

# Dell EMC Ready Stack: VMware Cloud Foundation on PowerEdge Servers and Unity Storage

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## Design Guide

### Abstract

This design guide provides architectural guidance, best practices, and sample configurations for a converged infrastructure that is based on VMware Cloud Foundation and Dell EMC PowerEdge servers, Open Networking, and all-flash storage.

Dell EMC Solutions

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# Chapter 1 Introduction

This chapter presents the following topics:

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## Ready Stack overview

As IT infrastructure in the data center becomes more complex, managing the infrastructure becomes increasingly difficult. Making changes to the traditional data center infrastructure can significantly affect stability, performance, costs, and upgradability.

The Dell EMC Ready Stack certified reference system for VMware Cloud Foundation on PowerEdge Servers and Unity Storage helps organizations meet long-term data center needs for various mixed workloads. Ready Stack provides the simplicity of a complete, yet flexible, validated converged infrastructure (CI) that is based on the following components:

- Dell EMC Unity storage
- Dell EMC PowerEdge servers
- Dell EMC S-Series switches
- Dell EMC Integrated Data Protection Appliance (IDPA) DP4400 backup solution
- VMware Cloud Foundation virtualization software stack

This Ready Stack provides:

- One trusted vendor for all CI stack components—compute, storage, networking, virtualization software and management platform, and data protection
- Design and deployment guidance that incorporates scale, flexibility, high availability, and best practices

## Ready Stack key benefits

This Ready Stack provides the following key benefits:

- **Resiliency**—The Ready Stack architecture ensures that no single point of failure exists. Redundancy is incorporated in the critical aspects of the Ready Stack, which includes server high-availability features, redundant networking, and multipath storage.
- **Virtualization support**—We designed this Ready Stack for general-purpose virtualized workloads. Each server is equipped with processing power, memory, and converged network adapters that support Ethernet and Fibre Channel (FC), as required for virtualization.
- **Scalability**—You can configure this Ready Stack to suit your needs for a virtualized infrastructure. The Ready Stack provides flexibility by supporting various options including server model, number of compute servers, server processor model, server memory capacity, type of FC storage, and FC storage capacity.
- **Powerful all-flash storage**—This Ready Stack includes the Unity x50 All Flash storage platform. With all-inclusive software, these all-flash systems deliver consistent performance with fast response times and are ideal for mixed virtual workload requirements.
- **Integrated data protection**—The IDPA preconfigured backup solution combines protection storage and software, search, analytics, and simplified management. The

IDPA DP4400 appliance that is included in this Ready Stack is optimized for VMware environments.

- **Integrated Dell EMC management**—This Ready Stack includes the following Dell EMC management tools:
  - **Dell EMC OpenManage Integration for VMware vCenter (OMIVV)**—A virtual appliance that enables administrators to view physical host details in VMware vSphere.
  - **Dell EMC Virtual Storage Integrator (VSI)**—A vCenter plug-in that enables administrators to view, manage, and optimize storage for vSphere servers and hosts.
  - **Dell EMC Integrated Dell Remote Access Controller 9 (iDRAC9)**—An out-of-band (OOB) management tool for Dell EMC PowerEdge rack servers. iDRAC9 has its own HTML5-based UI and can be accessed by using various methods including SSH, RACADM, and the Redfish API. iDRAC9 Group Manager provides a one-to-many console for accessing the details of multiple servers. As needed, administrators can also use Dell EMC OpenManage Enterprise (OME) and OME Modular Edition to manage server content that is accessible through iDRAC9.
  - **Brocade Web Tools**—An embedded UI on Dell EMC Connectrix switches that enables administrators to monitor and manage single or small fabrics, switches, and ports. Web Tools is launched directly from a web browser or from the Brocade Network Advisor.
  - **IDPA System Manager**—An HTML5-based UI that provides administrators with configurable dashboards to simplify and automate data protection management, monitoring, and reporting.

## VMware Cloud Foundation

VMware Cloud Foundation is a unified software-defined data center (SDDC) platform for the hybrid cloud. Composed of VMware vSphere, VMware vSAN, VMware NSX, and VMware SDDC Manager, VMware Cloud Foundation delivers a natively integrated cloud-infrastructure software stack coupled with a cloud management platform.

SDDC Manager features life-cycle management capabilities that automate critical day 0 to day 2 operations for the cloud infrastructure stack, enable rapid provisioning and one-click patching and upgrades, and use policy-based provisioning to simplify resource allocation.

## Document purpose

This design guide describes how VMware Cloud Foundation can use Dell EMC compute and Dell EMC Open Networking with Unity storage. It provides design principles, best practices, architectural guidance, and sample configurations for compute, management, networking, and storage.

## Audience

This guide is for Dell EMC personnel, channel partners, and end users.

## We value your feedback

Dell EMC and the authors of this document welcome your feedback. Contact the Dell EMC Solutions team by [email](#) or provide your comments by completing our [documentation survey](#).

**Authors:** Robert Percy, Don Pisinski, David Hartman, Karen Johnson

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**Note:** The following page of the Ready Stack space on the Dell EMC Communities website provides links to additional documentation for this and other Ready Stack systems:  
[Ready Stack Info Hub](#)

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# Chapter 2 Architecture and Components

This chapter presents the following topics:

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<b>Ready Stack architecture</b> .....	<b>10</b>
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## Introduction

Installing, configuring, and running an on-premises CI cloud solution involves multiple considerations, including:

- Operating system and virtualization software distributions
- Selection of monitoring and management software
- Allocation of cluster services and data storage to physical nodes and arrays
- Selection of appropriate server hardware
- Design of the network fabric
- Sizing and scalability
- Performance requirements

Complicating these considerations is the need to understand the types of workloads that will run on the cluster and the challenges of managing a system that is designed to accommodate multiple general-purpose, virtualized workloads.

Dell EMC's customer-centered approach creates rapidly deployable and highly available CI systems that run on enterprise-class hardware. Ready Stack designs include all the hardware, software, resources, and best practices that are needed to run a scalable, highly available CI environment. With this approach, organizations can be operational in a shorter time than is typically possible with homegrown solutions.

## Infrastructure requirements

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**Note:** Ensure that you have enough VMware licenses for the VMware Cloud Foundation package being installed and for the number of servers, CPUs, VMs, and vCenter instances that are planned for the environment. Work with your local Dell EMC or VMware sales team to find the most appropriate VMware Cloud Foundation package for your solution.

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Implementing Ready Stack for VMware vCloud Foundation requires that the following infrastructure elements are present in the existing data center or configured at the time of deployment:

- A Domain Name System (DNS) server on the management network
- A Network Time Protocol (NTP) server on the management network
- An Ethernet infrastructure

Dell EMC recommends a 10/25 GbE or 40/100 GbE infrastructure. Additional components, such as Dell Networking cables and transceivers, are required to uplink the Ready Stack to the network. The specific component requirements depend on your networking and uplink requirements.

- Sufficient power and cooling to support the Ready Stack components

Contact your Dell EMC Sales representative for more information about the power and cooling requirements.

## Ready Stack architecture

This Ready Stack architecture includes compute servers, data protection, management servers, LAN switches, SAN switches, storage arrays, and OOB switches, as shown in the following figure.

