



NetApp Verified Architecture

FlexPod Express with Cisco UCS C-Series and AFF A220 Series

NVA Design

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Abstract

The FlexPod[®] Express architecture leverages the NetApp[®] AFF A220 Series, which runs NetApp ONTAP[®] 9.4 software, Cisco UCS C-Series rack-mount servers, and Cisco Nexus 3172P switches. The architecture also includes VMware vSphere 6.7.

Reviewed by



TABLE OF CONTENTS

1	Executive Summary	4
2	Program Summary	4
2.1	FlexPod Converged Infrastructure Portfolio	4
2.2	NetApp Verified Architecture Program	5
3	Solution Overview	5
3.1	Target Audience.....	5
3.2	Solution Technology	6
4	Technology Requirements	7
4.1	Hardware Requirements	7
4.2	Software Requirements	7
5	Design Choices	8
5.1	NetApp AFF A220 Series with ONTAP 9.4	8
5.2	Cisco Nexus 3000 Series.....	9
5.3	Cisco UCS C-Series	10
5.4	VMware vSphere 6.7	11
5.5	Boot Architecture	12
6	Solution Verification	12
7	Conclusion	12
	Where to Find Additional Information	12

LIST OF TABLES

Table 1)	Hardware requirements	7
Table 2)	Software requirements for the base FlexPod Express implementation.	7
Table 3)	Software requirements for a VMware vSphere implementation.	7

LIST OF FIGURES

Figure 1)	FlexPod portfolio	4
Figure 2)	Hardware components of the FlexPod Express solution.....	5
Figure 3)	FlexPod Express 10GbE validated infrastructure and 40GbE supported f.....	6
Figure 4)	Compaction in ONTAP 9.4.....	8
Figure 5)	Root-data partitioning.....	9
Figure 6)	Cisco Nexus 3172P.....	9
Figure 7)	Cisco UCS C220 M5 Rack Server.....	10
Figure 8)	Cisco UCS VIC 1387 adapter.....	10

Figure 9) CVR-QSFP-SFP10G adapter.11

1 Executive Summary

Industry trends indicate a vast data center transformation toward shared infrastructure and cloud computing. In addition, organizations seek a simple and effective solution for remote and branch offices, leveraging the technology that they are familiar with in their data center.

FlexPod Express is a predesigned, best practice data center architecture that is built on the Cisco Unified Computing System (Cisco UCS), the Cisco Nexus family of switches, and NetApp AFF. The components in FlexPod Express are like their FlexPod Datacenter counterparts, enabling management synergies across the complete IT infrastructure environment on a smaller scale. FlexPod Datacenter and FlexPod Express are optimal platforms for virtualization and for bare-metal operating systems and enterprise workloads.

2 Program Summary

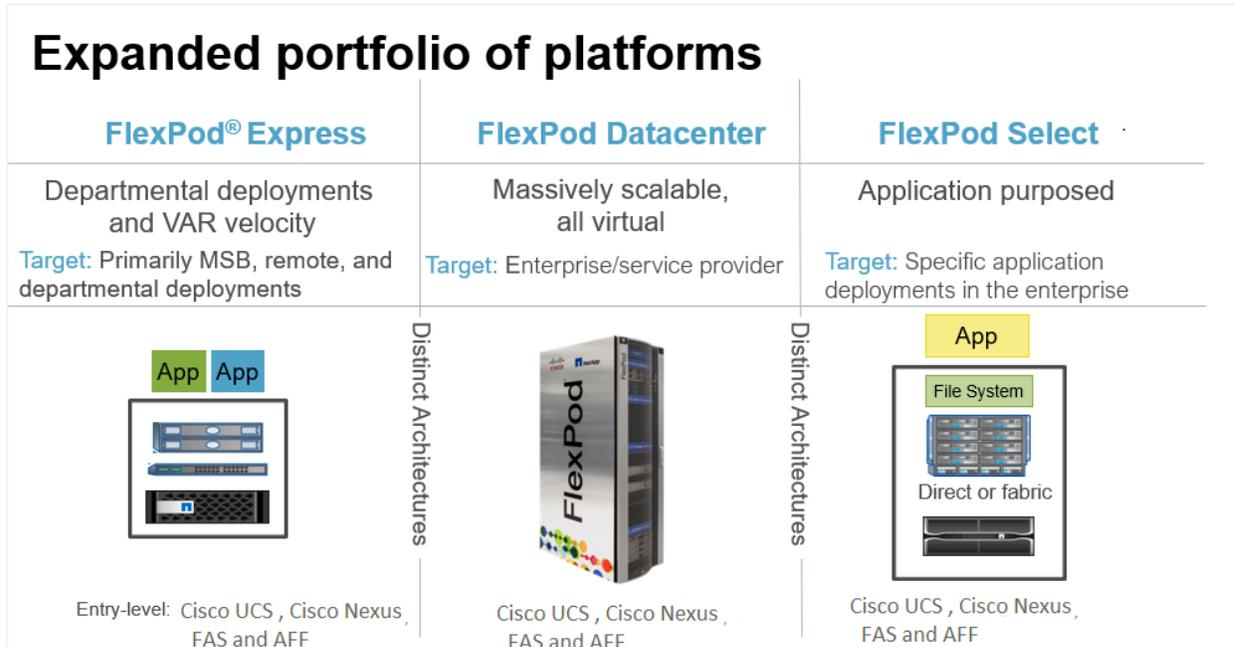
2.1 FlexPod Converged Infrastructure Portfolio

