NetApp Verified Architecture

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

NVA Design

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Abstract

The FlexPod® Express architecture leverages the all-new NetApp® FAS2600 series, which runs NetApp ONTAP® 9.1, Cisco UCS C-Series Rack-Mount Servers, and Cisco Nexus 31108 Switches. The architecture provides a choice of hypervisor VMware vSphere 6.5 or Microsoft Windows Server Hyper-V 2016.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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 (UCS), the Cisco Nexus family of switches, and NetApp FAS. 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.

FlexPod Datacenter and FlexPod Express deliver a baseline configuration and have the flexibility to be sized and optimized to accommodate many different use cases and requirements. Existing FlexPod Datacenter customers can manage their FlexPod Express by using the tools that they are accustomed to, and new FlexPod Express customers can easily adapt to managing a FlexPod Datacenter as their environment grows.

FlexPod Express is an optimal infrastructure foundation for remote and branch offices, and for small to midsize businesses. It is also an optimal solution for customers who want to provide infrastructure for a dedicated workload.

FlexPod Express provides an easy-to-manage infrastructure that is suitable for almost any workload.

2 Program Summary

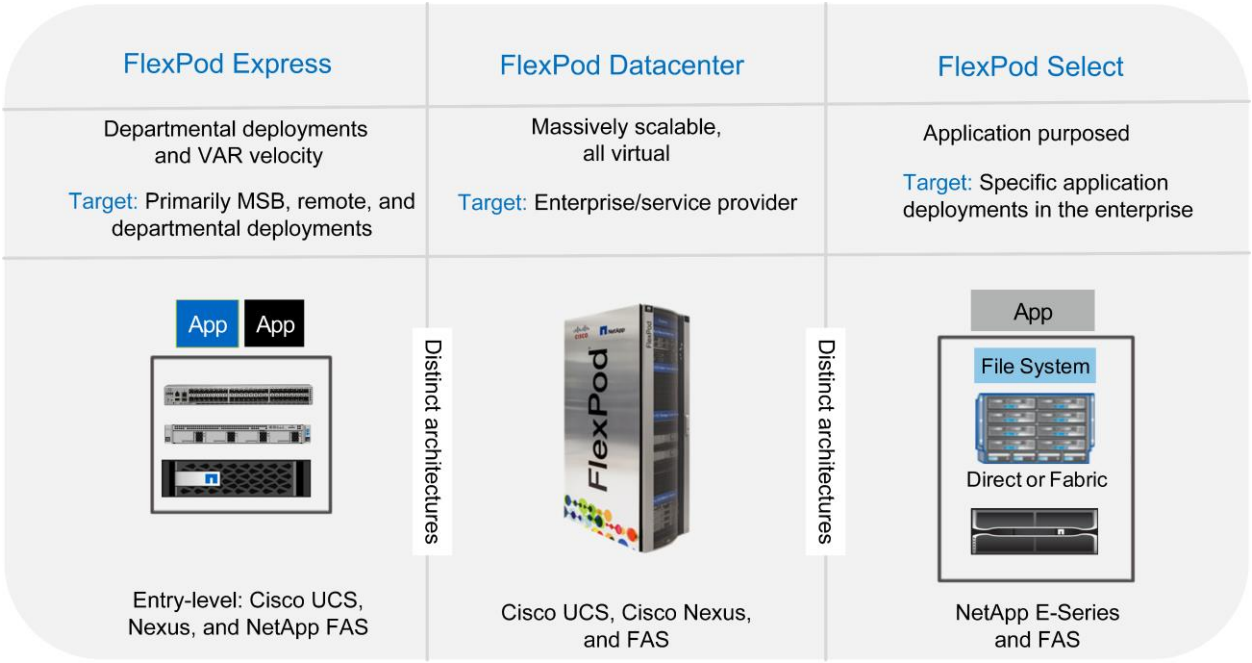
2.1 FlexPod Converged Infrastructure Program

FlexPod reference architectures are delivered as Cisco Validated Designs (CVDs) or 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 program includes three solutions: FlexPod Express, FlexPod Datacenter, and FlexPod Select:

- **FlexPod Express** offers customers 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.



The solution that we discuss in this design guide is part of the FlexPod Express family.