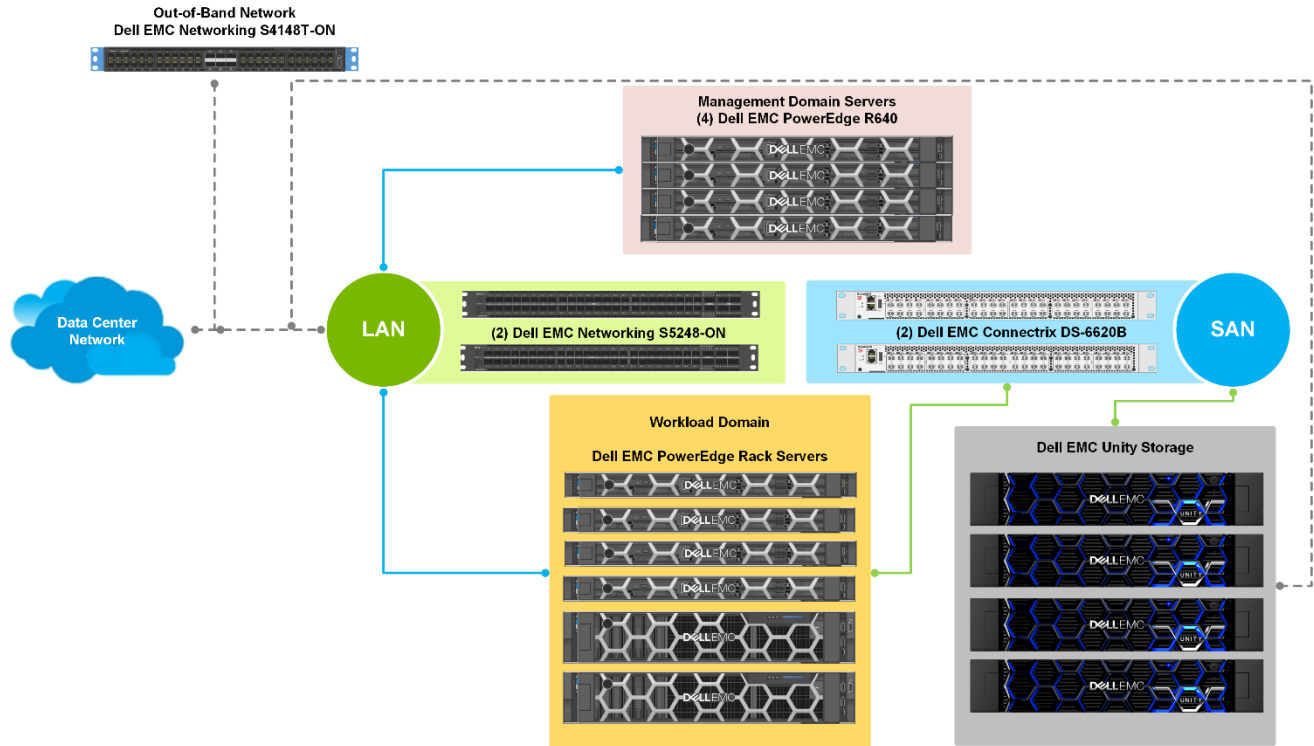


Figure 1. Ready Stack design architecture

## Key components

### Compute

The Dell EMC portfolio of PowerEdge rack servers is designed to optimize application performance. The servers support intuitive tools to simplify and automate tasks over the entire server life cycle. Every data center and virtual environment has unique requirements, and PowerEdge technology provides the flexibility that is needed to build a scalable vSphere infrastructure.

This Ready Stack supports the following PowerEdge servers:

- PowerEdge R640**—A 1U 2-socket server platform that supports up to 24 DIMM slots, ten 2.5 in. drives, and three PCIe cards. The scalable business architecture of the R640 server maximizes application performance and provides the flexibility to optimize configurations that are based on the application and use case.

- **PowerEdge R740/740xd**— A 2U, 2-socket server platform that supports up to 24 DIMM slots, thirty-two 2.5 in. drives, and eight PCIe cards and delivers a balance between storage scalability and performance. This platform is ideal for software-defined storage (SDS), service providers, and virtual desktop infrastructures. The PowerEdge R740 server accelerates application performance by using accelerator cards and storage scalability. The versatile R740xd server supports a mix of any drive types to create the optimum configuration of NVMe drives, SSDs, and HDDs for either performance or capacity, or both.

Embedded in each PowerEdge server in Ready Stack for VMware vCloud Foundation is iDRAC9, which provides secure and remote server access for a multitude of common management functions. iDRAC with Lifecycle Controller operates regardless of the operating system state or the presence of a hypervisor. It also offers a complete set of server management features, including configuration, operating system deployment, firmware updates, health monitoring, and maintenance.

iDRAC9 supports various remote connectivity interfaces and protocols, including IPMI, Redfish, SMASH-CLP, and WS-Man, enabling administrators to securely configure, deploy, manage, monitor, and update the server. The iDRAC9 HTML5 Web UI provides secure connectivity through HTTPS. The iDRAC9 Enterprise license includes Group Manager, which provides a one-to-many console experience. With Group Manager, administrators can view and manage a set of servers rather than visually inspect the servers for faults and manage them manually.

## Networking

The Ready Stack architecture network design consists of these functional groups:

- OOB network
- LAN
- SAN

### OOB network

The key building block of the OOB network is the Dell EMC S4148T-ON switch, which provides forty-eight 10GBase-T ports and multiple uplink port options. Using two S4148T-ON switches—also referred to as the management switches—provides redundancy.

### LAN

The Dell EMC S5248-ON switch provides LAN connectivity. This switch provides up to forty-eight 25 GbE ports and six 100 GbE ports. Using two S5248-ON switches—referred to as top-of-rack (ToR) switches—provides redundancy. Built-in NICs directly connect the ToR switches to the rackmount servers.

### SAN

For FC storage traffic, Ready Stack uses Dell EMC Connectrix DS-6620B switches. The DS-6620B switch delivers up to 32 Gb/s FC performance in a 1U form factor and, by default, has twenty-four 32 Gb/s ports enabled. More ports can be added, through Ports on Demand upgrade kits, up to 64 ports per chassis. Brocade Web Tools, the embedded UI on the Connectrix DS-6620B switches, facilitates the monitoring and management of single or small fabrics, switches, and ports.

## Storage

Dell EMC Unity All Flash storage systems offer simplicity, modern design, and flexible deployments. Unity All Flash storage systems implement an integrated architecture for block, file, and virtual hard disks, with concurrent support for native NAS, iSCSI, and FC protocols. Each system uses dual storage processors, full 12 Gb SAS back-end connectivity, and Dell EMC's patented multicore architected operating environment to deliver performance and efficiency. Disk array enclosures (DAEs) provide additional storage capacity, and online controller upgrades are available for additional performance. Unity all-flash technology supports:

- File and block environments
- Point-in-time snapshots
- Thin clones
- Synchronous and asynchronous replication
- Integrated encryption
- Tiering to the cloud
- Deep ecosystem integration with VMware, Microsoft, and OpenStack software

Although this guide describes VMware Cloud Foundation with external FC-attached Unity storage, you can also use an FC-attached external Dell EMC PowerMax array or externally attached NFS Unity storage. For information about these options, see [Dell EMC Storage with VMware Cloud Foundation](#).

### Data reduction

Dell EMC data reduction includes deduplication and compression logic. Unity data reduction features are available for block LUNs and datastores in an all-flash pool. Administrators can enable Unity data reduction at the resource level so that storage resources with and without enabled data reduction can exist in the same pool on a system. Data reduction savings also can be set at the system level, pool level, and other levels.

### Dynamic pools

Dynamic pools present an entirely redesigned pool structure that increases the flexibility of configuration options within a Unity system. Dynamic pools replace the existing pool technology as the default pool type within the Unisphere management platform for Unity All Flash systems. As with traditional pools, dynamic pools can be created, expanded, and deleted, but they also offer improvements. Expansion of a dynamic pool can be as granular as adding a single drive to the pool to increase its capacity. This feature provides a fully flexible deployment model, which improves the planning and provisioning process and reduces the total cost of ownership. For more information, see the [Dell EMC Unity: Dynamic Pools White Paper](#).

### Host I/O activity limits

The Host I/O Limits feature of the Unity array restricts the amount of I/O activity that the Unity system services. Limits can be applied on LUNs, vSphere VMFS datastores, and thin clones and their associated attached snapshots. Use the Host I/O Limits feature to limit incoming host activity based on IOPS, bandwidth, or both.

You can configure Host I/O Limits on LUNs or datastores that are consuming a large portion of the system's resources and reducing the performance of other system resources. A burst policies option, which is available for any Host I/O Limits policy, enables host activity or traffic to exceed the base policy limit by a user-specified amount. Specify the amount as a percentage along with the duration and frequency of the I/O limit burst allowance.

### Unisphere storage management

For vSphere hosts, Unisphere storage management for Unity arrays uses integration points to reduce required steps and performs several host-side functions. Unisphere storage management for Unity arrays includes an HTML5 UI that displays NFS, vSphere VMFS, and vSphere Virtual Volumes datastore storage and enables administrators to present storage to all host servers. The UI also displays system status and performance information, including a graphical representation of the Unity system, highlighting areas of interest such as drive faults and network link failures.

## VMware Cloud Foundation

VMware Cloud Foundation is an integrated software stack that bundles compute virtualization (VMware vSphere), storage virtualization (VMware vSAN), network virtualization (VMware NSX), and cloud management and monitoring (VMware vRealize Suite) into a single platform. The platform also includes SDDC Manager, which helps make the SDDC possible.

VMware Cloud Foundation can be deployed on the premises as a private cloud or run as a service within a public cloud, enabling a consistent operating model from the on-premises private cloud to the public cloud. With on-premises deployment of VMware Cloud Foundation, you can use existing infrastructure investments to enhance your private-cloud capabilities.

VMware Cloud Foundation uses on-board disks from the PowerEdge servers in a vSAN configuration as the primary storage. In this Ready Stack certified reference system, VMware Cloud Foundation uses Unity resources as secondary, FC-attached storage for its workload domains. By supporting external storage, VMware Cloud Foundation enables you to meet the demands of applications that require more storage resources but do not necessarily require more compute resources. VMware Cloud Foundation support for Unity storage enables you to use existing storage assets as you deploy applications in new workload domains.

VMware Cloud Foundation includes the following components:

- **vSphere**—A suite of server virtualization tools that includes the VMware ESXi hypervisor and vCenter management software.
- **NSX**—Networking and security software that provisions virtual networking environments by abstracting network operations from the underlying hardware onto a distributed virtualization layer.
- **vSAN**—A distributed layer of software that is included in the ESXi hypervisor and fully integrated in vSphere. vSAN pools direct-attached storage devices across a vSphere cluster to create a distributed shared datastore.
- **SDDC Manager**—A multithreaded execution engine that provides built-in automated life-cycle management of resources.

