per controller At least two 10GbE cables per controller (for iSCSI) or two FC cables matching speed requirements |
| 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.

14.1 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 | Cisco UCS B200 M5 |
|-----------------------------|---------------------------------|-------------------------------|---|
| Processor support | Intel Xeon E5-2600 | Intel Xeon E5-4600 | Intel Xeon Scalable processors |
| Maximum memory capacity | 24 DIMMs for a maximum of 768GB | 48 DIMMs for a maximum of 3TB | 24 DIMMs for a maximum of 3072GB |
| Memory size and speed | 32GB DDR4; 2133MHz | 64GB DDR4; 2400MHz | 16GB, 32GB, 64GB, and 128GB DDR4; 2666MHz |
| SAN boot support | Yes | Yes | Yes |
| Mezzanine I/O adapter slots | 2 | 3 | 2, front and rear, including GPU support |
| I/O maximum throughput | 80Gbps | 160Gbps | 80Gbps |

14.2 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 | Cisco UCS C220 M5 |
|-------------------------|-----------------------------|----------------------------------|---------------------------------------|---|
| 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 | Intel Xeon Scalable processors (1 or 2) |
| Maximum memory capacity | 1.5GB | 1.5TB | 6TB | 3072GB |
| PCIe slots | 2 | 6 | 10 | 2 |
| Form factor | 1RU | 2RU | 4RU | 1 RU |

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 | http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m4-sff-spec-sheet.pdf |

| Component | Cisco UCS Datasheet |
|-------------------|---|
| Cisco UCS C240 M4 | http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c240-m4-rack-server/datasheet-c78-732455.html |
| Cisco UCS C460 M4 | http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c460-m4-rack-server/datasheet-c78-730907.html |
| Cisco UCS C220 M5 | https://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/c220m5-sff-specsheet.pdf |

14.3 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 | Cisco Nexus 31108 | Cisco Nexus 3172PQ |
|---------------------|------------------|------------------|--------------------|--|
| Form factor | 1RU | 1RU | 1RU | 1 RU |
| Maximum 1Gbps ports | 48 | 24 | 48 (10/40/100Gbps) | 72 1/10GbE ports, or 48 1/10GbE plus six 40GbE ports |
| Forwarding rate | 132Mbps | 360Mbps | 1.2Bpps | 1Bpps |
| Jumbo frame support | Yes | Yes | 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 31108 | http://www.cisco.com/c/en/us/products/switches/nexus-31108pc-v-switch/index.html |
| Cisco Nexus 3172PQ | https://www.cisco.com/c/en/us/products/switches/nexus-3172pq-switch/index.html |
| Cisco Nexus 3048 | https://www.cisco.com/c/en/us/products/switches/nexus-3048-switch/index.html |
| Cisco Nexus 3172PQ-XL | https://www.cisco.com/c/en/us/products/switches/nexus-3172pq-switch/index.html |
| Cisco Nexus 3548 XL | https://www.cisco.com/c/en/us/products/switches/nexus-3548-x-switch/index.html |
| Cisco Nexus 3524 XL | https://www.cisco.com/c/en/us/products/switches/nexus-3524-x-switch/index.html |
| Cisco Nexus 3548 | https://www.cisco.com/c/en/us/products/switches/nexus-3548-x-switch/index.html |
| Cisco Nexus 3524 | https://www.cisco.com/c/en/us/products/switches/nexus-3524-x-switch/index.html |

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 | http://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-736967.html |
| Cisco Nexus 9372 | http://www.cisco.com/c/en/us/products/collateral/switches/nexus-9000-series-switches/datasheet-c78-736967.html |
| Nexus 9396X | https://www.cisco.com/c/en/us/products/switches/nexus-9396px-switch/index.html?dtid=osscdc000283 |

14.4 NetApp FAS Storage Controllers

Table 24 lists the current NetApp FAS storage controller options.

Table 24) NetApp storage controller options.

| Current Component | FAS2620 | FAS2650 |
|---|--------------------------------|-------------------------------|
| Configuration | 2 controllers in a 2U chassis | 2 controllers in a 4U chassis |
| Maximum raw capacity | 1440TB | 1243TB |
| Internal drives | 12 | 24 |
| Maximum number of drives (internal plus external) | 144 | 144 |
| Maximum volume size | 100TB | |
| Maximum aggregate size | 4TB | |
| Maximum number of LUNs | 2,048 per controller | |
| Storage networking supported | iSCSI, FC, FCoE, NFS, and CIFS | |
| Maximum number of NetApp FlexVol® volumes | 1,000 per controller. | |
| Maximum number of NetApp Snapshot® copies | 255,000 per controller | |
| Maximum NetApp Flash Pool™ intelligent data caching | 24TB | |

Note: For details about the FAS storage controller option, see the [FAS models](#) section of the Hardware Universe. For AFF, see [AFF models](#) section.