FlexPod reference architectures are delivered as Cisco Validated Designs (CVDs) or as NetApp Verified Architectures (NVAs). Deviations that are based on customer requirements from a given CVD or NVA are permitted, if variations do not result in the deployment of unsupported configurations.

As depicted in Figure 1, the FlexPod portfolio includes three solutions: FlexPod Express, FlexPod Datacenter, and FlexPod Select:

- **FlexPod Express** offers an entry-level solution that consists of technologies from Cisco and NetApp.
- **FlexPod Datacenter** delivers an optimal multipurpose foundation for various workloads and applications.
- **FlexPod Select** incorporates the best aspects of FlexPod Datacenter and tailors the infrastructure to a given application.

Figure 1) FlexPod portfolio.



2.2 NetApp Verified Architecture Program

The NetApp Verified Architecture (NVA) program offers customers a verified architecture for NetApp solutions. An NVA means that the NetApp solution has the following qualities:

- Is thoroughly tested
- Is prescriptive in nature
- Minimizes deployment risks
- Accelerates time to market

This guide details the design of FlexPod Express with VMware vSphere. In addition, this design leverages the all-new AFF A220 system, which runs NetApp ONTAP 9.4 software; Cisco Nexus 3172P switches; and Cisco UCS C220 M5 servers as hypervisor nodes.

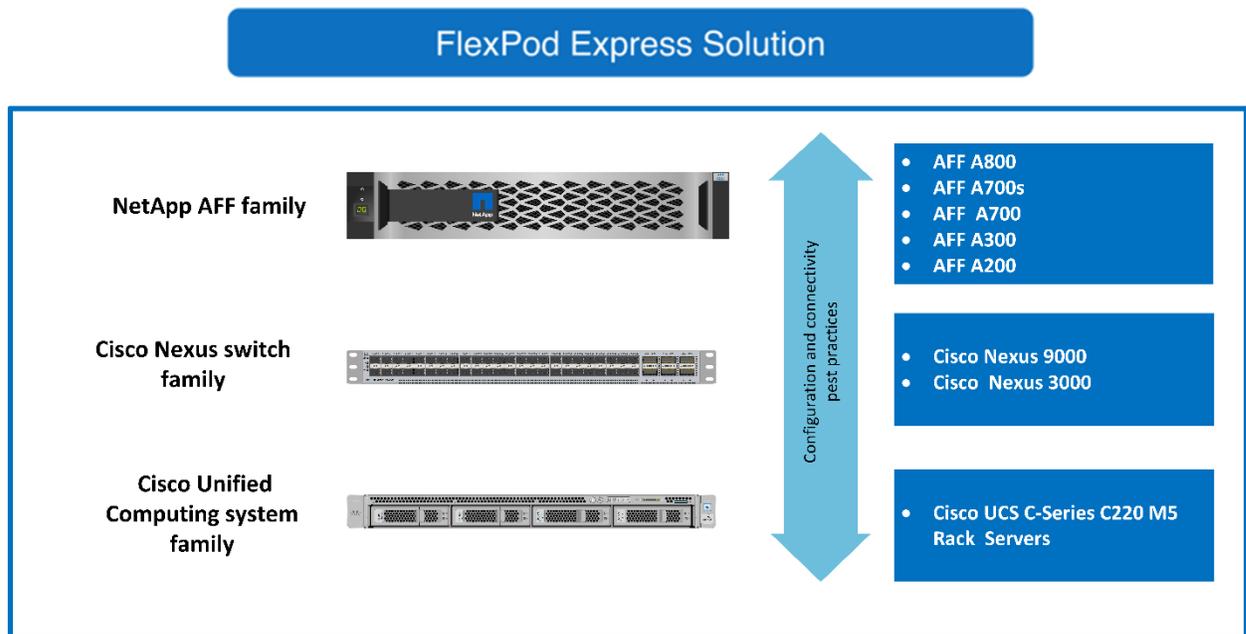
Although this document is validated for AFF A220, this solution also supports FAS2700.