## Resource requirements

In this Ready Stack certified reference system, a vSAN ReadyNode is a validated server configuration in a tested, certified hardware form factor for vSAN deployment, jointly recommended by Dell EMC and VMware. Each vSAN ReadyNode profile specifies a server's size; type and quantity of CPUs, memory, network, and I/O controllers; and type of disks. Thus, you can choose the vSAN ReadyNode profiles that best suit your application workloads.

Although vSAN ReadyNodes can help accelerate vSAN deployment, they are optional. Dell EMC servers can be customized to meet your requirements. You can add resources such as more powerful CPUs, RAM, and storage, provided that the resources meet the minimum requirements for similar vSAN Ready Nodes.

For information about the minimum hardware requirements (server and networking requirements, for example) for running the individual software products in VMware Cloud Foundation, see the [VMware Compatibility Guide](#).

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**Note:** This Ready Stack certified reference system supports VMware Cloud Foundation 3.5. The VMware Compatibility Guide does not list vSAN ReadyNodes for VMware Cloud Foundation 3.x; therefore, refer to the individual components along with the corresponding VMware software product.

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## Licensing

Ensure that you have the required number of software licenses. You cannot create or expand workload domains if you do not enter license keys for the following products:

- VMware vCloud Suite
- vSAN
- vCenter Server
- NSX for vSphere
- SDDC Manager
- vRealize Log Insight

Ensure that you have enough VMware licenses for the VMware Cloud Foundation package being installed and for the number of servers, CPUs, VMs, and vCenter instances that are planned for the environment. Work with your Dell EMC or VMware sales team to find the most appropriate VMware Cloud Foundation package for your solution and to ensure that you have the required number of licenses.

## Virtualization software requirements

To support VMware Cloud Foundation, the components in this Ready Stack certified reference system require the virtualization software that is listed in the following table.

**Table 1. Ready Stack components and their VMware Cloud Foundation roles**

Dell EMC component	Purpose	Minimum virtualization software required
4–32 x PowerEdge R740 servers	VMware Cloud Foundation workload domain servers (per rack)	vSphere 6.7u1
2 (min.) x S4148T-ON switches	OOB management switches	NSX-V 6.4.4
4 (min.) x PowerEdge R640 servers	VMware Cloud Foundation management domain servers	vSphere 6.7u1
2 x S5248-ON switches	ToR leaf switches	NSX-V 6.4.4
1 (min.) x Z9264F-ON switch	Spine switches for multi-rack scale-out	NSX-V 6.4.4
2 x Connectrix DS-6620B switches	FC SAN switches for workload domains	Not applicable
Unity storage arrays	Secondary storage for workload domains	vSphere 6.7u1

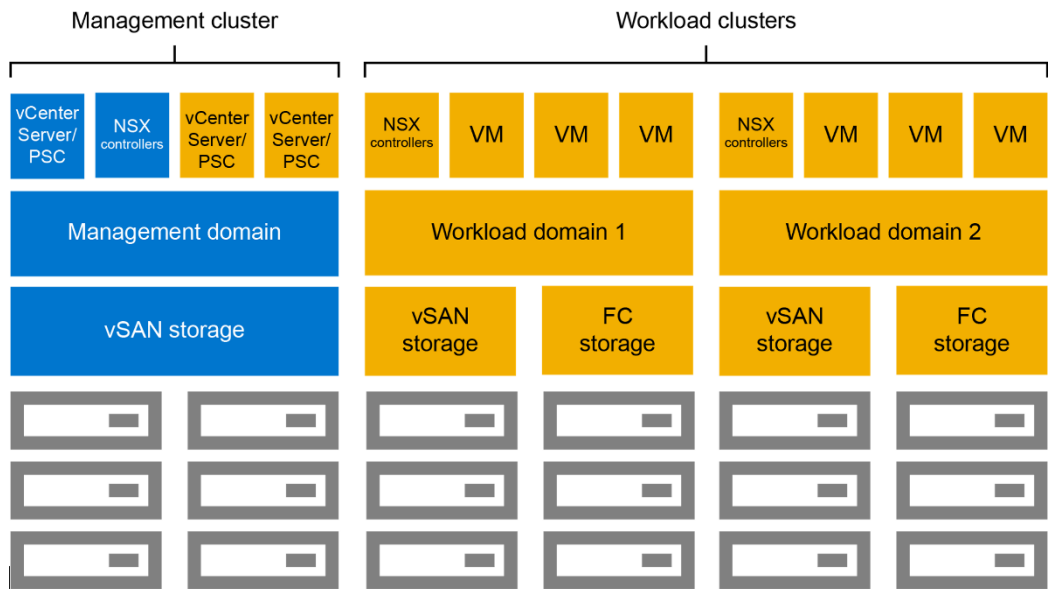
For additional details, see the following VMware knowledge base article:

[Correlating VMware Cloud Foundation version with the versions of its constituent products \(52520\)](#)

### vSAN

vSAN is an object-based, in-kernel solution that uses vSphere Storage Policy Based Management (SPBM) to provide storage on a per-VM basis. vSAN enables you to address the needs of specific VMs and their application workload requirements without directly modifying or enhancing the services that are provided by the underlying storage array. vSAN runs in the kernel of each ESXi host in a cluster, and all hosts in the cluster share a single vSAN datastore.

As shown in the following figure, each cluster in VMware Cloud Foundation is a domain. One cluster is a dedicated management domain, and one or more clusters are workload domains that contain deployed applications. Workload domains are policy-based resource containers with specific availability and performance attributes that combine compute (vSphere), storage (vSAN), and networking (NSX) into a single consumable entity.



**Figure 2. VMware Cloud Foundation with Dell EMC Storage**

Each workload domain instantiates a dedicated vSAN cluster with its own performance and availability characteristics, which enables multiple workload domains to be deployed in the cloud, each supporting different service-level agreements.

The local storage on each host is then configured into a pair of disk groups. These disk groups from all servers in the workload domain are then aggregated into a single vSAN datastore.

You can extend storage capacity by expanding a workload domain. As SDDC Manager adds more hosts to the cluster, it automatically extends the VMware vSAN datastore. The external Unity storage is managed by using native storage tools (Dell EMC Unisphere) or the VSI plug-in to vCenter; however, it does not participate in the automated functions of VMware Cloud Foundation SDDC Manager.

### **VMware Cloud Foundation networking**

VMware Cloud Foundation is seamlessly deployed into your existing data center and requires no modification to the physical network. Its software-defined networking subsystem provides network virtualization with VMware NSX. VMware Cloud Foundation supports both L2 and L3 uplink connectivity.

When creating the private cloud (that is, the management domain), VMware Cloud Foundation SDDC Manager configures a link aggregation group (LAG) to provide bandwidth aggregation and to protect against NIC failures. Then, when creating workload domains, SDDC Manager:

- Allocates cloud capacity into workload domains. Each workload domain consists of a dedicated vSphere cluster and is managed by its own vCenter Server.
- Creates a vSphere Distributed Switch that has multiple VLAN-backed port groups to logically segregate and isolate the different traffic types.
- Automatically deploys and configures NSX, which includes modern virtual networking and advanced security services such as virtual extensible LAN (VXLAN), virtual-to-physical routing, Distributed Firewall (DFW), and distributed



routing for east-west routing and security. NSX edge service gateways can also be deployed to manage north-south routing along with load balancing and NAT services for workloads running inside the workload domain.

You can increase capacity later by adding servers within a rack (scale up) or adding racks (scale out). In larger environments where multiple racks are deployed, racks are connected to each other from the ToR switches to a pair of redundant inter-rack switches in a dual LAG configuration, using separate 25 Gb or 40 Gb uplinks depending on the switch port types available. The network automatically scales, to the maximum number of connections available per spine pair, as you increase capacity. The result is a high-performance, resilient, and scalable network.

### Unity integration with VMware Cloud Foundation

The Unity family of storage arrays provides numerous native features and tools within the Unisphere platform, as well as integration with various VMware APIs for enhanced storage resource management and utilization. Unity arrays support vSphere Storage APIs – Array Integration (VAAI), which defines a set of storage primitives that enable the ESXi hosts to offload certain storage operations to the array. VAAI reduces resource overhead on the ESXi hosts and can significantly improve performance for storage-intensive operations such as storage cloning and zeroing.

Unity arrays also support VMware vSphere APIs – Storage Awareness (VASA). VASA is a set of VMware APIs that enables storage arrays to integrate with vCenter for management operations. Storage monitoring and reporting activities that are typically done within the Unisphere platform are available within vCenter, providing administrators with a single interface from which to manage Unity storage within the VMware environment. vCenter captures information regarding the features of the physical Unity storage arrays, including health status, capacity utilization, and configuration capabilities, which can significantly simplify storage administration and workflow provisioning within a VMware environment.