Table 25 lists the characteristics of a FAS8020 controller system.

Table 25) FAS8020 controller characteristics.

| Component | FAS8020 |
|--|-------------------------------|
| Configuration | 2 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™ intelligent data caching | 3TB |
| Maximum Flash Pool data caching | 24TB |

Table 26 lists the datasheets for NetApp storage controllers.

Table 26) Datasheets for NetApp storage controllers.

| Component | Storage Controller Datasheet |
|----------------|---|
| FAS2600 series | http://www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx |
| FAS2500 series | http://www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx |
| FAS8000 series | http://www.netapp.com/us/products/storage-systems/fas8000/fas8000-tech-specs.aspx |

14.5 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](#).

Note: For more adapter details based on the AFF or FAS model, see the [Adapter section](#) in the Hardware Universe.

14.6 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, see the [NetApp disk shelves datasheet](#).

Note: For more information about the disk shelves, see the NetApp Hardware Universe [Disk Shelves section](#).

14.7 NetApp FAS Disk Drives

The technical specifications for the NetApp disks 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](#).

14.8 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 controllers in a 2U chassis | 2 controllers in a 2U chassis | 2 controllers in a 4U chassis |
| Maximum raw capacity | 1800TB | 1756.8TB | 1800TB |
| Internal drives | 12 | 24 | 60 |
| Maximum number of drives (internal plus external) | 180 | | |
| Maximum SSD | 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 | http://www.netapp.com/us/media/ds-3805.pdf |

14.9 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 |

14.10 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 |

14.11 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 use 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 before the end-of-sale date can use 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 3 illustrates the FlexPod Express small configuration.

Figure 3) FlexPod Express small configuration.

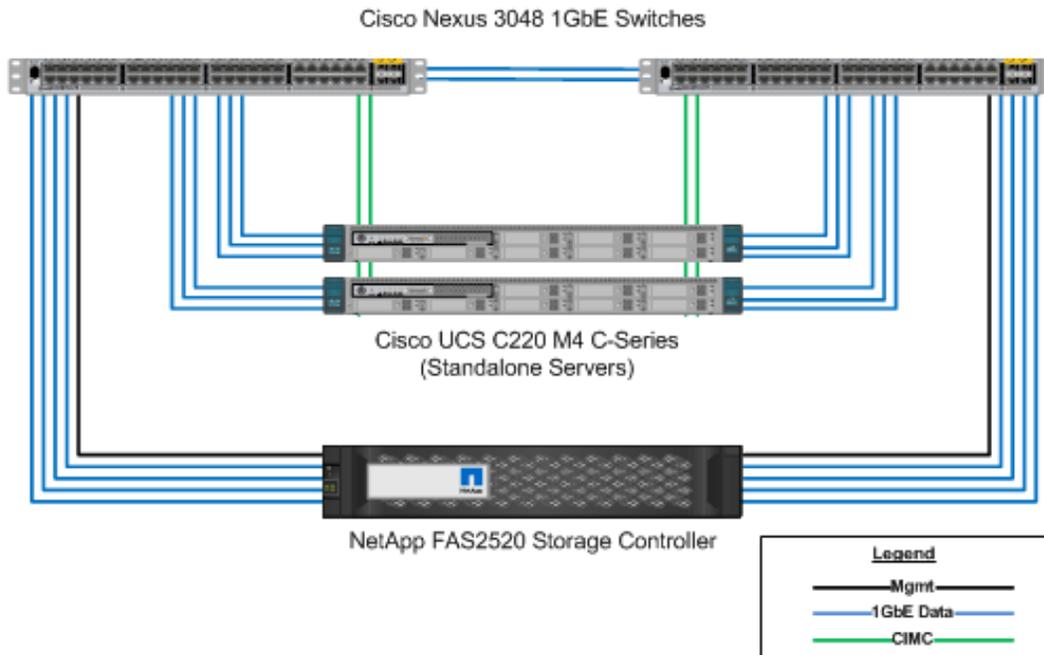
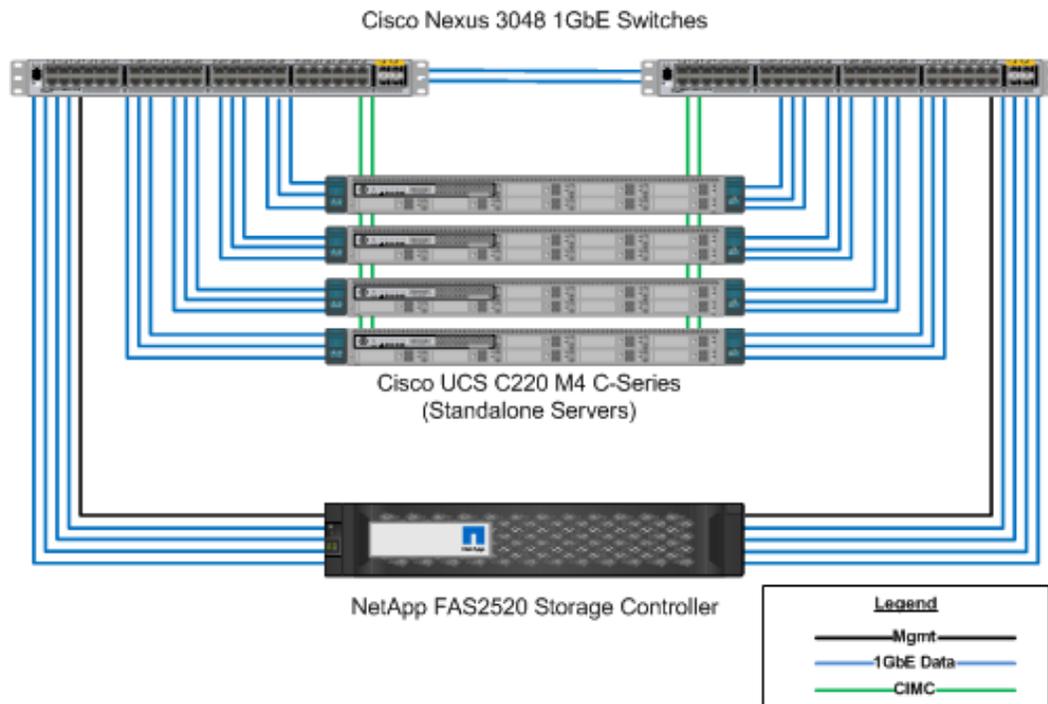


