



NetApp Verified Architecture

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

NVA Design

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Abstract

The FlexPod® Express architecture leverages the NetApp® AFF C190 Series, which runs NetApp ONTAP® 9.6 data management software, Cisco UCS C-Series Rack-Mount Servers, and Cisco Nexus 31108 switches. The solution architecture also includes VMware vSphere 6.7U2.

In partnership with



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
2.3	Solution Overview	5
2.4	Target Audience	5
2.5	Solution Technology	6
3	Technology Requirements	6
3.1	Hardware Requirements	6
3.2	Software Requirements	7
4	Design Choices	7
4.1	NetApp AFF C190 Series with ONTAP 9.6	7
4.2	Cisco Nexus 3000 Series	9
4.3	Cisco UCS C-Series	10
4.4	VMware vSphere 6.7U2	11
4.5	Boot Architecture	12
5	Conclusion	12
	Where to Find Additional Information	13
	Version History	13

LIST OF TABLES

Table 1)	Hardware requirements.	6
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.	6
Figure 4)	UTA 2 ports where SFP+ module can be inserted.	8
Figure 5)	10GBASE-T ports for connection through conventional RJ-45 Ethernet cables.	8
Figure 6)	Compaction in ONTAP 9.6.	9
Figure 7)	Cisco Nexus 31108PC-V switch.	10
Figure 8)	Cisco UCS C220 M5 Rack Server.	10

Figure 9) Cisco UCS VIC 1457 adapter.....11
Figure 10) ESXI host vNIC layout.....12

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 systems. The components of 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

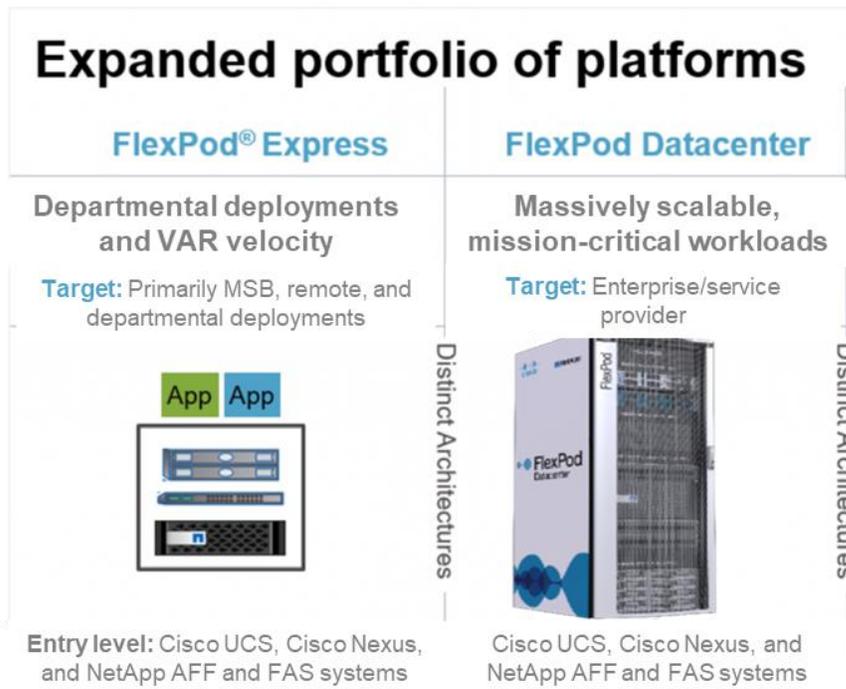
2.1 FlexPod Converged Infrastructure Portfolio

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 those variations do not result in the deployment of unsupported configurations.

As illustrated in Figure 1, the FlexPod portfolio includes the following solutions: FlexPod Express and FlexPod Datacenter.

- **FlexPod Express** is an entry-level solution that consists of technologies from Cisco and NetApp.
- **FlexPod Datacenter** delivers an optimal multipurpose foundation for various workloads and applications.

Figure 1) FlexPod portfolio.