### VMware Cloud Foundation with FC storage

Consider the following information when using FC storage with VMware Cloud Foundation:

- Presenting FC datastores to the management domain is not supported. Present FC datastores to workload domains only.
- When external storage is presented to the vSphere hosts, FC datastores are considered ancillary/secondary storage for workload domains. Therefore, vSAN or NFS storage is required for the initial deployment of a workload domain. After initial deployment, you can make the FC datastores available to the workload hosts.
- Although vSAN and NFS storage can be managed from within the SDDC Manager interface, all FC datastores must be managed from the vCenter instance in the workload domain through the VSI plug-in. This external storage does not participate in the automated SDDC Manager functions.

This design guide describes how to use vSAN as primary storage with VMware Cloud Foundation. If you prefer to use NFS storage as primary storage for workload domains, see [Dell EMC Storage with VMware Cloud Foundation](#).

## Private cloud deployment process overview

The following steps outline the procedure for deploying a private cloud, including assembling the physical Ready Stack components, imaging the servers, and creating the management domain. For detailed information, see [VMware Cloud Foundation Architecture and Deployment Guide](#) in the VMware Docs library.

1. Deploy the VMware Cloud Foundation Builder VM.

The VMware Cloud Foundation Builder VM includes the VMware Imaging Appliance that you can use to install ESXi on your servers.

2. Install ESXi software on VMware Cloud Foundation servers.

To image servers for use in the management domain and workload domains, do one of the following:

- Use the VMware Imaging Appliance (VIA) that is included with the VMware Cloud Foundation Builder VM.
- Image the servers with existing tools or processes you have, provided that the documented host prerequisite configurations are already in place.

3. Download the Deployment Parameter Sheet from the VMware Cloud Foundation Builder VM and complete it.

The Deployment Parameter Sheet is a multi-tab spreadsheet in which you specify the required deployment information for your environment. This information includes hosts, license keys, DNS, network (VLANS, IPs, MTUs), and credentials. The completed spreadsheet is converted to a JSON file, and the VMware Cloud Foundation Builder VM then validates the network information that you provide. You can reuse the Deployment Parameter Sheet to deploy multiple VMware Cloud Foundation instances of the same version.

4. Initiate the VMware Cloud Foundation bring-up process.

During the bring-up process, the management domain is created on the ESXi hosts that are specified in the Deployment Parameter Sheet. The VMware Cloud Foundation software components are automatically deployed, configured, and licensed using the information that you provided.

When the bring-up process is complete, the VMware Cloud Foundation Builder VM transfers inventory and control to SDDC Manager and you can begin creating workload domains.

## Creating workload domains

In SDDC Manager, you can select from various workload domain types, depending on the requirements of the applications you intend to deploy on your VMs. During this process, you also select from among the available licenses for NSX and vSphere.

After initial deployment, VMware Cloud Foundation makes it easy to add capacity to the private cloud by adding new ReadyNodes, or their equivalent, as you scale up resources within existing racks or scale out into multiple racks.

## Chapter 3 Configuration and Specifications

This chapter presents the following topics:

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## Introduction

This chapter provides details about the recommended platforms for Ready Stack for VMware Cloud Foundation, component specifications for three sample configurations, and information about scaling Ready Stack.

## Recommended components

Ready Stack for VMware Cloud Foundation uses the latest Dell EMC PowerEdge rack servers, LAN switches, SAN switches, and all-flash Unity storage arrays. It also includes platform management software.

The following table lists the recommended components.

**Table 2. Recommended components**

Platform/category	Components
Workload domain server platform	Dell EMC PowerEdge R740/R740xd
LAN connectivity for Ethernet traffic	<ul style="list-style-type: none"> <li>For leaf: 2 x Dell EMC Networking S5248-ON switches</li> <li>For spine (if needed): Dell EMC Networking Z9264F-ON switch</li> </ul>
SAN connectivity	2 x Dell EMC Connectrix DS-6620B 32 Gb/s FC switches
OOB connectivity	2 x Dell EMC Networking S4148T-ON switches <b>Note:</b> We recommend using 2 OOB management switches for high availability.
Storage array	Unity 350F, 450F, 550F, or 650F
Management domain server platform	Minimum of 3 x PowerEdge R640
Data protection	IDPA DP4400
Server and storage management software	<ul style="list-style-type: none"> <li>VMware vCenter</li> <li>Dell EMC OpenManage Integration for VMware vCenter</li> <li>Dell EMC Virtual Storage Integrator</li> <li>iDRAC9</li> </ul>
Virtualization software	VMware Cloud Foundation base, which includes: <ul style="list-style-type: none"> <li>SDDC Manager</li> <li>NSX Data Center Professional</li> <li>vSAN Advances</li> <li>vSphere Enterprise Plus</li> </ul>

## Design configuration and specifications

### Overview

Ready Stack for VMware Cloud Foundation offers flexibility to address various virtualization use cases and workloads. Sizing a physical infrastructure for all virtualized workloads requires knowledge of all the individual workloads and their compute, memory, storage, and network performance requirements. After you create one or more VM profiles that meet the Ready Stack requirements, approximate the physical infrastructure that is required to support VMs and account for expected future growth. When finalizing sizing, ensure that you also consider server and storage maintenance requirements and virtualization features such as high availability. If an approximation is not sufficient, we recommend a site survey.

The following table details a medium-size configuration of Ready Stack for VMware Cloud Foundation. The configuration is based on a balanced VM profile of 2 vCPUs, 6 GB of memory, a 60 GB virtual disk, and 50 IOPS.

**Table 3. Ready Stack sample configuration**

Configuration	Number of VMs	Number of vCPUs	vRAM size	vDisk size	IOPS
Enterprise Medium	240	480	1.44 TB	14.4 TB	12,000

The balanced VM profile totals for VMs, vCPUs, vRAM, vDisk, and IOPS are based on an Intel SP Skylake generation processor configuration of 10 cores per CPU and a 2:1 virtual-to-physical CPU utilization ratio. Depending on the VM profile, the required compute resource values might be different from the values that are shown in the preceding table. For more information about tuning the Ready Stack product configuration and counts to meet infrastructure requirements, consult your Dell EMC Sales representative.

### Sample configuration

The following table lists the component specifications for a sample Ready Stack configuration.

**Table 4. Sample configuration: Component specifications<sup>1</sup>**

Component	Details	
Virtualization hosts in workload domain	6 x PowerEdge R740 servers	
	Processor	2 x Intel Xeon Gold 6126 2.6 GHz, 12C/24T, 10.4 GT/s, 19.25 MB Cache, Turbo, HT (125 W) DDR4-2666
	Memory	384 GB, 12 x 32 GB RDIMM, 2,666 MT/s, dual rank
	Storage adapter	PERC H330
	Caching tier	2 X 400 GB SSD SAS write-intensive 12 Gb/s 512n 2.5 in. hot-plug drive, PX05SM, 10 DWPD, 7,300 TBW
	Local storage: Capacity tier	8 x 1.8 TB 10K RPM SAS 12 Gb/s 512e 2.5 in. hot-plug hard drive
	Boot device	BOSS controller card + with 2 M.2 Sticks 120 GB (RAID 1), FH or Internal SD Module with 2 x 16 GB SD card

Component	Details	
	Network	BOSS controller card + with 2 M.2 Sticks 120 G (RAID 1), FH or Internal SD Module with 2 x 16 GB SD card
	HBA	QLogic 2692 dual-port FC PCIe card
	Hypervisor	VMware vSphere 6.7u1
Management hosts in workload domain	4 x PowerEdge R640 servers	
	Processor	2 x Intel Xeon Gold 6126 2.6 GHz, 12C/24T, 10.4 GT/s, 19.25 MB Cache, Turbo, HT (125 W) DDR4-2666
	Memory	384 GB: 12 x 32 GB DDR4 RDIMMs
	Storage adapter	PERC H330
	Local storage: Caching tier	2 X 400 GB SSD SAS write-intensive 12 Gb/s 512n 2.5 in. hot-plug drive, PX05SM, 10 DWPD, 7,300 TBW
	Local storage: Capacity tier	8 x 1.8 TB 10K RPM SAS 12 Gb/s 512e 2.5 in. hot-plug hard drive
	Boot Device	BOSS controller card + with 2 M.2 Sticks 120 GB (RAID 1), FH or Internal SD Module with 2 x 16 GB SD Card
	Network	Intel X710 quad-port 10 GbE, Base-T, PCIe adapter, low profile
	Hypervisor	VMware vSphere 6.7u1
Storage array for secondary storage for servers/VMs in workload domain	Dell EMC Unity 450F with 25 x 3.84 TB SSDs (RAID 5, 6, 10)	
Networking	OOB	2 x Dell EMC Networking S4148T-ON switches
	ToR	2 x Dell EMC Networking S5248-ON switches
	SAN fabric	2 x Connectrix DS-6620B 32 Gb/s FC switches
Licenses	iDRAC9 Enterprise—1 per PowerEdge server	
	OpenManage Integration for VMware vCenter <sup>2</sup> —1 per PowerEdge server	

<sup>1</sup>Specifications are for a minimum configuration.

<sup>2</sup> 3-year license.