Figure 4 illustrates the FlexPod Express medium configuration.

Figure 4) FlexPod Express medium configuration.



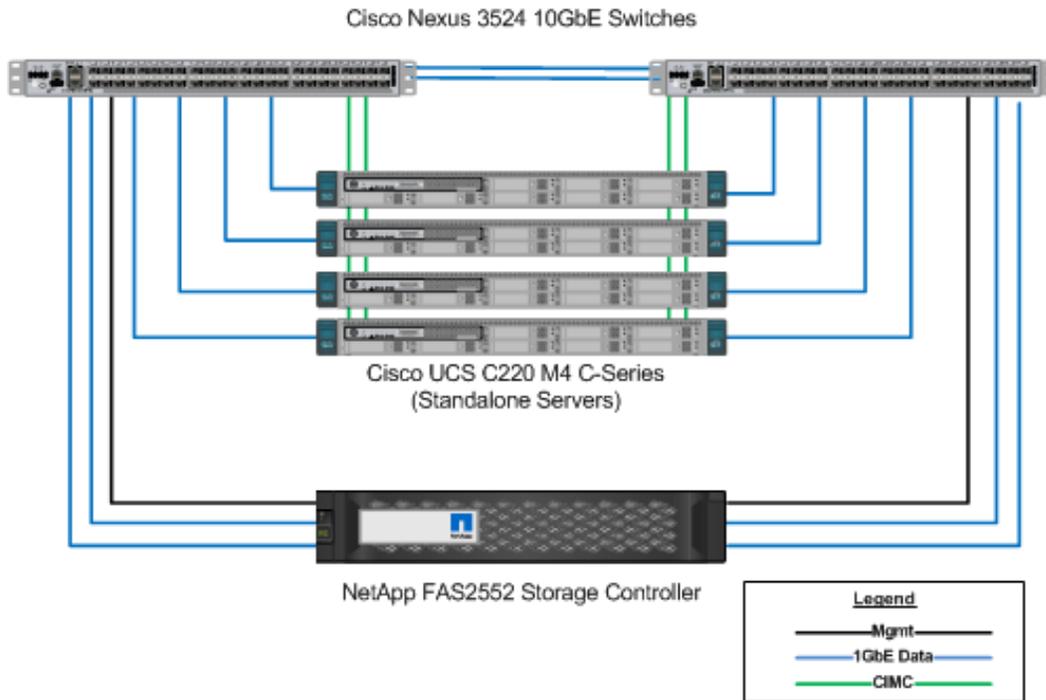
FlexPod Express Large Configuration

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 5 illustrates the FlexPod Express large configuration.