2.2 NetApp Verified Architecture Program

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

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

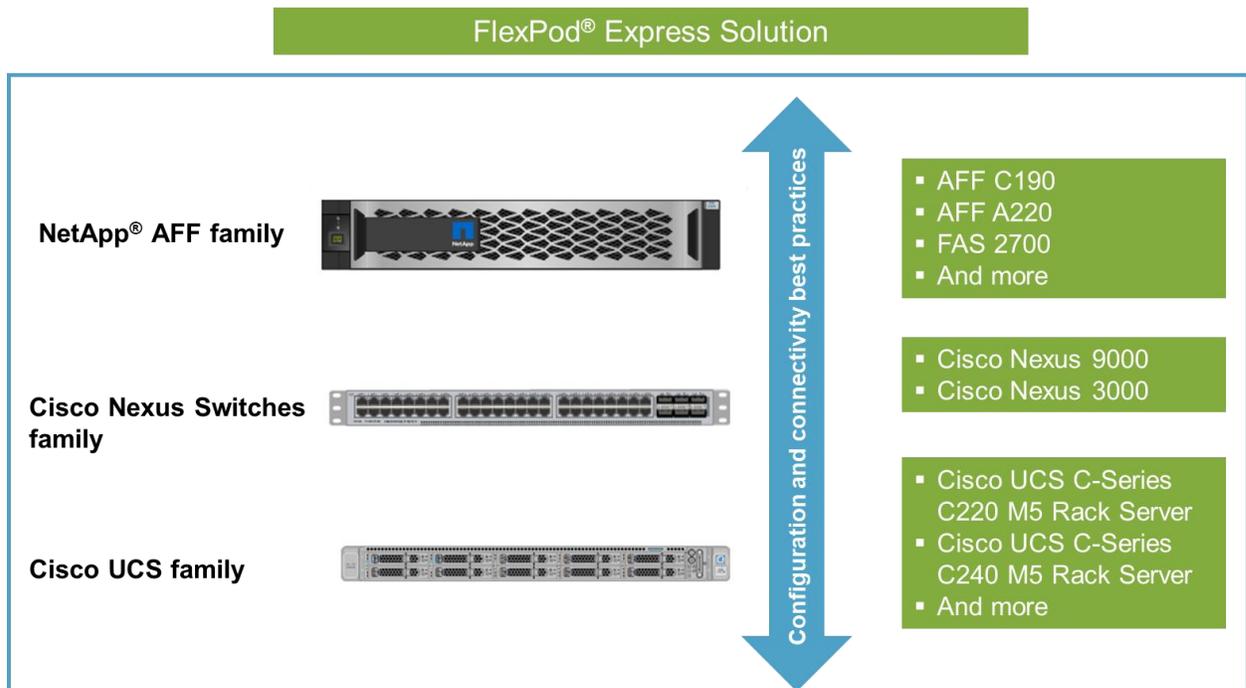
This guide details the design of FlexPod Express with VMware vSphere. In addition, this design leverages the all-new AFF C190 system, which runs NetApp ONTAP® 9.6 software, Cisco Nexus 31108 switches, and Cisco UCS C220 M5 servers as hypervisor nodes.

2.3 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 specific purpose. This new solution for FlexPod Express adds new technologies such as NetApp ONTAP 9.6, NetApp AFF C190 system, and VMware vSphere 6.7U2.

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

Figure 2) Hardware components of the FlexPod Express solution.