3 Solution Overview

FlexPod Express is designed to run mixed virtualization workloads. It is targeted for remote and branch offices and for small to midsize businesses. It is also optimal for larger businesses that want to implement a dedicated solution for a purpose. This new solution for FlexPod Express adds new technologies such as NetApp ONTAP 9.4, NetApp AFF A220, and VMware vSphere 6.7.

Figure 2 shows the hardware components that are included in the FlexPod Express solution.

Figure 2) Hardware components of the FlexPod Express solution.



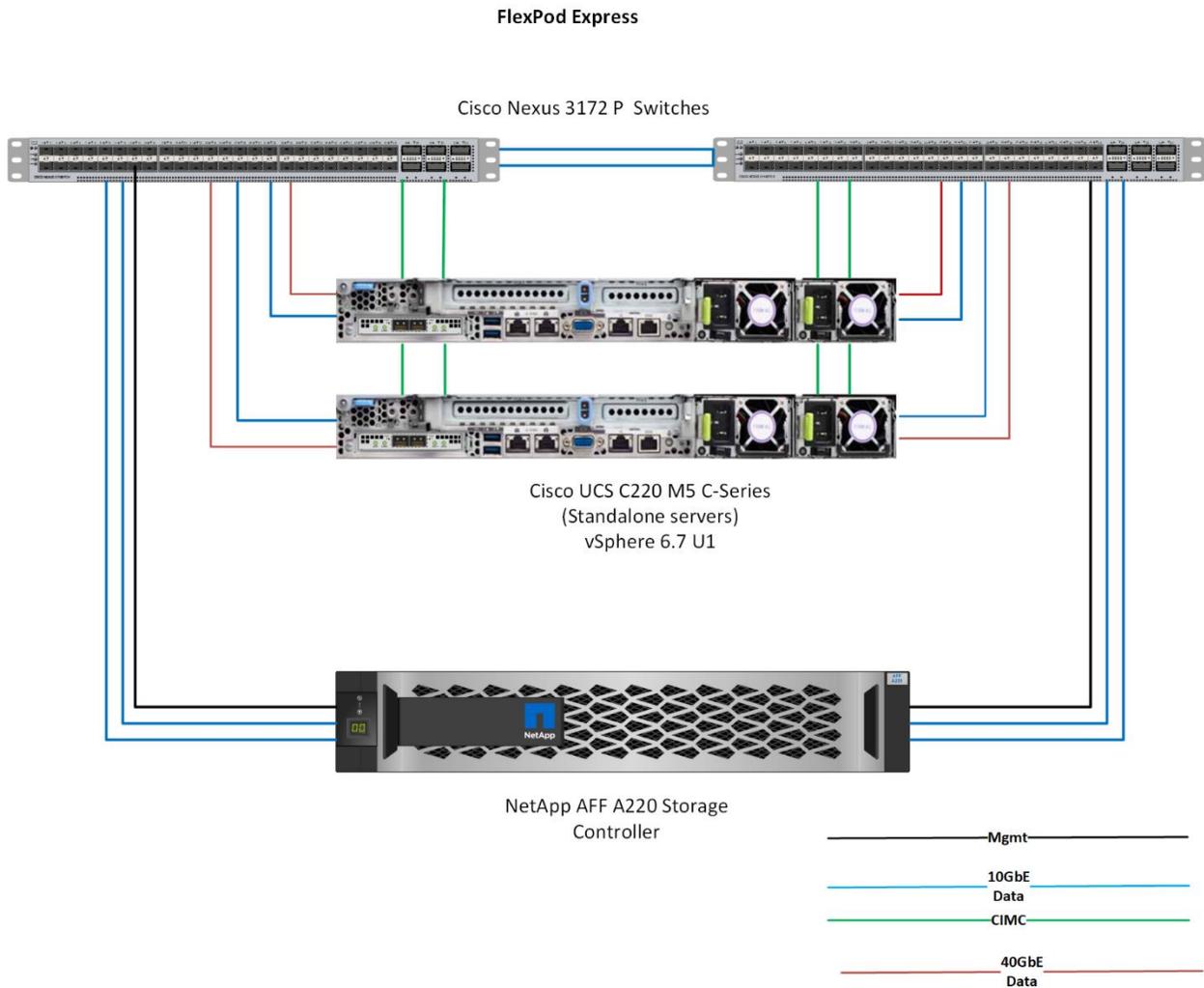
3.1 Target Audience

This document is intended for people who want to take advantage of an infrastructure that is built to deliver IT efficiency and to enable IT innovation. The audience for this document includes, but is not limited to, sales engineers, field consultants, professional services personnel, IT managers, partner engineers, and customers.

3.2 Solution Technology

This solution leverages the latest technologies from NetApp, Cisco, and VMware. This solution features the new NetApp AFF A220 system, which runs ONTAP 9.4 software; dual Cisco Nexus 3172P switches; and Cisco UCS C220 M5 Rack Servers that run VMware vSphere 6.7. This validated solution uses 10-Gigabit Ethernet (10GbE) technology. Figure 3 presents an overview. Guidance is also provided on how to scale by adding two hypervisor nodes at a time so that the FlexPod Express architecture can adapt to an organization's evolving business needs.

Figure 3) FlexPod Express 10GbE validated infrastructure and 40GbE supported.



Note: 40GbE is not validated, but it is supported infrastructure.

4 Technology Requirements

FlexPod Express requires a combination of hardware and software components that depends on the selected hypervisor and network speed. In addition, FlexPod Express lays out the hardware components that are required to add hypervisor nodes to the system in units of two.