2.2 NetApp Verified Architecture Program

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

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

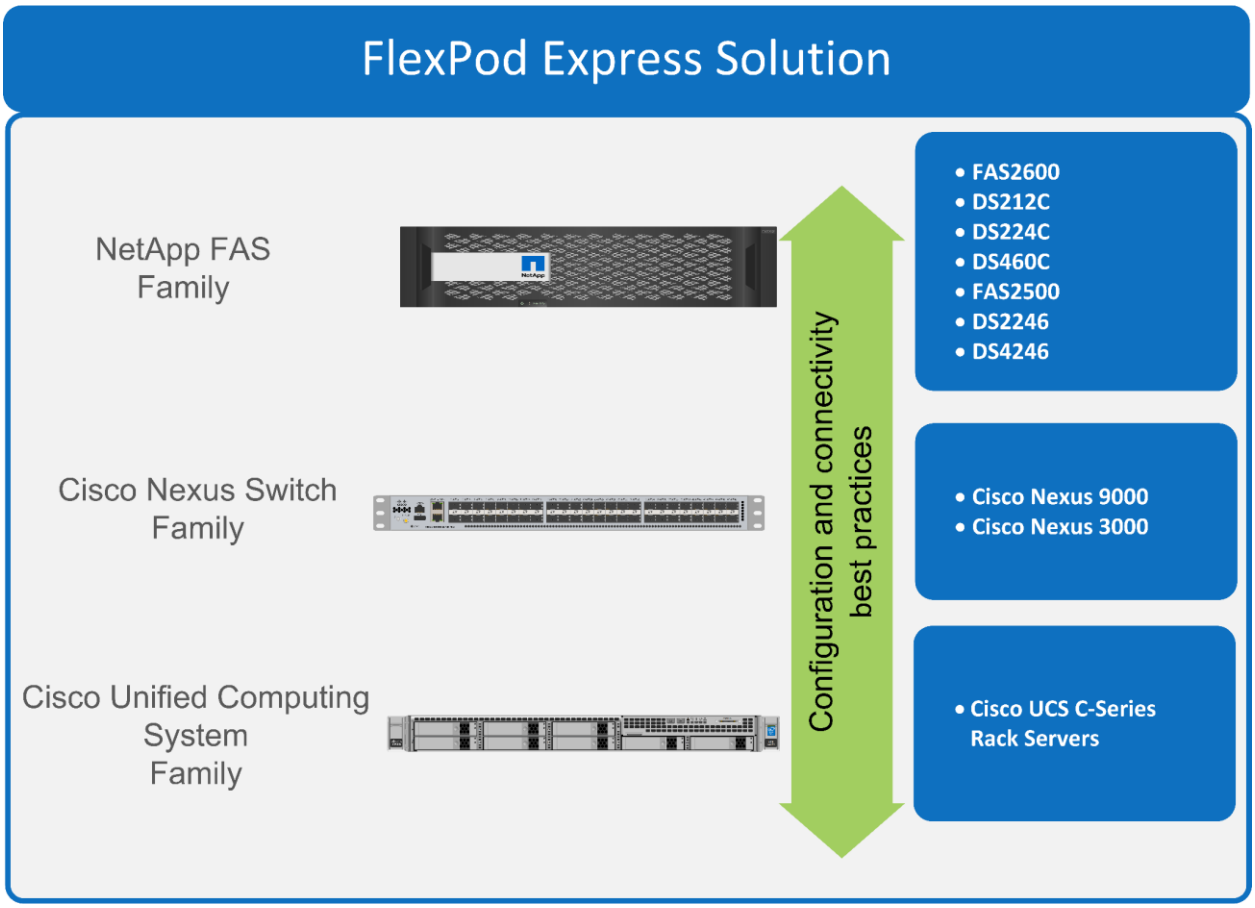
This guide details the design of FlexPod Express with VMware vSphere and FlexPod Express with Microsoft Windows Server Hyper-V 2016. In addition, this design leverages the all-new FAS2650 system, which runs NetApp ONTAP 9.1; Cisco Nexus 31108; and Cisco UCS C-Series C220 M4 servers as hypervisor nodes.

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. The primary driver of the new FlexPod Express solution is to add new technologies such as ONTAP 9, FAS2600, VMware vSphere 6.5, and Microsoft Windows Server 2016 Hyper-V to FlexPod Express.