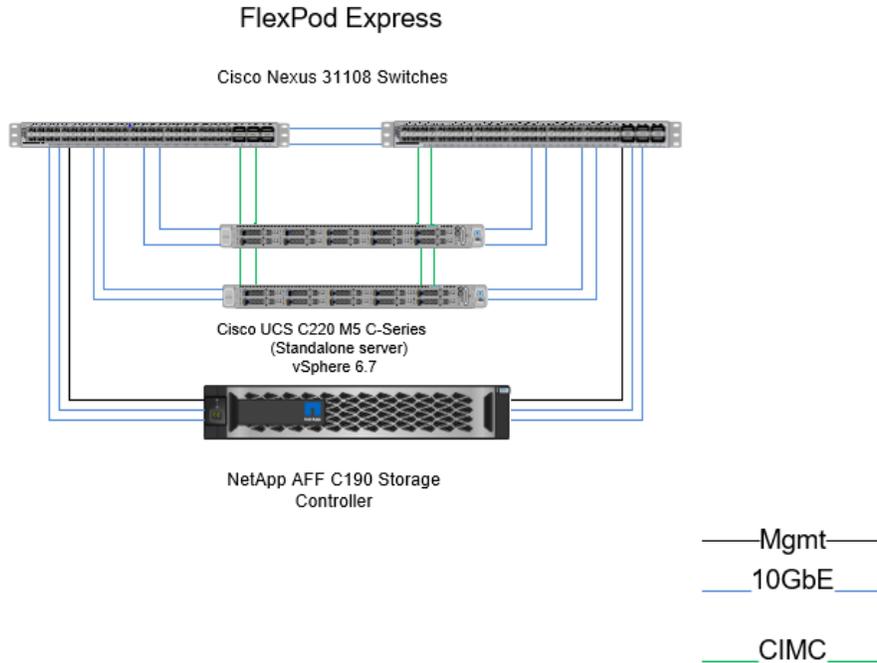
2.4 Target Audience

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.

2.5 Solution Technology

This solution leverages the latest technologies from NetApp, Cisco, and VMware. It features the new NetApp AFF C190 system, which runs ONTAP 9.6 software, dual Cisco Nexus 31108 switches, and Cisco UCS C220 M5 Rack Servers that run VMware vSphere 6.7U2. This validated solution, illustrated in Figure 3, uses 10 Gigabit Ethernet (10GbE) technology. 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.



3 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.

3.1 Hardware Requirements

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

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

Table 1) Hardware requirements.

Hardware	Quantity
AFF C190 2-node cluster	1

Hardware	Quantity
Cisco UCS C220 M5 Server	2
Cisco Nexus 31108 Switch	2
Cisco UCS Virtual Interface Card (VIC) 1457 for Cisco UCS C220 M5 Rack Server	2

3.2 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)	4.0.4	For C220 M5 Rack Servers
Cisco NX-OS	7.0(3)I7(6)	For Cisco Nexus 31108 switches
NetApp ONTAP	9.6	For NetApp AFF C190 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	6.7U2
VMware vSphere ESXi	6.7U2
NetApp VAAI Plug-In for ESXi	1.1.2
NetApp Virtual Storage Console	9.6

4 Design Choices

The technologies listed in this section were chosen during the architectural design phase. Each technology serves a specific purpose in the FlexPod Express infrastructure solution.

4.1 NetApp AFF C190 Series with ONTAP 9.6

This solution leverages two of the newest NetApp products: NetApp AFF C190 system and ONTAP 9.6 software.

AFF C190 System

The target group is customers who want to modernize their IT infrastructure with all-flash technology at an affordable price. The AFF C190 system comes with the new ONTAP 9.6 and flash bundle licensing, which means that the following functions are on board:

- CIFS, NFS, iSCSI, and FCP
- NetApp SnapMirror® data replication software, NetApp SnapVault® backup software, NetApp SnapRestore® data recovery software, NetApp SnapManager® storage management software product suite, and NetApp SnapCenter® software
- FlexVol® technology

- Deduplication, compression, and compaction
- Thin provisioning
- Storage QoS
- NetApp RAID DP® technology
- NetApp Snapshot™ technology
- FabricPool

Figure 4 and Figure 5 show the two options for host connectivity.

Figure 4) UTA 2 ports where SFP+ module can be inserted.



Figure 5) 10GBASE-T ports for connection through conventional RJ-45 Ethernet cables.



Note: For the 10GBASE-T port option, you must have a 10GBASE-T based uplink switch.