4.1 Hardware Requirements

Regardless of the hypervisor chosen, all FlexPod Express configurations use the same hardware. Therefore, even if business requirements change, either hypervisor can run on the same FlexPod Express hardware.

Table 1 lists the hardware components that are required for all FlexPod Express configurations and to implement the solution. The hardware components that are used in any particular implementation of the solution might vary based on customer requirements.

Table 1) Hardware requirements.

Hardware	Quantity
AFF A220 two-node cluster	1
Cisco UCS C220 M5 server	2
Cisco Nexus 3172P switch	2
Cisco UCS Virtual Interface Card (VIC) 1387 for Cisco UCS C220 M5 Rack Server	2
Cisco CVR-QSFP-SFP10G adapter	4

4.2 Software Requirements

Table 2 and Table 3 list the software components that are required to implement the architectures of the FlexPod Express solution.

Table 2) Software requirements for the base FlexPod Express implementation.

Software	Version	Details
Cisco Integrated Management Controller (CIMC)	3.1.3	For C220 M5 Rack Servers
Cisco NX-OS	nxos.7.0.3.17.5.bin	For Cisco Nexus 3172P switches
NetApp ONTAP	9.4	For AFF A220 controllers

Table 3 lists the software that is required for all VMware vSphere implementations on FlexPod Express.

Table 3) Software requirements for a VMware vSphere implementation.

Software	Version
VMware vCenter Server Appliance	6.7
VMware vSphere ESXi	6.7
NetApp VAAI Plug-In for ESXi	1.1.2

5 Design Choices

The following technologies were chosen during the process of architecting this design. Each technology serves a specific purpose in the FlexPod Express infrastructure solution.

5.1 NetApp AFF A220 Series with ONTAP 9.4

This solution leverages two of the newest NetApp products: NetApp AFF A220 and ONTAP 9.4 software.