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

Figure 2) FlexPod Express family.



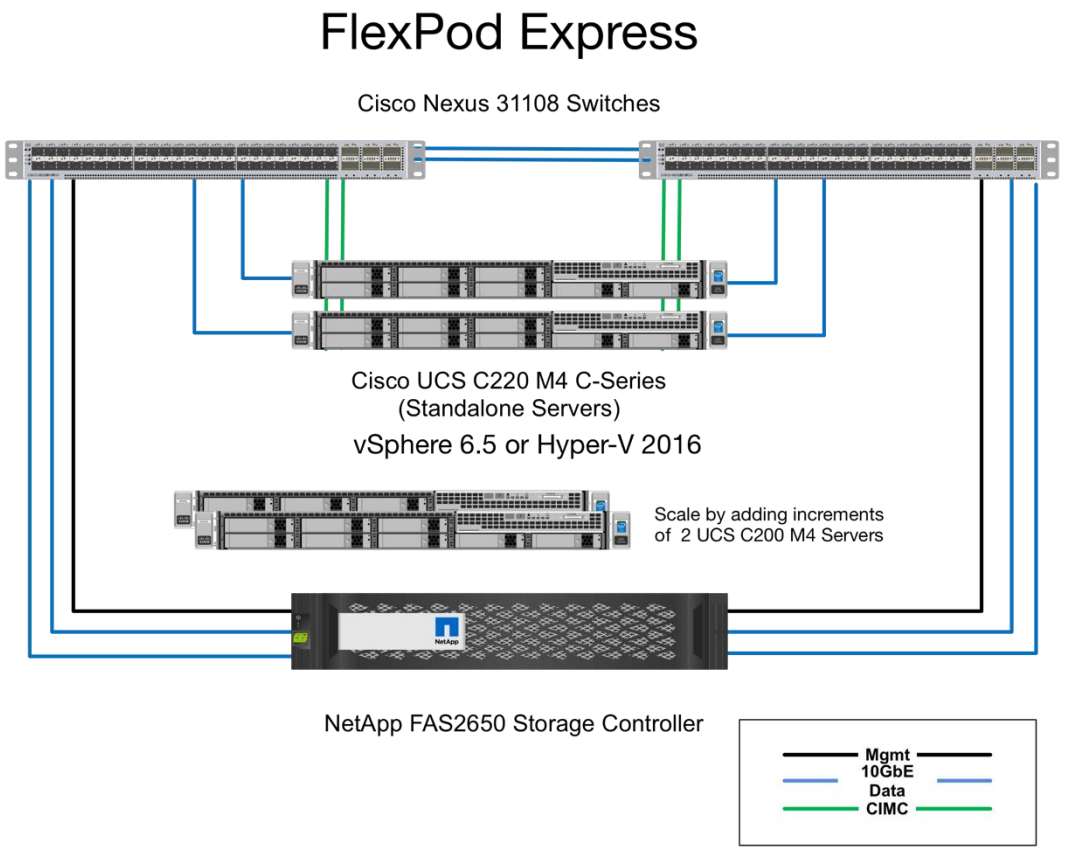
3.1 Target Audience

This document is intended for people who want to take advantage of an infrastructure that is built to deliver IT efficiency and 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, VMware, and Microsoft. This solution features the new NetApp FAS2650, which runs ONTAP 9.1; dual Cisco Nexus 31108 Switches; and Cisco UCS C220 M4 Rack Servers that run either VMware vSphere 6.5 or Microsoft Windows Hyper-V 2016. This validated solution 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.



Both 10GbE and 1GbE connectivity options are validated as part of the FlexPod Express solution. The deployment guide features an end-to-end 10GbE architecture configuration and includes guidance for the 1GbE uplinks to an existing network, enabling customers to find the FlexPod Express that fits their specific use case.

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.

Table 1) Hardware requirements for the base configuration.

Hardware	Quantity
FAS2650 two-node cluster	1

Hardware	Quantity
Cisco C220 M4 server	2
Cisco Nexus 31108 Switch	2
Cisco VIC 1227 for C220 M4 server	2

Table 2 lists the hardware required to scale the solution by adding two hypervisor nodes. The adapter card chosen for the Cisco UCS C220 Rack Server depends on the connectivity required.

