Dell EMC Microsoft Storage Spaces Direct Ready Node

Deployment Guide for Hyper-Converged Infrastructure with Dell PowerEdge R730xd

DELL EMC

Notes, cautions, and warnings

NOTE: A NOTE indicates important information that helps you make better use of your product.

CAUTION: A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

WARNING: A WARNING indicates a potential for property damage, personal injury, or death.

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Contents

1 Audience and scope 5
Assumptions 5

2 Virtualization infrastructure with Dell EMC Ready Nodes overview 6
Dell PowerEdge R730xd 8
Dell Networking S4048-ON 10
Dell Networking S3048-ON 11
Windows Server 2016 11
Storage Spaces Direct 11
System Center Virtual Machine Manager 2016 11
System Center Operations Manager 2016 11

3 Integrating solution components 14

4 Virtualized infrastructure deployment by using Dell EMC Ready Nodes 18
Deployment prerequisites 18
Software versions 19
Dell EMC validated firmware matrix 19
Deployment checklist 19
Management environment checklist 19
Network configuration checklist 20
Host OS network checklist 21
Pre-deployment configuration 22
Network switch configuration 22
iDRAC configuration 27
BIOS configuration 32
OS RAID configuration 36
Firmware baselining 36
Hyper-converged infrastructure deployment 36
OS deployment 37
Install roles and features 37
Update Out of Box (OOB) drivers 38
Change host name 38
Configure firewall 38
VMM based cluster deployment and configuration 38
Manual cluster deployment and configuration 41
QoS Policy and RDMA configuration 45
Remove host management network from Live Migration 46
Update hardware timeout for Spaces port 47
Configuring cluster witness 47
Recommended next steps 47

5 Dell EMC Ready Nodes operations..... 48
Post deployment verification..... 48
Cluster Validation..... 48
Day 0 OS updates..... 48
Windows activation..... 49
Creating and managing virtual disks..... 49
Monitoring Storage Spaces Direct cluster in SCOM (optional)..... 49
Monitoring Storage Spaces Direct cluster..... 49
Optimizing Storage Spaces Direct 52
Performing PowerEdge server updates..... 53
Expand cluster..... 53
Adding server nodes and drives..... 53
Extending volumes..... 55
Performing cluster node recovery..... 55
OS Recovery using manual deployment..... 55
Factory OS using recovery media..... 55

6 Deployment services..... 57

7 Additional resources..... 58
A Sample switch configuration..... 59
B Firewall port requirements..... 68
C Sample deployment checklists..... 70
D VMM preparation..... 73
Create VMM host group..... 73
Add Run as account for cluster creation..... 73
VMM logical network details..... 74
Create and configure logical and VM networks..... 75
Create IP address pools..... 75
Create an uplink port profile..... 76
Create a logical switch..... 77

1

Audience and scope

This deployment guide focuses on deploying a hyper-converged infrastructure solution on Dell EMC Ready Nodes for Windows Server 2016 with Hyper-V and Storage Spaces Direct. This deployment guide includes an overview of the solution infrastructure, guidance to integrate the solution components, and instructions on preparing and deploying the solution infrastructure. This guide is applicable only to infrastructure built by using the validated and certified Dell EMC Ready Nodes for Windows Server 2016 with Hyper-V.

The audience for this document includes, but is not limited to, systems engineers, field consultants, partner engineering team members, and customers with a fair amount of knowledge in deploying hyper-converged infrastructures with Microsoft Windows Server 2016 Hyper-V and Storage Spaces Direct.

The virtualized infrastructure solution based on Dell EMC Ready Nodes as described in this guide can be deployed in two different ways.

- Manual OS deployment - A manual method of installation starting from OS deployment to cluster creation.
- Factory OS deployment - Dell EMC Ready Nodes can be ordered from the factory with Windows Server 2016 OS pre-installed.