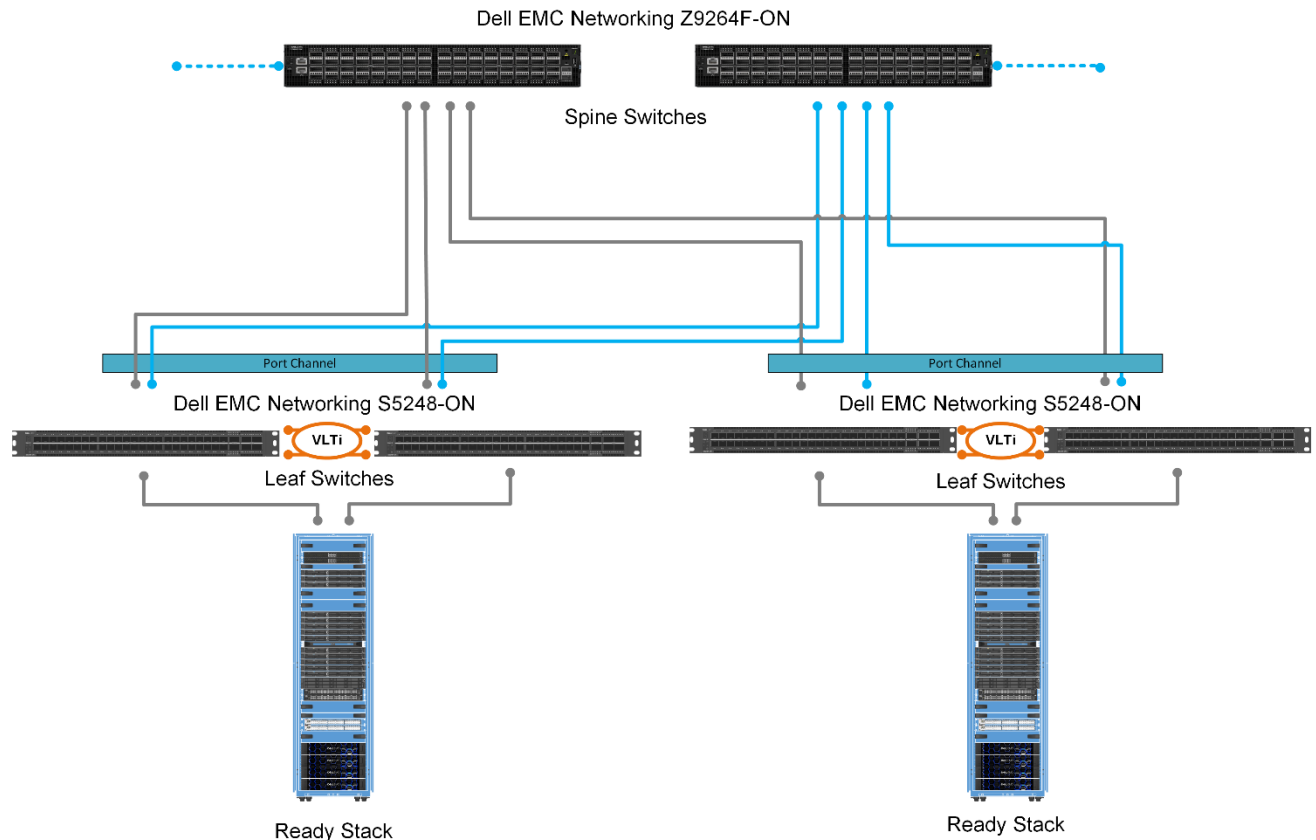
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**Note:** Ensure that you have enough VMware licenses for the VMware Cloud Foundation package being installed and for the number of servers, CPUs, VMs, and vCenter instances that are planned for the environment. Work with your local Dell EMC or VMware sales team to find the most appropriate VMware Cloud Foundation package for your solution.

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## Ready Stack scaling

Scale the Ready Stack by adding multiple compute nodes (pods) in the data center. You can use Dell EMC Networking Z9264 switches to create a simple yet scalable network, as shown in the following figure. The Z9264 switches serve as the spine switches in the leaf-spine architecture. The Z9264 is a multiline rate switch that supports 10/25/40/50/100 GbE connectivity and can aggregate multiple racks with little or no oversubscription.



**Figure 3. Multiple compute pods scaled out by using leaf-spine architecture**

When connecting multiple racks by using the 40/100 GbE uplinks from the rack, you can build a large fabric that supports multi-terabit clusters. The density of the Z9264 allows flattening of the network tiers, enabling you to create an equal-cost fabric from any point to any other point in the network.

For large-domain Layer 2 requirements, use extended Virtual Link Trunking (eVLT) on the Z9264, as shown in the following figure. The VLT pair that is formed can scale to hundreds of servers inside multiple racks. Each rack has four 40/100 GbE links to the core network, providing enough bandwidth for all the traffic between each rack.

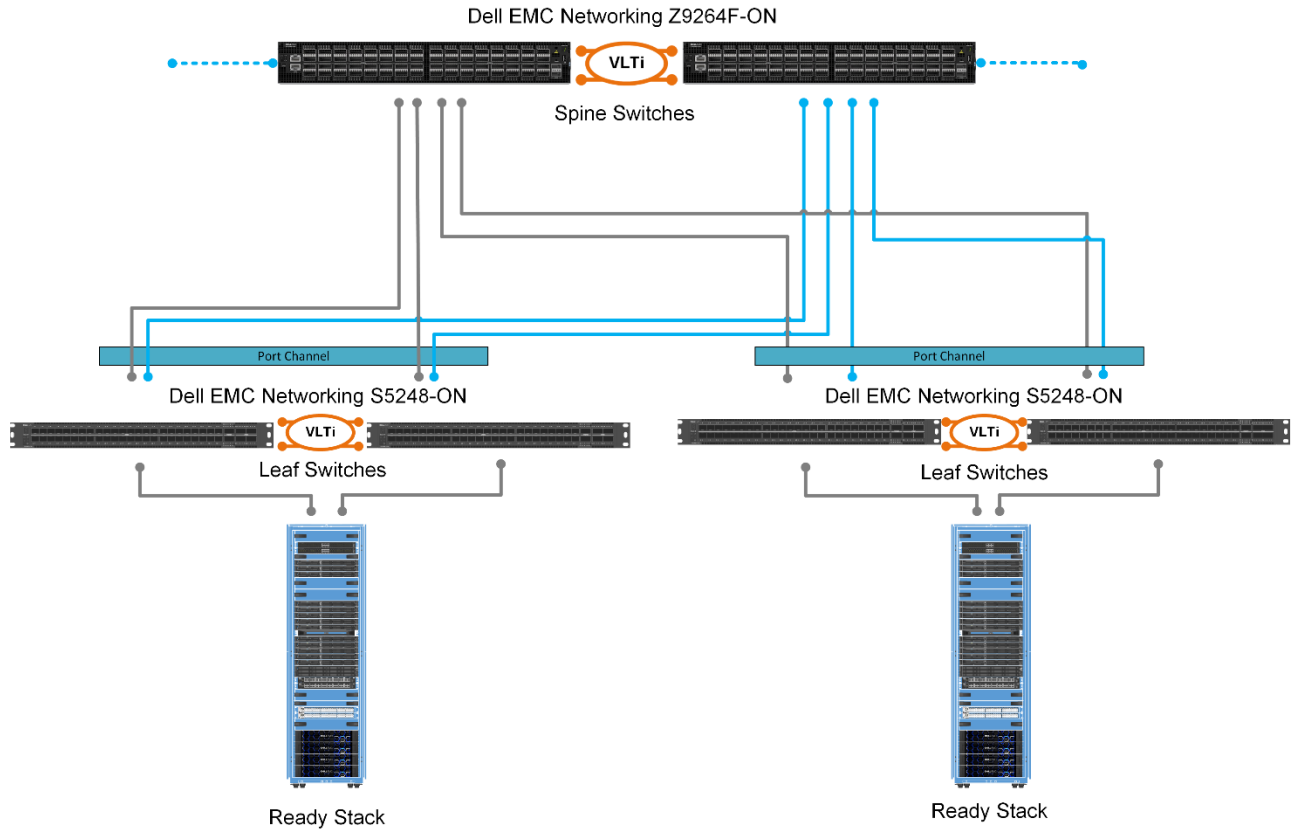


Figure 4. Multiple compute pods scaled out by using eVLT



## Chapter 4 Design

This chapter presents the following topics:

<b>Introduction</b> .....	<b>26</b>
<b>Compute design</b> .....	<b>26</b>
<b>Network design</b> .....	<b>27</b>
<b>Storage design</b> .....	<b>29</b>
<b>Management design</b> .....	<b>32</b>

## Introduction

This chapter summarizes the design of all the main components of a production Ready Stack, including the physical compute server hardware, network fabric, storage infrastructure, software layers, and ongoing management.

## Compute design

The latest Intel SP Skylake generation processors power Dell EMC Ready Stack. With up to 28 cores per CPU and clock speeds of up to 3.6 GHz in the PowerEdge rack servers, the processors reduce CPU socket-based licensing costs and provide greater VM density. Scaling compute resources with Intel Xeon scalable processors delivers a 27 percent increase in processing cores and a 50 percent increase in bandwidth over previous generations of Xeon processors.