Table 2) Hardware for scaling solution using two hypervisor nodes.

Hardware	Quantity
Cisco UCS C220 M4 server	2
Cisco VIC 1227	2

4.2 Software Requirements

Tables 5 and 6 list the software components that are required to implement the architectures of the FlexPod Express solutions.

Table 3) Software requirements for the base FlexPod Express implementation.

Software	Version	Details
Cisco Integrated Management Controller (CIMC)	2.0(13h)	For C220 M4 Rack Servers
Cisco NX-OS	7.0(3)I5(2)	For Cisco Nexus 31108 Switches
NetApp ONTAP	9.1	For FAS2650 controllers

Table 4 lists the software that is required for all VMware vSphere implementations on FlexPod Express.

Table 4) Software requirements for a VMware vSphere implementation.

Software	Version
VMware vCenter Server Appliance	6.5
VMware vSphere ESXi	6.5
NetApp VAAI Plug-in for ESXi	1.1.2
NetApp Virtual Storage Console	6.2.1P1

Table 5 lists the software required for all Microsoft Windows Server Hyper-V implementations on FlexPod Express.

Table 5) Software requirements for Microsoft Windows Server Hyper-V 2016 implementation.

Software	Version
Microsoft Windows Server Hyper-V	2016
Microsoft System Center Virtual Machine Manager	2016

Software	Version
Windows Unified Host Utilities	7.0
NetApp SMI-S Provider	5.2.4

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 FAS2600 Series with ONTAP 9.1

This solution leverages two of the newest NetApp products, the NetApp FAS2650 system and ONTAP 9.1 software.

FAS2650

The NetApp FAS2600 series combines value, performance, and scalability into a 2U form factor. The FAS2650 system that is used in this validation can contain up to 24 SAS and/or solid-state drives (SSDs) in 2U and can scale up to 144 drives. To suit an environment's needs, the FAS series features onboard unified target adapter ports, which can be configured as 8G or 16G FC or 1GbE or 10GbE FCoE or Ethernet.

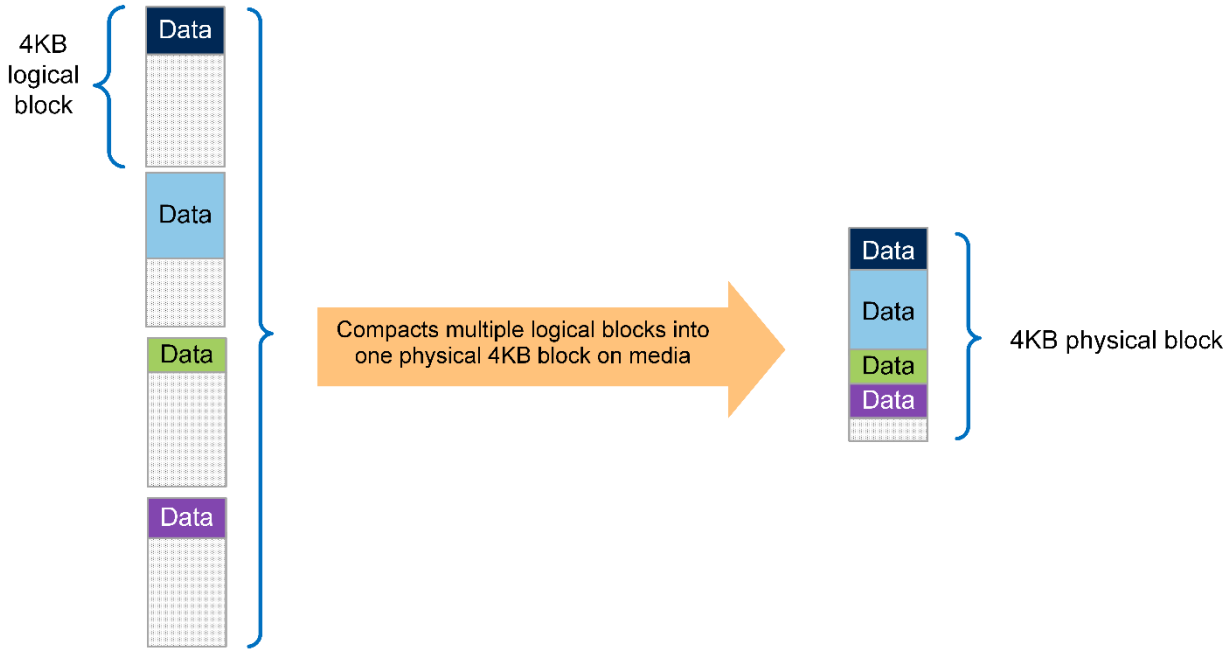
For more information about the FAS2600 hardware system, see www.netapp.com/us/products/storage-systems/fas2600/fas2600-tech-specs.aspx.