The AFF C190 system is offered exclusively with 960GB SSDs. There are four stages of expansions from which you can choose:

- 8x 960GB
- 12x 960GB
- 18x 960GB
- 24x 960GB

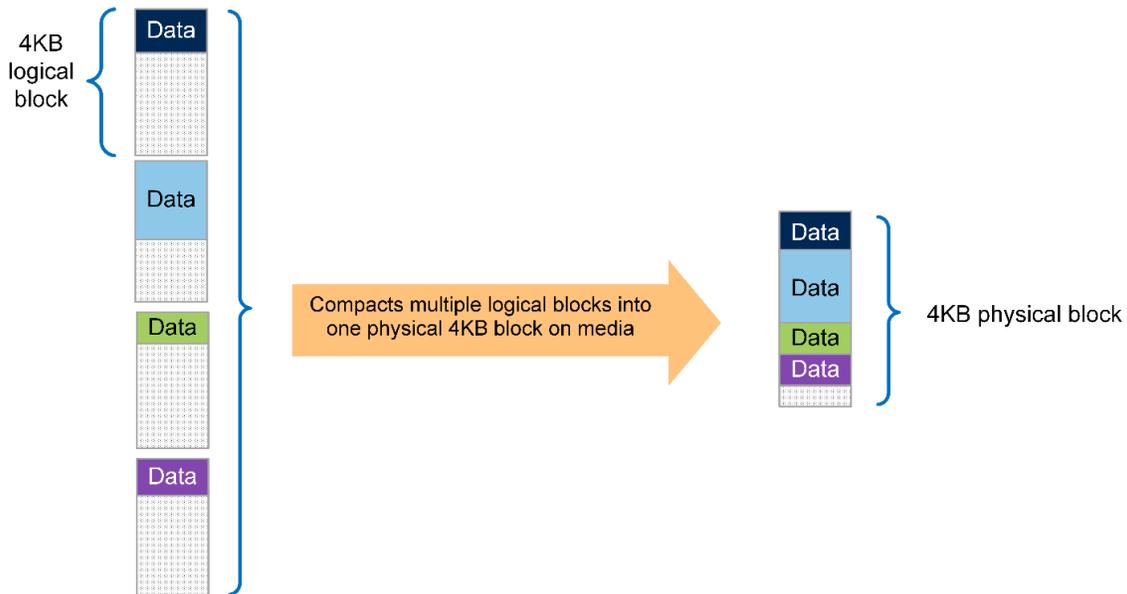
For full information about the AFF C190 hardware system, see the [NetApp AFF C190 All-Flash Array page](#).

ONTAP 9.6 Software

NetApp AFF C190 systems use the new ONTAP 9.6 data management software. ONTAP 9.6 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 9.6 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, compaction, and thin provisioning are available in ONTAP 9.6. The NetApp WAFL® system always writes 4KB blocks; therefore, compaction combines multiple blocks into a 4KB block when the blocks are not using their allocated space of 4KB. Figure 6 illustrates this process.

Figure 6) Compaction in ONTAP 9.6.



ONTAP 9.6 now supports an optional 512-byte block size for NVMe volumes. This capability works well with the VMware Virtual Machine File System (VMFS), which natively uses a 512-byte block. You can stay with the default 4K size or optionally set the 512-byte block size.

Other feature enhancements in ONTAP 9.6 include:

- **NetApp Aggregate Encryption (NAE).** NAE assigns keys at the aggregate level, thereby encrypting all volumes in the aggregate. This feature allows volumes to be encrypted and deduplicated at the aggregate level.
- **NetApp ONTAP FlexGroup volume enhancement.** In ONTAP 9.6, you can easily rename a FlexGroup volume. There's no need to create a new volume to migrate the data to. The volume size can also be reduced by using ONTAP System Manager or CLI.
- **FabricPool enhancement.** ONTAP 9.6 added additional support for object stores as cloud tiers. Support for Google Cloud and Alibaba Cloud Object Storage Service (OSS) was also added to the list. FabricPool supports multiple object stores, including AWS S3, Azure Blob, IBM Cloud object storage, and NetApp StorageGRID® object-based storage software.
- **SnapMirror enhancement.** In ONTAP 9.6, a new volume replication relationship is encrypted by default before leaving the source array and is decrypted at the SnapMirror destination.