The PowerEdge rack server platforms support the RDIMM and Load Reduced DIMM (LRDIMM) memory types. LRDIMM uses an internal buffer to isolate electrical loading from the host memory controller, enabling the use of quad-ranked DIMMs to increase overall memory capacity. For general-purpose virtualization solutions, we recommend 2,666 MT/s RDIMMs. You can configure memory in various modes from within the BIOS. To provide an optimized memory performance, the default Optimizer Mode works best for most virtualization use cases. Mirror Mode, Single Rank Spare Mode, and Multi Rank Spare Mode are available for improved reliability and resiliency.

The following table lists the recommended adapters.

**Table 5. Recommended network and HBA adapters**

Adapter	Purpose
Intel X710 quad-port 10 GbE Ethernet	Virtual workload and host communication
QLogic 2692 dual-port 16 Gb FC	FC SAN connectivity for PowerEdge servers in the workload domain that connect to Unity storage

PowerEdge servers support various BIOS configuration profiles that control the processor, memory, and other options. Dell EMC recommends that you:

- Enable the Performance Optimized virtualization profile.
- Disable the processor C States and C1E options to ensure the highest performance in a virtualized environment.
- Enable Intel Hyper-Threading and virtualization features.

### Compute server configuration

The Dell server platforms recommended for Ready Stack for VMware Cloud Foundation, Dell PowerEdge R640 and R740, are configured with specifications similar to their vSAN ReadyNode counterpart servers. If the Dell servers meet or exceed the specifications for their counterpart vSAN ReadyNode server model types, the use of vSAN ReadyNodes is not required. For specification details, see [Table 4, Sample configuration: Component specifications](#), on page 21.

## Network design

This section provides an overview of the network architecture, including compute and management server connectivity, and configuration details for the ToR and virtual switches.

### Dell EMC Open Networking

Open Networking is a core element of Dell EMC's networking strategy and mission. Open Networking disaggregates the hardware from the operating system, giving you the choice of picking the operating system that best fits your unique network infrastructure needs. Open Networking is achieved by using standards-based building blocks that use open source where possible.

The Open Network Install Environment (ONIE) is an open-source project within the Open Computer Project that provides an installation environment for bare-metal networking switches. ONIE also provides the option to install different network operating systems on a common set of networking hardware. ONIE is like any operating system boot loader for Windows or Linux and uses the same GRand Unified Bootloader (GRUB) structure that is commonly found in Linux distributions.

In the Dell EMC Networking portfolio, any switch model with an "-ON" suffix, such as the Dell EMC Networking Z9264F-ON and the Dell EMC Networking S5248-ON switches, has ONIE enabled.

For information about ONIE, see <http://onie.org/>.

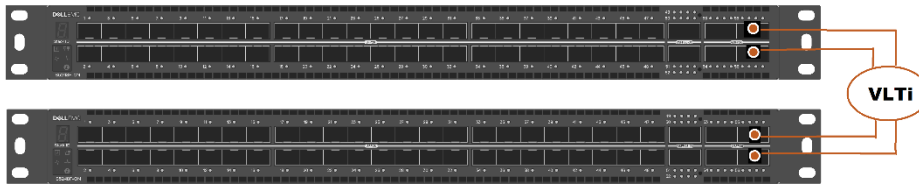
### Network traffic

The network architecture employs a VLT connection between the two ToR switches. The inherent redundancy of a non-VLT environment requires standby equipment, which increases infrastructure costs and risks. In a VLT environment, all paths are active, adding immediate value and throughput while protecting against hardware failures. VLT technology enables a server or bridge to uplink a physical trunk into more than one Networking S5248-ON switch by treating the uplink as one logical trunk. A VLT-connected pair of switches acts as a single switch to a connecting bridge or server. Both links from the bridge network can forward and receive traffic. VLT provides a replacement for Spanning Tree Protocol (STP)-based networks by using multiple active paths to provide both redundancy and full bandwidth utilization. The major benefits of VLT technology are:

- Dual control plane for highly available resilient network services
- Full utilization of the active LAG interfaces
- Active/active design for seamless operations during maintenance events

The Dell EMC Networking S5248-ON switches each provide six 40/100 GbE uplink ports. The VLT interconnect (VLTi) configuration in this architecture uses two 40/100 GbE ports from each ToR switch to provide a 200 GB data path between the switches.

The following figure illustrates the Networking S5248-ON VLTi configuration.



**Figure 5. Networking S5248-ON VLTi configuration**

**vSphere Distributed Switch configuration for LAN traffic**

The Dell EMC network switching infrastructure uses VMware NSX network virtualization, which is part of the VMware Cloud Foundation software infrastructure.

NSX technology enables the decoupling of network services from the physical infrastructure. Logical networks are created on top of a basic Layer 2 (switched) or Layer 3 (routed) physical infrastructure to decouple the physical and virtual environments. This decoupling enables agility and security in the virtual environment while allowing the physical environment to focus on throughput.

The NSX platform also provides for network services in the logical space, including switching, routing, firewalls, load balancing, and VPN services.

NSX provides:

- Simplified network service deployment, migration, and automation
- Reduced provisioning and deployment time
- Scalable multi-tenancy across one or more data centers
- Distributed routing and a distributed firewall at the hypervisor, to enable better east-to-west traffic flow and an enhanced security model
- Solutions for traditional networking problems, such as limited VLANs, MAC addresses, and FIB and ARP entries
- Normalization of underlying hardware, enabling easier hardware migration and interoperability

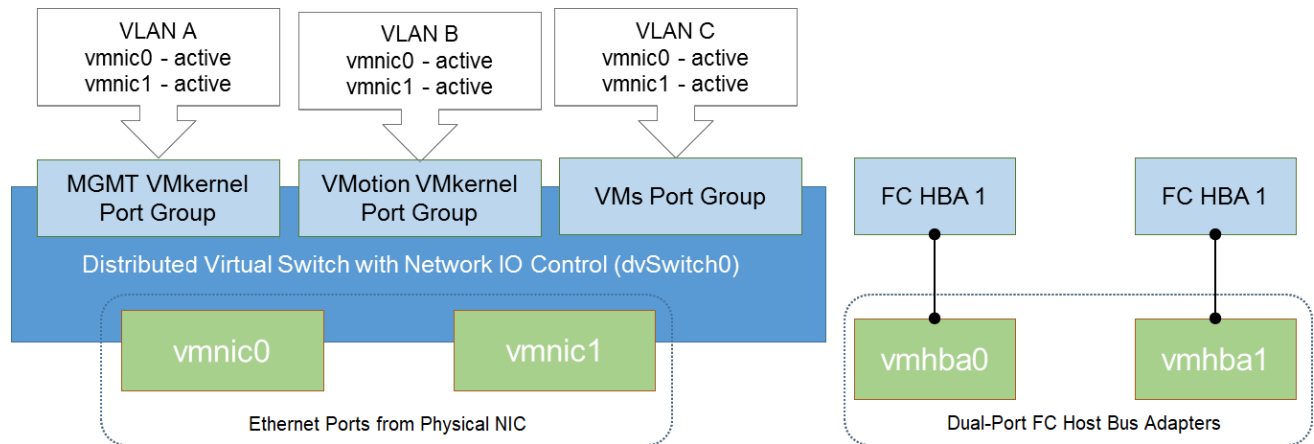
In addition, application requirements do not require modification to the physical network.

**vSphere Distributed Switch configuration for LAN traffic**

You can achieve bandwidth prioritization for different traffic classes such as host management, vSphere vMotion, and the VM network by using vSphere Distributed Switch (VDS). VDS, which can be configured, managed, and monitored from a central interface, provides:

- Simplified VM network configuration
- Enhanced network monitoring and troubleshooting capabilities
- Support for network bandwidth partitioning

The following figure shows the VDS configuration for the management and compute servers.



**Figure 6. vSphere Distributed Switch for dual-port configuration**

## Storage design

Ready Stack for VMware Cloud Foundation uses the Unity x50F storage platform that is integrated with vSphere and connected to a 32 Gb FC storage network. The Unity x50F platform is a flexible storage product that is designed for all-flash needs. Unity All Flash systems deliver consistent performance with fast response times and are ideal for mixed virtual workload requirements. Two Connectrix DS-6620B switches comprise the FC fabrics.

VMware Cloud Foundation enables you to deploy and manage the on-board vSAN-based storage. When you create a workload domain, SDDC Manager virtualizes the on-board storage resources of the PowerEdge servers and combines them into a single vSAN. The storage resources in this single vSAN can then be apportioned according to the needs of specific applications in the workload domain. After the workload domain is deployed, all ESXi hosts in the cluster share a single vSAN datastore.

Accordingly, VMware Cloud Foundation uses on-board storage for its management domain and for the workload domains on which applications are deployed. For secondary/ancillary storage, VMware Cloud Foundation supports either on-board storage or external storage. This guide describes using VMware Cloud Foundation with Unity storage arrays, but you can also use Dell EMC PowerMax arrays for external storage.