AFF A220 System

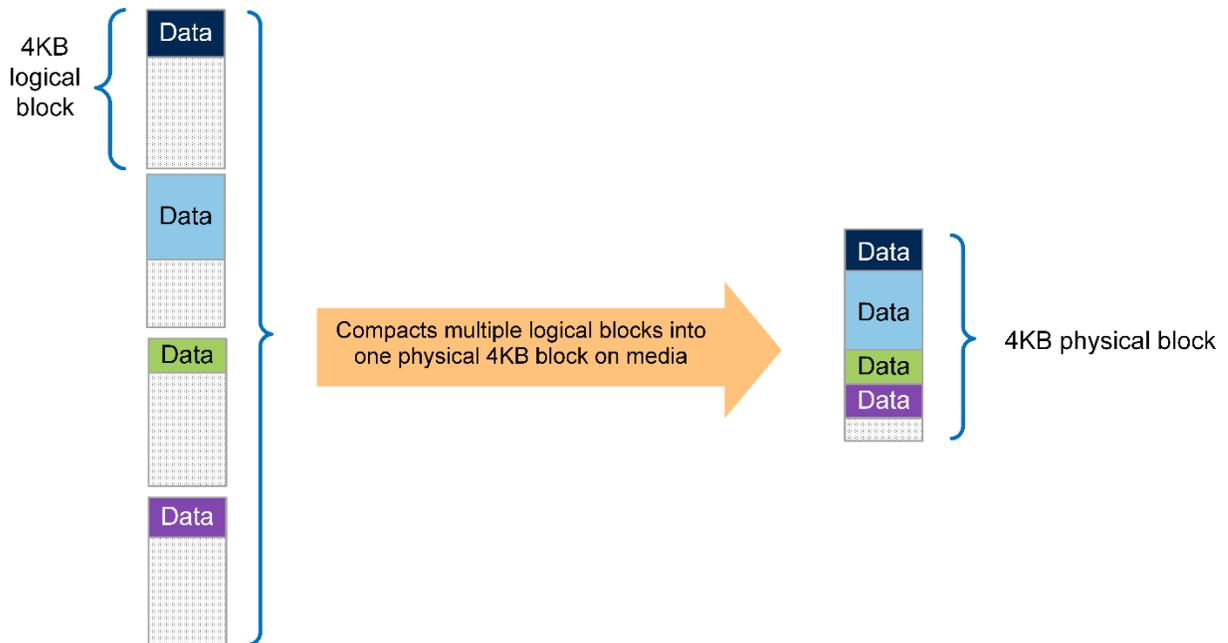
For more information about the AFF A220 hardware system, see <https://www.netapp.com/us/products/storage-systems/all-flash-array/aff-a-series.aspx>.

ONTAP 9.4 Software

NetApp AFF A220 systems use the new ONTAP 9.4 software. ONTAP 9.4 is the industry's leading enterprise data management software. It combines new levels of simplicity and flexibility with powerful data management capabilities, storage efficiencies, and leading cloud integration.

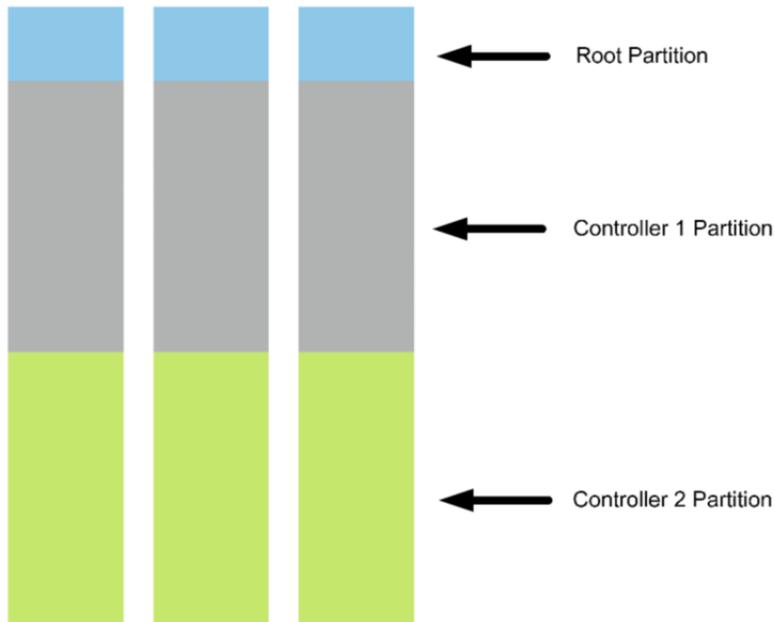
ONTAP 9.4 has several features that are well suited for the FlexPod Express solution. Foremost is NetApp's commitment to storage efficiencies, which can be one of the most important features for small deployments. The hallmark NetApp storage efficiency features such as deduplication, compression, and thin provisioning are available in ONTAP 9.4 with a new addition, compaction. Because the NetApp WAFL® system always writes 4KB blocks, compaction combines multiple blocks into a 4KB block when the blocks are not using their allocated space of 4KB. Figure 4 illustrates this process.