4.2 Cisco Nexus 3000 Series

The Cisco Nexus 31108PC-V is a 10Gbps SFP+ based top-of-rack (ToR) switch with 48 SFP+ ports and 6 QSFP28 ports. Each SFP+ port can operate in 100Mbps, 10Gbps, and each QSFP28 port can operate in native 100Gbps or 40Gbps mode or 4x 10Gbps mode, offering flexible migration options. This switch is a true PHY-less switch that is optimized for low latency and low power consumption.

The Cisco Nexus 31108PC-V specification includes the following components:

- 2.16Tbps switching capacity and forwarding rate of up to 1.2Tbps for 31108PC-V
- 48 SFP ports support 1 and 10 Gigabit Ethernet (10GbE); 6x QSFP28 ports support 4x 10GbE or 40GbE each or 100GbE

Figure 7 illustrates the Cisco Nexus 31108PC-V switch.

Figure 7) Cisco Nexus 31108PC-V switch.



For more information about Cisco Nexus 31108PC-V switches, see [Cisco Nexus 3172PQ, 3172TQ, 3172TQ-32T, 3172PQ-XL, and 3172TQ-XL Switches Data Sheet](#).

4.3 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 offer 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 8) Cisco UCS C220 M5 Rack Server.



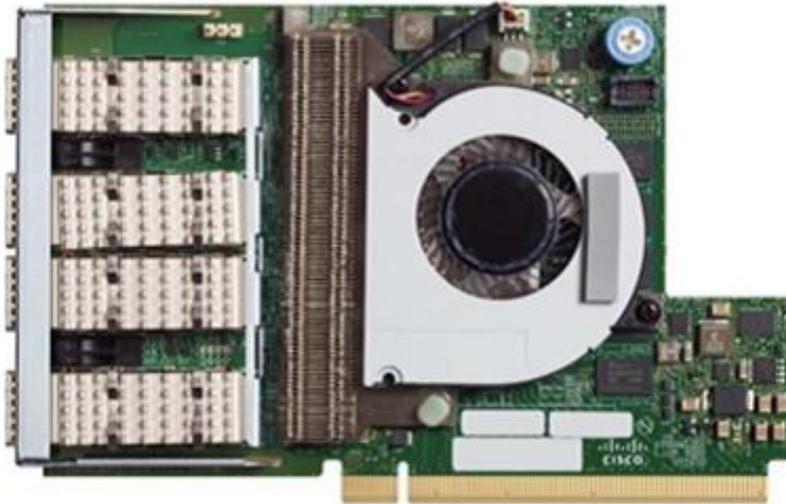
The Cisco UCS C220 M5 Rack Server, shown in Figure 8, is among the most versatile general-purpose enterprise infrastructure and application servers in the industry. It is a high-density two-socket rack server that delivers industry-leading performance and efficiency for a wide range of workloads, including 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 [Cisco UCS C220 M5 Rack Server Data Sheet](#).

Cisco UCS VIC 1457 Connectivity for C220 M5 Rack Servers

The Cisco UCS VIC 1457 adapter shown in Figure 9 is a quad-port small form-factor pluggable (SFP28) modular LAN on motherboard (mLOM) card designed for the M5 generation of Cisco UCS C-Series Servers. The card supports 10/25Gbps Ethernet or FCoE. The card can present PCIe standards-compliant interfaces to the host, and these can be dynamically configured as either NICs or HBAs.

Figure 9) Cisco UCS VIC 1457 adapter.



For full information about the Cisco UCS VIC 1457 adapter, see [Cisco UCS Virtual Interface Card 1400 Series Data Sheet](#).

4.4 VMware vSphere 6.7U2

VMware vSphere 6.7U2 is one of the hypervisor options 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 in maintenance mode, or VMware DRS-MM).

Because it restarts only the kernel, VMware vSphere 6.7U2 allows customers to “quick boot,” loading vSphere ESXi without restarting the hardware. The vSphere 6.7U2 vSphere client (HTML5-based client) has some new enhancements like Developer Center with Code Capture and API Explore. With Code Capture, you can record your actions in the vSphere client to deliver simple, usable code output. vSphere 6.7U2 also contains new features like DRS in maintenance mode (DRS-MM).