ONTAP 9.1

NetApp FAS2650 uses the new ONTAP 9.1 software. Built on over two decades of innovation, ONTAP 9.1 is next-generation storage software. ONTAP 9.1 allows a hybrid cloud to be the foundation of a Data Fabric that spans from on the premises to the cloud and back again.

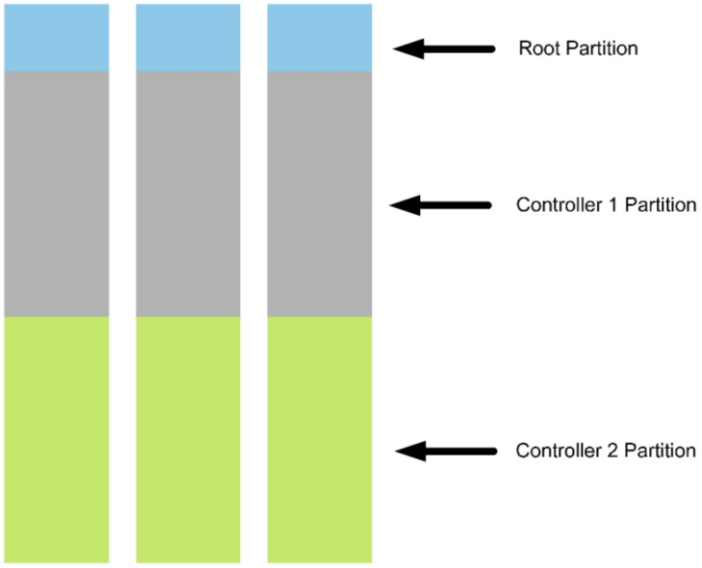
ONTAP 9.1 has several features that are suited for the FlexPod Express solution. First and foremost is NetApp's commitment to storage efficiencies, which can be one of the most important features for small deployments. The hallmark NetApp storage efficiency features such as deduplication, compression, and thin provisioning are available in ONTAP 9.1 with a new addition, compaction. Because the NetApp WAFL® (Write Anywhere File Layout) 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 9.1.



Additionally, root-data partitioning can be leveraged on the FAS2650 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 FAS2650 cluster can leverage the performance of all the disks in the aggregate.

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 9.1, see the ONTAP 9 Data Management Software Datasheet.

For more information about ONTAP 9.1, see the NetApp ONTAP 9 Documentation Center, which has been updated to include ONTAP 9.1.

FAS2600 Software

The FAS2600 series software is available in three different bundles. The included base bundle encompasses all storage protocols (FC, FCoE, iSCSI, NFS, CIFS) and hallmark NetApp features, such as storage efficiencies, RAID-TEC™ data protection, and quality of service.

The ONTAP 9 Premium Bundle includes NetApp FlexClone® software for creating instant copies of virtual machines, and NetApp SnapMirror®, SnapVault®, SnapRestore®, and SnapManager® software.

Also available is the ONTAP 9 optional extended-value software, which includes NetApp SnapLock® software and volume encryption.

For details about the software bundles that are available for the FAS2600 system, see www.netapp.com/us/products/storage-systems/fas2600/fas2600-software.aspx.

5.2 Cisco Nexus 3000 Series

The Cisco Nexus 31108PC-V is a robust, cost effective switch offering 1/10/40/100-Gbps switching. It offers 48 1/1-Gbps ports, and 40/100-Gbps uplinks allowing for flexibility.

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.

Figure 6) Cisco Nexus 31108.