Figure 4) Compaction in ONTAP 9.4.



Also, root-data partitioning can be leveraged on the AFF A220 system. This partitioning allows the root aggregate and two data aggregates to be striped across the disks in the system. Therefore, both controllers in a two-node AFF A220 cluster can leverage the performance of all the disks in the aggregate. See Figure 5.

Figure 5) Root-data partitioning.



These are just a few key features that complement the FlexPod Express solution. For details about the additional features and functionality of ONTAP 9.4, see the [ONTAP 9 Data Management Software datasheet](#). Also, see the NetApp [ONTAP 9 Documentation Center](#), which has been updated to include ONTAP 9.4.

5.2 Cisco Nexus 3000 Series

The Cisco Nexus 3172P is a robust, cost-effective switch that offers 1/10/40/100Gbps switching. The Cisco Nexus 3172PQ switch, part of the Unified Fabric family, is a compact, 1-rack-unit (1RU) switch for top-of-rack data center deployments. See Figure 6. It offers up to seventy-two 1/10GbE ports in 1RU or forty-eight 1/10GbE plus six 40GbE ports in 1RU. And for maximum physical layer flexibility, it also supports 1/10/40Gbps.

Because all the various Cisco Nexus series models run the same underlying operating system, NX-OS, multiple Cisco Nexus models are supported in the FlexPod Express and FlexPod Datacenter solutions.

Performance specifications include:

- Line-rate traffic throughput (both layers 2 and 3) on all ports
- Configurable maximum transmission units (MTUs) of up to 9216 bytes (jumbo frames)

Figure 6) Cisco Nexus 3172P.



For more information about Cisco Nexus 3172 switches, see https://www.cisco.com/c/en/us/products/collateral/switches/nexus-3000-series-switches/data_sheet_c78-729483.html.

5.3 Cisco UCS C-Series

The Cisco UCS C-Series Rack Server was chosen for FlexPod Express because its many configuration options allow it to be tailored for specific requirements in a FlexPod Express deployment.

Cisco UCS C-Series Rack Servers deliver unified computing in an industry-standard form factor to reduce TCO and to increase agility.

Cisco UCS C-Series Rack Servers provide the following benefits:

- A form-factor-agnostic entry point into Cisco UCS
- Simplified and fast deployment of applications
- Extension of unified computing innovations and benefits to rack servers
- Increased customer choice with unique benefits in a familiar rack package

Figure 7) Cisco UCS C220 M5 Rack Server.



The Cisco UCS C220 M5 Rack Server (Figure 7) is among the most versatile general-purpose enterprise infrastructure and application servers in the industry. It is a high-density two-socket rack server that delivers industry-leading performance and efficiency for a wide range of workloads, including virtualization, collaboration, and bare-metal applications. Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of Cisco UCS to take advantage of Cisco's standards-based unified computing innovations that help reduce customers' TCO and increase their business agility.

For more information about C220 M5 servers, see

<https://www.cisco.com/c/en/us/products/collateral/servers-unified-computing/ucs-c-series-rack-servers/datasheet-c78-739281.html>.

Connectivity Options for C220 M5 Rack Servers

The connectivity options for the C220 M5 Rack Servers are as follows:

- **Cisco UCS VIC 1387**

The Cisco UCS VIC 1387 (Figure 8) offers dual-port enhanced QSFP+ 40GbE and FC over Ethernet (FCoE) in a modular-LAN-on-motherboard (mLOM) form factor. The mLOM slot can be used to install a Cisco VIC without consuming a Peripheral Component Interconnect Express (PCIe) slot, providing greater I/O expandability.