VMware vSphere 6.7U2 offers the following features:

- VMware is deprecating the external VMware Platform Services Controller (PSC) deployment model.
Note: Starting with the next major vSphere release, external PSC will not be an available option.
- New protocol support for backing up and restoring a vCenter server appliance. Introducing NFS and SMB as supported protocol choices, up to 7 total (HTTP, HTTPS, FTP, FTPS, SCP, NFS, and SMB) when configuring a vCenter Server for file-based backup or restore operations.
- New functionality when using the content library. Syncing a native VM template between content libraries is now available when the vCenter Server is configured for enhanced linked mode.
- Update to the [Client Plug-Ins page](#).
- VMware vSphere Update Manager also adds enhancements to the vSphere client. You can perform attach-check compliance and remediate actions all from one screen.

For more information about VMware vSphere 6.7 U2, see the [VMware vSphere Blog page](#).

For more information about the VMware vCenter Server 6.7 U2 updates, see the [Release Notes](#).

Note: Although this solution was validated with vSphere 6.7U2, it supports any vSphere version qualified with the other components by the [NetApp Interoperability Matrix Tool \(IMT\)](#). NetApp

recommends that you deploy the next released version of vSphere for its fixes and enhanced features.

4.5 Boot Architecture

The supported options for the FlexPod Express boot architecture include:

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

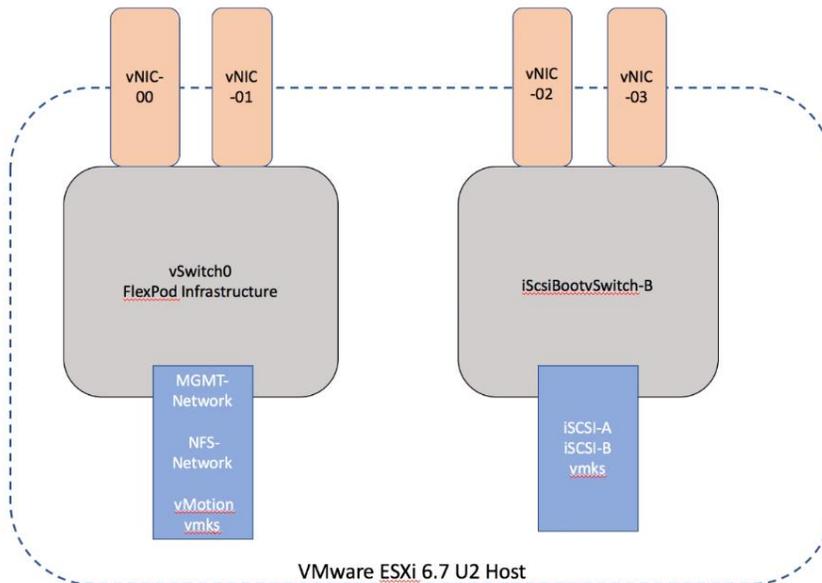
FlexPod Datacenter is booted from iSCSI LUNs; therefore, solution manageability is enhanced by using iSCSI boot for FlexPod Express as well.

ESXi Host Virtual Network Interface Card Layout

Cisco UCS VIC 1457 has four physical ports. This solution validation includes these four physical ports in using the ESXi host. If you have a smaller or larger number of NICs, you might have different VMNIC numbers.

In an iSCSI boot implementation, iSCSI boot requires separate virtual network interface cards (vNICs) for iSCSI boot. These vNICs use the appropriate fabric's iSCSI VLAN as the native VLAN and are attached to the iSCSI boot vSwitches, as shown in Figure 10.

Figure 10) ESXi host vNIC layout.



5 Conclusion

The FlexPod Express validated design is a simple and effective solution that uses industry-leading components. By scaling and providing options for the hypervisor platform, FlexPod Express can be tailored for specific business needs. FlexPod Express was designed for 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:

- 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>
- FlexPod Express with Cisco UCS C-Series and NetApp AFF C190 Series Deployment Guide
<https://www.netapp.com/us/media/nva-1142-deploy.pdf>
- NetApp documentation
<https://docs.netapp.com>

Version History

Version	Date	Document Version History
Version 1.0	October 2019	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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