The Cisco Nexus 31108 provides a comprehensive layer 2 feature set that includes virtual LANs (VLANs), IEEE 802.1Q trunking, and the Link Aggregation Control Protocol (LACP). Additional layer 3 functionality is available by adding licenses to the system.

For more information about the Cisco Nexus 3000 series, see www.cisco.com/c/en/us/products/switches/nexus-31108pc-v-switch/index.html.

5.3 Cisco UCS C-Series

The Cisco UCS C-Series Rack Server was chosen for FlexPod Express because its many configuration options, which allows 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 total cost of ownership and increase agility.

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

- 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 M4 Rack Server.

The Cisco UCS C220 M4 Rack Server is versatile and is suited for almost any infrastructure. It features the power of the latest Intel Xeon Processor E5-2600 v4 product family CPUs in a high-density two-socket enterprise-class rack server. The Cisco UCS C220 M4 delivers industry-leading performance and efficiency for a wide range of enterprise workloads, including virtualization, collaboration, and bare-metal applications. Cisco UCS C-Series Rack Servers can be deployed as standalone servers or as part of a Cisco UCS managed infrastructure.

In this design, Cisco UCS C-Series Rack Servers are deployed in a standalone configuration, leveraging the Cisco Integrated Management Controller (CIMC). CIMC is an easy-to-use, powerful interface that allows rapid configuration of Cisco UCS C-Series Rack Servers in an environment.

The Cisco Integrated Management Controller (IMC) Supervisor enables centralized management for standalone Cisco UCS C-Series Rack Servers, Cisco UCS E-Series Servers, reducing costs and increase efficiency in managing Cisco standalone servers.

The IMC Supervisor provides the following information and capabilities:

- Platform hardware inventory and health status
- Server management, including virtual keyboard, video, and mouse (vKVM) launch
- Northbound API (representational state transfer [REST] and XML API) for programmatic access
- Firmware inventory and management (noninteractive firmware updates)
- Firmware update scheduler
- Cisco Call Home (e-mail alerting)
- Cisco Smart Call Home
- Power control management
- System discovery scheduler
- Noninteractive diagnostic tool integration
- Server utilization statistics collection (Cisco UCS C220 M4 and C240 M4 Rack Servers)
- Policy-based configuration with hardware profiles (requires Advanced license)

The IMC Supervisor provides insight into the platforms being managed, including information about system inventory and faults reported on one or more systems. Managed systems can be assigned to user-defined groups to help keep platforms organized based on criteria important to the administration team. Across and within these groups, each system can be assigned one or more tags to assign searchable metadata to the server. Administrators can perform basic management tasks on individual systems such as power on, power off, and vKVM launch. Tasks for multiple platforms, including noninteractive firmware updates and diagnostic tools, are also supported.

The Cisco UCS C220 M4 server has a one-rack-unit (1RU) form factor and provides the following features:

- Dual Intel Xeon E5-2600 v4 processors for improved performance that is suitable for nearly all two-socket applications
- Next-generation DDR4 memory and 12Gbps SAS throughput
- Innovative Cisco UCS VIC support in PCIe or a modular LAN on motherboard form factor

The Cisco UCS C220 M4 server also offers maximum reliability, availability, and serviceability features, including:

- Tool-free CPU insertion
- An easy-to-use latching lid
- Hot-swappable and hot-pluggable components
- Redundant Cisco flexible flash SD cards

For more information about Cisco UCS C220 M4, see www.cisco.com/c/en/us/support/servers-unified-computing/ucs-c220-m4-rack-server/model.html.

Connectivity Options for C220 M4 Rack Servers

Cisco UCS Virtual Interface Card 1227

The Cisco UCS VIC 1227 is a dual-port card that is capable of 10GbE and FCoE. These dual ports can be logically divided into multiple adapters to enhance connectivity options in a 10GbE environment.

Figure 8) Cisco VIC 1227.

For more information about Cisco VIC 1227, see www.cisco.com/c/en/us/products/interfaces-modules/ucs-virtual-interface-card-1227/index.html.

5.4 VMware vSphere 6.5

VMware vSphere 6.5 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).

VMware vSphere 6.5 features the latest VMware innovations. The VMware vCenter Server Appliance (VCSA) that is used in this design adds a host of new features and functionality, such as VMware vSphere Update Manager integration. The VCSA also provides native vCenter High Availability for the first time. To add clustering capability to hosts and to use features such as VMware HA and VMware DRS, VMware vCenter Server is required.