Assumptions

This deployment guide makes certain assumptions about the necessary prerequisite knowledge of the deployment personnel. This includes the prerequisite knowledge of:

- Dell EMC PowerEdge Servers and deploying and configuring PowerEdge BIOS and iDRAC settings.
- Dell EMC Networking switches and concepts such as data center bridging and virtual link trunk
- Deploying and configuring Windows Server 2016 Hyper-V infrastructure
- Deploying and configuring System Center products such as SCOM, if the deployment involves onboarding Storage Spaces Direct cluster into the existing System Center

2

Virtualization infrastructure with Dell EMC Ready Nodes overview

Dell EMC Ready Nodes for Virtualization with Microsoft Hyper-V encompasses various configurations of Dell PowerEdge R730xd servers with Microsoft Storage Spaces Direct technology to power the primary compute cluster deployed as hyper-convereged infrastructure. This hyper-converged infrastructure built by using the Dell EMC Ready Nodes uses a flexible solution architecture rather than a fixed component design. The following figure illustrates one of the flexible solution architectures consisting of compute cluster along side the redundant top of rack switches, a separate out of band network, and an existing management infrastructure in the data center.

This hyper-converged virtualized solution based on Dell EMC Ready Nodes is available in both hybrid and all-flash configurations.

NOTE: At present, within the Hybrid configuration, the minimum number of nodes in a cluster is four and maximum is sixteen. For All-Flash configurations, the minimum and maximum number of nodes in a cluster is four.

For information about the Dell EMC Ready Nodes configurations with Microsoft Hyper-V, contact a Dell EMC sales representative. For more information on Dell EMC hyper-converged offerings, see dell.com/hyperconverged.