Figure 5) 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 | http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c220-m3-rack-server/data_sheet_c78-700626.html |
| Cisco UCS C24 M3 | http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/data_sheet_c78-706103.html |
| Cisco UCS C22 M3 | http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/data_sheet_c78-706101.html |

| Hardware Used in Previous Architectures | Technical Specifications (If Available) |
|---|---|
| Cisco UCS C240 M3 | http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c240-m3-rack-server/data_sheet_c78-700629.html |
| Cisco UCS C260 M2 | http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/c260m2_specsheet.pdf |
| Cisco UCS C420 M3 | http://www.cisco.com/en/US/products/ps12770/index.html |
| Cisco UCS C460 M2 | http://www.cisco.com/en/US/prod/collateral/ps10265/ps10493/ps11587/specsheet_c17-662220.pdf |
| Cisco UCS B200 M3 | http://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-b200-m3-blade-server/data_sheet_c78-700625.html |
| Cisco UCS B420 M3 | N/A |
| Cisco UCS B22 M3 | http://www.cisco.com/c/dam/en/us/products/collateral/servers-unified-computing/ucs-b-series-blade-servers/b22m3_specsheet.pdf |
| Cisco Nexus 3524 | http://www.cisco.com/c/en/us/products/switches/nexus-3524-switch/index.html |
| FAS2240 | http://www.netapp.com/us/products/storage-systems/fas2000/fas2000-tech-specs.html |
| FAS2220 | http://www.netapp.com/us/products/storage-systems/fas2200/fas2200-tech-specs.aspx |
| DS4243 | N/A |

16 Legacy Equipment

Table 34) NetApp legacy storage controller options.

| Storage Controller | FAS Part Number | Technical Specifications |
|--------------------|------------------------------------|--|
| FAS2520 | Based on individual options chosen | www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx |
| FAS2552 | Based on individual options chosen | www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx |
| FAS2554 | Based on individual options chosen | www.netapp.com/us/products/storage-systems/fas2500/fas2500-tech-specs.aspx |
| FAS8020 | Based on individual options chosen | www.netapp.com/us/products/storage-systems/fas8000/fas8000-tech-specs.aspx |

Table 35) NetApp legacy disk shelf options for NetApp FAS.

| Disk Shelf | Part Number | Technical Specifications |
|------------|---------------------|---|
| DE1600 | E-X5682A-DM-0E-R6-C | Disk Shelves Technical Specifications Supported Drives on NetApp Hardware Universe |

| Disk Shelf | Part Number | Technical Specifications |
|------------|----------------|---|
| DE5600 | E-X4041A-12-R6 | Disk Shelves Technical Specifications Supported Drives on NetApp Hardware Universe |
| DE6600 | X-48564-00-R6 | Disk Shelves Technical Specifications Supported Drives on NetApp Hardware Universe |

16.1 NetApp Legacy FAS Controllers

Table 36 lists the legacy NetApp FAS controller options.

Table 36) NetApp legacy FAS options.

| Current Component | FAS2554 | FAS2552 | FAS2520 |
|---|--------------------------------|-------------------------------|-------------------------------|
| Configuration | 2 controllers in a 4U chassis | 2 controllers in a 2U chassis | 2 controllers in a 2U chassis |
| Maximum raw capacity | 576TB | 509TB | 336TB |
| Internal drives | 24 | 24 | 12 |
| Maximum number of drives (internal plus external) | 144 | 144 | 84 |
| Maximum volume size | 60TB | | |
| Maximum aggregate size | 120TB | | |
| Maximum number of LUNs | 2,048 per controller | | |
| Storage networking supported | iSCSI, FC, FCoE, NFS, and CIFS | | iSCSI, NFS, and CIFS |
| Maximum number of NetApp FlexVol® volumes | 1,000 per controller | | |
| Maximum number of NetApp Snapshot® copies | 255,000 per controller | | |

Note: For more NetApp FAS models, see the [FAS models section](#) in the Hardware Universe.

Where to Find Additional Information

To learn more about the information that is described in this document, see the following documents and websites:

- AFF and FAS System Documentation Center
<https://docs.netapp.com/platstor/index.jsp>
- AFF Documentation Resources page
<https://www.netapp.com/us/documentation/all-flash-fas.aspx>
- FAS Storage Systems Documentation Resources page
<https://www.netapp.com/us/documentation/fas-storage-systems.aspx>
- FlexPod
<https://flexpod.com/>
- NetApp documentation
<https://docs.netapp.com>

Version History

| Version | Date | Document Version History |
|-------------|----------------|---|
| Version 1.6 | October 2019 | Added NetApp AFF C190 series and revised the FlexPod Express architecture. |
| Version 1.5 | April 2019 | Added Cisco M5 servers, NetApp FAS2700 series and AFF220, Cisco Nexus 3000 series new models and new disk shelves models. |
| 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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