VMware vSphere 6.5 also has several enhanced core features. VMware HA introduces an orchestrated restart for the first time, so virtual machines restart in the proper order in case of an HA event. In addition, the DRS algorithm has now been enhanced, and more configuration options have been introduced for more granular control of compute resources inside vSphere.

The vSphere Web Client is now the management tool of choice for VMware vSphere environments, because vSphere 6.5 marks the first release in which the C# client is no longer available. Several user

enhancements have also been made to the vSphere Web Client, such as reorganization of the home screen and the inventory tree's now being the default view upon login.

For more information about VMware vSphere, see www.vmware.com/products/vsphere.html.

For more information about the new features of VMware vSphere 6.5, see What's New in VMware vSphere 6.5.

VMware vSphere and NetApp Integration

There are two main integration points for VMware vSphere and NetApp. The first is the NetApp Virtual Storage Console (VSC). The Virtual Storage Console is a plug-in for VMware vCenter. This plug-in enables virtualization administrators to manage their storage from the familiar vCenter management interface. VMware datastores can be deployed to multiple hosts with just a few clicks. This tightly coupled integration is key for branch offices and smaller organizations, where administrative time is at a premium.

The second integration is the NetApp NFS Plug-in for VMware VAAI. Although VAAI is supported natively by block protocols, all storage arrays require a VAAI plug-in to provide the VAAI integration for NFS. Some NFS VAAI integrations include space reservation and copy offload. The VAAI plug-in can be installed by using VSC.

For more information on the NetApp VSC for VMware vSphere, see www.netapp.com/us/products/management-software/vsc/index.aspx.

5.5 Microsoft Windows Server Hyper-V 2016

To provide an additional hypervisor option to suit specific requirements, Microsoft Windows Server Hyper-V 2016 is also validated in the FlexPod Express architecture.

The Microsoft Windows Server Hyper-V 2016 release has focused on ease of use for the customer. Two main new features of Hyper-V are Nano Server and containers. Hyper-V has developed Nano Server as a compact version of Windows Server that is optimized for hosting Hyper-V. Windows containers come in two different configurations: Windows Server containers, which involve a shared kernel for all containers on the host, and Hyper-V containers, which run each container in its very own highly optimized virtual machine.

For more information, see https://technet.microsoft.com/en-us/windows-server-docs/compute/hyper-v/what-s-new-in-hyper-v-on-windows.

Microsoft Windows Server Hyper-V and NetApp Integration

Microsoft Windows Server Hyper-V can integrate with NetApp storage in several ways. System Center Virtual Machine Manager (SCVMM), which is the cluster manager for Hyper-V, integrates with the Data ONTAP SMI-S Provider to provide storage management features within SCVMM.

Although it is not shown in the FlexPod Express architecture, NetApp SnapManager for Hyper-V can automate and simplify backup and restore operations for Microsoft Windows Server Hyper-V 2016.

For more information about SnapManager for Hyper-V, see www.netapp.com/us/products/management-software/snapmanager-hyperv.aspx.

5.6 Boot Architecture

The following are supported options for FlexPod Express boot architecture:

- iSCSI SAN LUN
- 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. The FlexPod Express solution also supports the options to boot from Cisco FlexFlash SD cards and from internal hard drives for VMware vSphere ESXi and from local hard drives for Microsoft Windows Server Hyper-V.

Note: The largest FlexFlash SD card that is supported in the C220 M4 at this time is 64GB. Therefore, for local boot, local hard drives are the better choice for Microsoft Windows Server Hyper-V.

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 program, 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.

Both the VMware vSphere 6.5 and Microsoft Windows Server Hyper-V 2016 hypervisors were verified on the FlexPod Express infrastructure components. This validation included both 10GbE and 1GbE uplink connectivity options for both hypervisors.

7 Conclusion

FlexPod Express provides 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 the small to midsize businesses, remote and branch offices, and other businesses that require dedicated solutions.

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Version History

Version	Date	Document Version History
Version 1.0	February 2017	Initial release.
Version 1.1	May 2017	Updated to include 1GbE uplink connectivity, Hyper V, and hypervisor integration options.

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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