### Unity All Flash array models

The following table shows a comparison of the Unity x50F storage arrays that the Ready Stack supports. The Disk Processor Enclosure (DPE) contains up to 25 SSD drives and includes two storage processors. You can use additional drive enclosures to expand overall storage capacity.

**Table 6. Unity All Flash systems comparison**

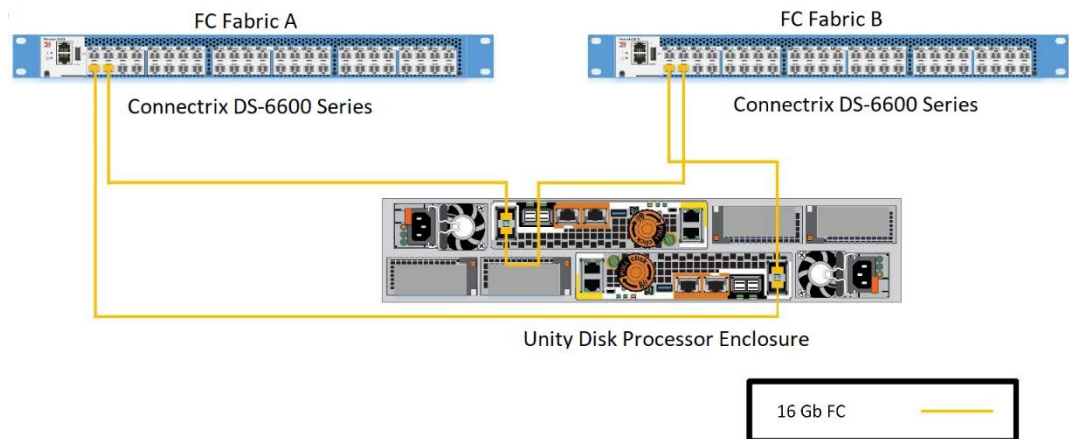
Component	Unity 350F	Unity 450F	Unity 550F	Unity 650F
Minimum/maximum drives	6/150	6/250	6/500	6/1000
Array enclosure	A 2U DPE with 25 x 2.5 in. drives			
Drive enclosure	All models support 2U 25-drive and 3U 80-drive trays for 2.5 in. drives			
RAID options	1/0, 5, 6			
SAS I/O ports per array	4 x embedded 4-lane* 12 Gb/s SAS	4 x embedded 4-lane 12 Gb/s SAS	4 x embedded 4-lane 12 Gb/s SAS	4 x embedded 4-lane 12 Gb/s SAS
			6 x 4-lane, or 2 x 4-lane with I/O module	6 x 4-lane, or 2 x 4-lane with I/O module
Host connectivity	4 embedded ports: 8/16 Gb FC, 10 Gb IP/iSCSI, or 1 Gb RJ45			
CNA ports per array	4 additional ports per I/O module			
Maximum raw capacity (drive type dependent)	2.4 PB	4.0 PB	8.0 PB	16.0 PB
IOPS (100% reads, 8K blocks)	Up to 130 K	Up to 305 K	Up to 395 K	Up to 440 K
I/O modules per array	Up to 4	Up to 4	Up to 4	Up to 4

\*PCIe lane. For more information, see the [Dell EMC Unity Hybrid Storage Specification Sheet](#).

**Storage fabric configuration**

Ready Stack for VMware Cloud Foundation is configured with two FC fabrics for high availability.

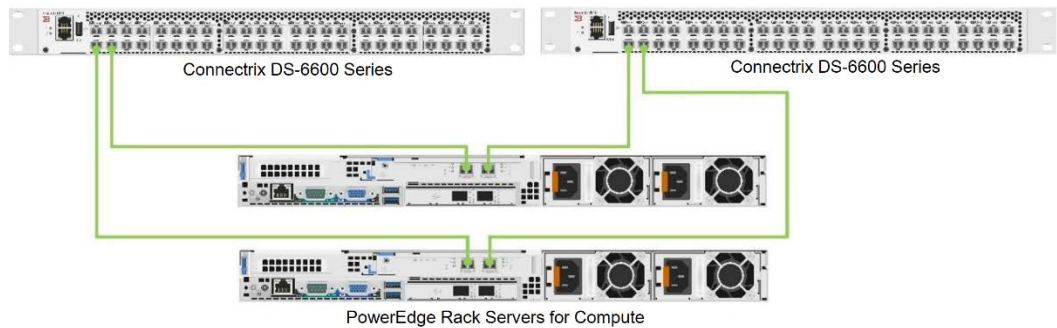
The following figure illustrates the storage fabric configuration. For the Unity x50F arrays, FC port 0 from each controller connects to the FC fabric switch A, while port 1 connects to FC fabric switch B. Unity x50F arrays have expansion slots (not shown in the following figure) that can provide additional front-end (FC) or back-end (mini-SAS HD) ports. For more information, see the [Dell EMC Unity Family Hardware Information Guide](#).



**Figure 7. Dell EMC Unity x50F storage fabric configuration**

## Storage connectivity for compute servers

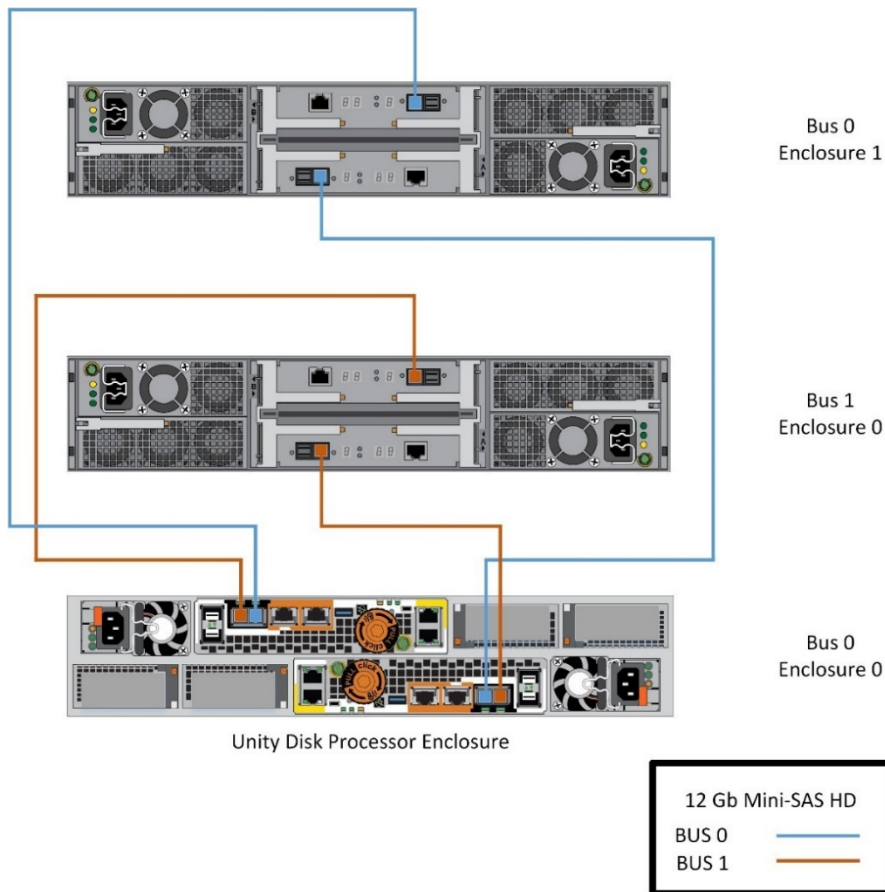
Each workload domain server that will have additional storage from the Unity array is configured with a QLogic 2692 dual-port FC adapter for connecting to the storage fabrics, with each port connecting to the Connectrix switch, as shown in the following figure.



**Figure 8. PowerEdge rack server SAN connectivity**

## Unity x50F enclosures

Unity x50F series storage arrays are equipped with two back-end buses that use mini-SAS HD connectivity, as shown in the following figure. Connect any additional enclosures so that the load is balanced equally between the available buses. Expansion slots on the Unity x50F arrays (not shown in the following figure) can provide additional front-end or back-end (mini-SAS HD) ports. The DPE is on bus 0. Therefore, the first expansion enclosure must be on bus 1 while the second expansion enclosure must be on bus 0, and so on.



**Figure 9. Dell EMC Unity x50F storage array back-end connectivity**

### Storage configuration

For both rack server platforms, each server's HBA port 1 connects to Connectrix switch 1, while HBA port 2 connects to Connectrix switch 2. These ports are then zoned with the Unity array target ports to enable storage access for the hypervisor hosts.

### Unity FC storage with VMware Cloud Foundation

For important considerations when using FC storage with VMware Cloud Foundation, see [VMware Cloud Foundation with FC storage](#) on page 17.