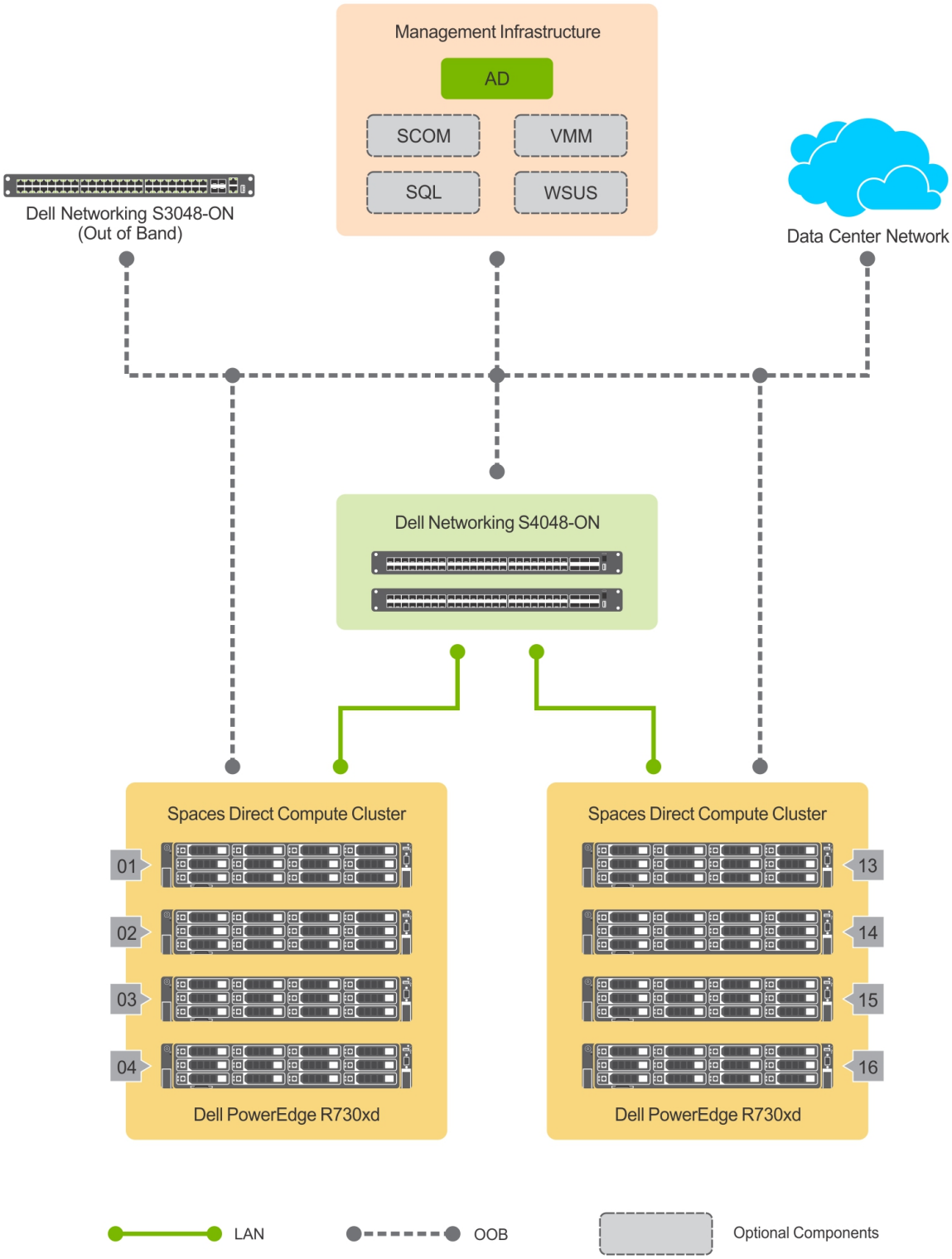

Figure 1. Hyper-converged virtualized solution using Dell EMC Ready Nodes

This Dell EMC Ready Nodes for Storage Spaces Direct with Microsoft Hyper-V does not include management infrastructure components such as a cluster for hosting management VMs and services such as Active Directory (AD), Domain Name Service (DNS), Windows Server Update Services (WSUS), and System Center components such as Virtual Machine Manager (VMM) and Operations Manager (OM).

Therefore, the instructions in this guide do not include deployment of any of these services and/or components and assume that at least an Active Directory domain controller is available in the existing management infrastructure.

The subsequent sections provide an overview of the hardware and software components in the virtualized solution based on Dell EMC Ready Nodes.

Topics:

- Dell PowerEdge R730xd
- Dell Networking S4048-ON
- Dell Networking S3048-ON
- Windows Server 2016
- System Center Virtual Machine Manager 2016
- System Center Operations Manager 2016

Dell PowerEdge R730xd

Dell PowerEdge R730xd, part of Dell's 13th generation of PowerEdge servers, is optimized for Hyper-Converged Infrastructure (HCI) deployments such as the architecture recommended in this deployment guide. With 2 CPU sockets and a wide range of CPU options, the R730xd also provides capabilities to match your computational needs.

This 2U rack mounted server provides high storage density with 12 - 3.5'' (front bay), 4 - 3.5'' (internal bay) and 2 - 2.5'' (flex bay) drive slots to help achieve storage needs in HCI. PowerEdge R730xd can also be configured by using a 2.5'' chassis form factor that supports up to 24 drives in the chassis.

The different HDD, SSD, and NVMe drive options available with PowerEdge R730xd server enable multiple hybrid and all-flash configurations for the Dell EMC Ready Nodes. See the *Dell EMC Ready Nodes for Microsoft Storage Spaces Direct with Hyper-V Solution Overview* for details on the validated configurations as part of the Dell EMC Ready Nodes.

NOTE: The PowerEdge 730xd system with 16-drive configuration is not supported in a solution with factory-installed OS.