Figure 8) Cisco UCS VIC 1387 adapter.



For more information about the Cisco UCS VIC 1387 adapter, see <https://www.cisco.com/c/en/us/products/interfaces-modules/ucs-virtual-interface-card-1387/index.html>.

- **CVR-QSFP-SFP10G adapter**

The Cisco QSA Module converts a QSFP port into an SFP or SFP+ port. With this adapter, customers have the flexibility to use any SFP+ or SFP module or cable to connect to a lower-speed port on the other end of the network. This flexibility enables a cost-effective transition to 40GbE by maximizing the use of high-density 40GbE QSFP platforms. This adapter supports all SFP+ optics and cable reaches, and it supports several 1GbE SFP modules. Because this project has been validated by using 10GbE connectivity and because the VIC 1387 used is 40GbE, the CVR-QSFP-SFP10G adapter (Figure 9) is used for conversion.

Figure 9) CVR-QSFP-SFP10G adapter.



5.4 VMware vSphere 6.7

VMware vSphere 6.7 is one hypervisor option for use with FlexPod Express. VMware vSphere allows organizations to reduce their power and cooling footprint while confirming that the purchased compute capacity is used to its fullest. In addition, VMware vSphere allows hardware failure protection (VMware High Availability, or VMware HA) and compute resource load balancing across a cluster of vSphere hosts (VMware Distributed Resource Scheduler, or VMware DRS).

Because it restarts only the kernel, VMware vSphere 6.7 allows customers to “quick boot” where it loads vSphere ESXi without restarting the hardware. This feature is available only with platforms and drivers that are on the Quick Boot Whitelist. vSphere 6.7 extends the capabilities of the vSphere Client, which can do about 90% of what the vSphere Web Client can do.

In vSphere 6.7, VMware has extended this capability to enable customers to set Enhanced vMotion Compatibility (EVC) per virtual machine (VM) rather than per host basis. In vSphere 6.7, VMware has also exposed the APIs that can be used to create instant clones.

The following are some of the features of vSphere 6.7 U1:

- Fully featured HTML5 web-based vSphere Client
- vMotion for NVIDIA GRID vGPU VMs. Support for Intel FPGA.
- vCenter Server Converge Tool to move from external PSC to internal PCS.
- Enhancements for vSAN (HCI updates).
- Enhanced content library.

For details about vSphere 6.7 U1, see <https://blogs.vmware.com/vsphere/2018/10/whats-new-in-vcenter-server-6-7-update-1.html>.

Note: Although this solution was validated with vSphere 6.7, it supports any vSphere version qualified with the other components by the NetApp Interoperability Matrix Tool. NetApp recommends deploying vSphere 6.7U1 for its fixes and enhanced features.

5.5 Boot Architecture

Following are the supported options for the FlexPod Express boot architecture:

- iSCSI SAN LUN
- Cisco FlexFlash SD Card
- Local disk

Because FlexPod Datacenter is booted from iSCSI LUNs, solution manageability is enhanced by also using iSCSI boot for FlexPod Express.

6 Solution Verification

Cisco and NetApp designed and built FlexPod Express to serve as a premier infrastructure platform for their customers. Because it was designed by using industry-leading components, customers can trust FlexPod Express as their infrastructure foundation. In keeping with the fundamental principles of the FlexPod portfolio, the FlexPod Express architecture was thoroughly tested by Cisco and NetApp data center architects and engineers. From redundancy and availability to each individual feature, the entire FlexPod Express architecture is validated to instill confidence in our customers and to build trust in the design process.

VMware vSphere 6.7 was verified on the FlexPod Express infrastructure components. This validation included 10GbE uplink connectivity options for the hypervisor.

7 Conclusion

FlexPod Express offers a simple and effective solution by providing a validated design that uses industry-leading components. By scaling and by providing options for the hypervisor platform, FlexPod Express can be tailored for specific business needs. FlexPod Express was designed keeping in mind small to midsize businesses, remote and branch offices, and other businesses that require dedicated solutions.

Where to Find Additional Information

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

- NetApp documentation
<https://docs.netapp.com>
- FlexPod Express with VMware vSphere 6.7 and NetApp AFF A220 Deployment Guide
<https://www.netapp.com/us/media/nva-1123-deploy.pdf>

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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