### Unity arrays and VMware vSphere

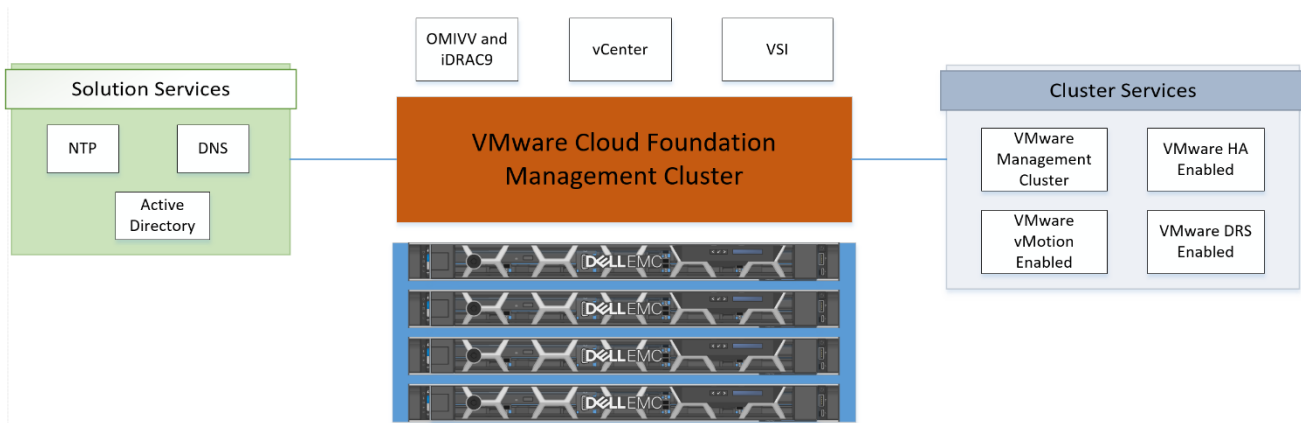
Unity All Flash systems support thin provisioning with VMware ESXi. For details about how to take advantage of thin provisioning and about using vSphere with Unity storage, see [Dell EMC Unity Storage with VMware vSphere](#) and [Dell EMC Unity: Best Practices Guide](#).

## Management design

### Management infrastructure

The management of this Ready Stack design centers around VMware Cloud Foundation management tools such as SDDC Manager and vCenter. Additional plug-ins such as Dell EMC OpenManage Integration for VMware vCenter (OMIVV) and iDRAC provide ease of management for the physical PowerEdge servers. Dell EMC Virtual Storage Integrator (VSI) provides ease of management for the Unity storage.

The following figure illustrates the management infrastructure.



**Figure 10. Management infrastructure**

### Management server

The management system consists of at least three PowerEdge R640 servers that are configured as the management domain within VMware Cloud Foundation. The management domain then deploys the VMs and provides ongoing life-cycle management through the SDDC Manager.



### VMware vCenter Server Appliance

vCenter Server Appliance 6.7 is a preconfigured Linux VM that is optimized for running vCenter Server and its associated services. The appliance package contains the following software:

- Project Photon OS 1.0
- PostgreSQL database
- vCenter Server 6.7 and vCenter Server 6.7 components
- VMware Platform Services Controller, which bundles all the necessary services for running vCenter Server, such as vCenter Single Sign On, vSphere License Service, and VMware Certificate Authority

vCenter Server provides management of virtualized hosts and VMs from a single console. It gives administrators visibility into the configuration of the critical components of a virtual infrastructure. vCenter Server enables key capabilities such as vSphere vMotion, vSphere Distributed Resource Scheduler (DRS), vSphere High Availability (HA), and vSphere Fault Tolerance (FT). The open plug-in architecture of vCenter Server supports a broad range of additional capabilities from VMware and its partners. The vCenter Server APIs also enable integration of physical and virtual management tools for maximum flexibility.

### Dell EMC Virtual Storage Integrator

VSI for VMware vSphere Web Client is a plug-in for VMware vCenter. It enables administrators to view, manage, and optimize storage for vSphere servers and hosts, and then map that storage to the hosts. VSI consists of a UI and the Dell EMC Solutions Integration Service (SIS), which provides communication and access to the storage systems.

Using the SIS, a storage administrator can enable VM administrators to perform management tasks on a set of storage pools. Tasks that you can perform with VSI include provisioning datastores, reclaiming space, and setting multipathing policies.

During installation, VSI automatically registers Dell EMC PowerPath/VE software, enabling you to set multipathing policies for all devices by using the VMware Native Multipathing Plug-in (NMP) or PowerPath/VE software. After VSI is installed, you can provision VMFS6 datastores in vCenter inventory lists in data centers, folders, clusters, and hosts. Additionally, using the space reclamation feature in VSI, you can reclaim unused storage on datastores, hosts, clusters, folders, and storage folders. Space reclamation tasks are created per datastore. Scheduling from the host, cluster, folder, or storage folder level results in one scheduled task per datastore under the target object. Only one scheduled reclamation task can exist for each datastore.

### Dell EMC OpenManage Integration for VMware vCenter

OMIVV streamlines the management processes in the data center environment by enabling the use of vCenter to manage the entire server infrastructure—both physical and virtual. OMIVV expands data center management with PowerEdge servers through many ways, including:

- Monitoring system-level information
- Producing system alerts
- Rolling out cluster-level BIOS and firmware updates for an ESXi cluster
- Supporting bare-metal deployments

OMIVV provides deep-level details for inventory, monitoring, and alerting of Dell EMC hosts within vCenter, and it recommends or performs vCenter actions based on Dell EMC hardware events.

Proactive HA is a feature of vSphere HA that works with OMIVV. Proactive HA safeguards workloads by proactively taking measures based on degradation of redundancy health of supported components in a host. When OMIVV detects a change in the redundancy health status of supported components, through either traps or polling, the health update notification for the component is sent to the vCenter server. Polling runs every hour, and it is available as a fail-safe mechanism to cover the possibility of a trap loss. After assessing the redundancy health status of the supported host components, the OMIVV appliance updates the vCenter server with the health status change.

Deployment templates contain a system profile, hardware profile, hypervisor profile, a combination of system profile and hypervisor profile, or a combination of the hardware profile and hypervisor profile. The OMIVV deployment wizard uses the template to provision server hardware and deploy hosts within vCenter. Dell EMC recommends using the system profile type for the servers that are described in this Ready Stack certified reference system. For Dell EMC Internal Dual SDM Module (IDSDM) deployment, enable the IDSDM from the BIOS before you deploy a hypervisor with OMIVV.

## Management software resources

The management software components run on VMs that reside in the management cluster. The following table shows the recommended VM sizing of the management components.

**Table 7. Recommended VM sizing of management components**

Component	Number of VMs	Number of CPU cores	RAM (GB)	Disk space (GB)	Number of NICs
vCenter Server Appliance	1	4	16	290	1
OMIVV	1	2	8	44	1
VSI	1	2	8	11	1

# Chapter 5 References

This chapter presents the following topics:

- Dell EMC documentation ..... 36**
- ONIE documentation ..... 36**
- VMware documentation ..... 36**

## Dell EMC documentation

The following Dell EMC documentation provides relevant information. Access to these documents depends on your login credentials. If you do not have access to a document, contact your Dell EMC representative.

- [\*Brocade Fabric OS Web Tools Administration Guide\*](#)
- [\*Dell EMC Connectrix DS-6600B Switches Specification Sheet\*](#)
- [\*Dell EMC Networking ONIE Quick Start Guide\*](#)
- [\*Dell Networking S-Series 25/40/50/100GbE switches \(with links to S5000 series spec sheets\)\*](#)
- [\*Dell EMC Networking Z9264F-ON Spec Sheet\*](#)
- [\*S5200F-ON Series Installation Guide\*](#)
- [\*Dell EMC PowerEdge R640 Installation and Service Manual\*](#)
- [\*Dell EMC PowerEdge R740 Installation and Service Manual\*](#)
- [\*Dell EMC Storage with VMware Cloud Foundation\*](#)
- [\*Dell EMC Unity: Best Practices Guide\*](#)
- [\*Dell EMC Unity: Dynamic Pools White Paper\*](#)
- [\*Dell EMC Unity Family Hardware Information Guide\*](#)
- [\*Dell EMC Unity Family Installation Guide\*](#)
- [\*Dell EMC Unity Hybrid Storage Specification Sheet\*](#)
- [\*Dell EMC Unity Storage with VMware vSphere\*](#)
- [\*Dell EMC Unity: Unisphere Overview White Paper\*](#)
- [\*Dell EMC Virtual Storage Integrator \(VSI\) for VMware vSphere Client Product Guide\*](#)
- [\*iDRAC9 Knowledge Base\*](#)
- [\*Dell EMC Integrated Data Protection Appliance \(IDPA\) DP4400 Data Sheet\*](#)
- [\*Integrated Data Protection Appliance \(IDPA\) DP4400 Spec Sheet\*](#)
- [\*Integrated Dell Remote Access Controller 9 User Guide\*](#)
- [\*OpenManage Integration for VMware vCenter Knowledge Base\*](#)

## ONIE documentation

For ONIE documentation, see the [Open Network Install Environment wiki](#).

## VMware documentation

The following VMware documentation provides information from VMware:

- [\*Correlating VMware Cloud Foundation version with the versions of its constituent products \(52520\)\*](#)
- [\*VMware Cloud Foundation Architecture and Deployment Guide\*](#)