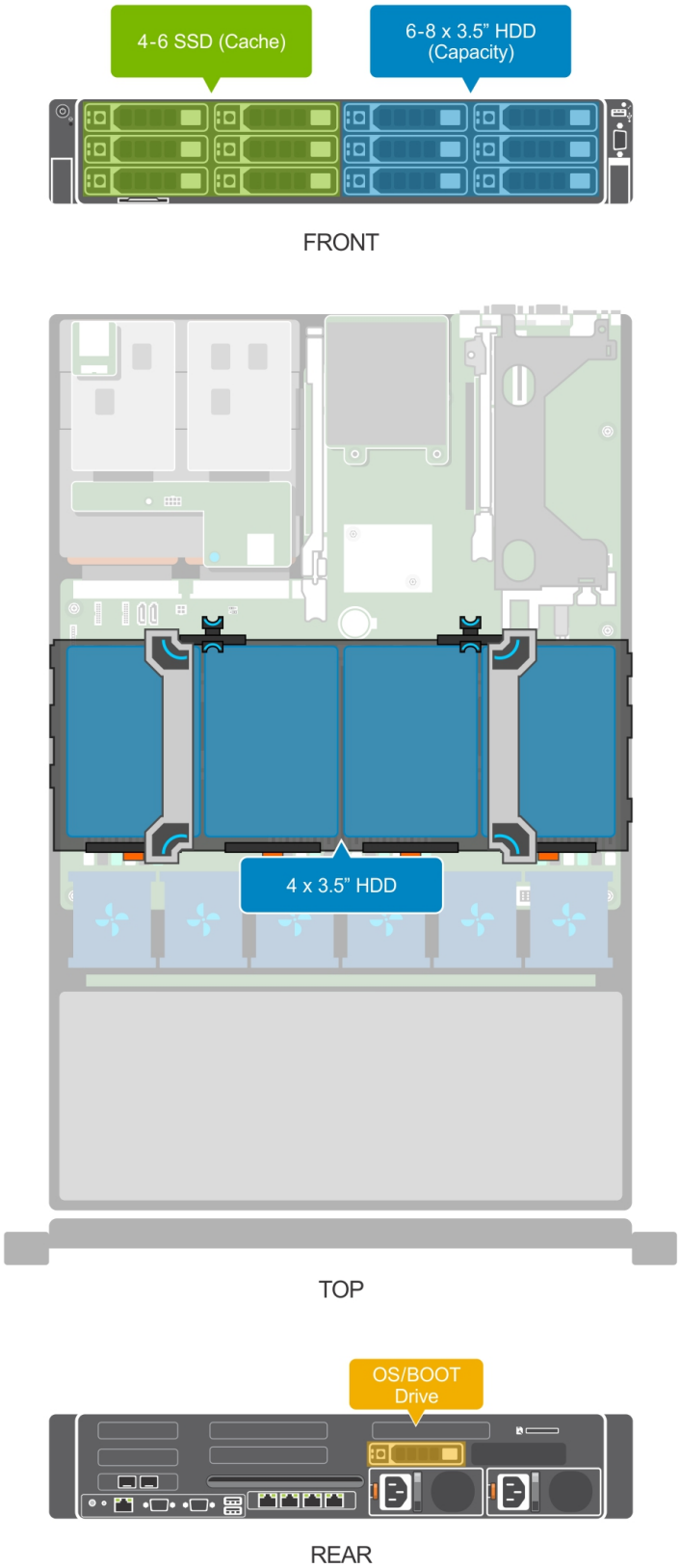

Figure 2. Disk configuration in a Dell EMC Ready Node based on PowerEdge R730xd with 16 drives

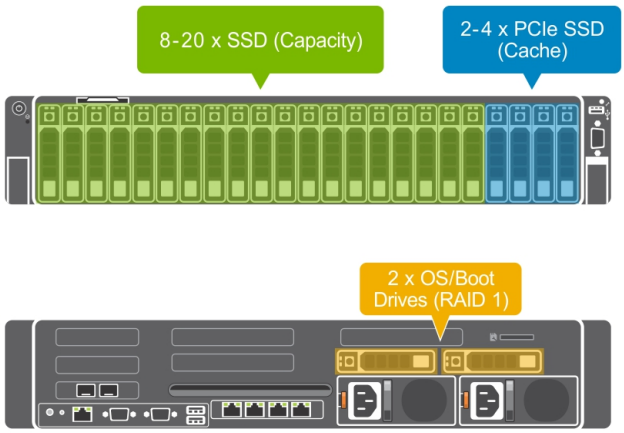

Figure 3. Disk configuration in a Dell EMC Ready Node based on PowerEdge R730xd with 24 drives

The following table provides an overview of the PowerEdge R730xd servers in the solution.

Table 1. System components

Compute Cluster Node	
Model	(4-16) PowerEdge R730xd
NIC	(1) Mellanox Connect-X 3 Pro Dual Port 10 GbE Add in card and (1) Intel i350 Quad Port 1 GbE NDC
Storage Adapter	HBA 330
Additional Storage Adapter (for 12 and 24-drive configurations)	PowerEdge RAID Controller H330
Boot Device	2.5-inch SSD in Flexbay
Drives	Hybrid and All-Flash Configurations (All-Flash limited to 4 nodes)
LAN Switch	(2) S4048
OOB Switch	(1) S3048

The network connectivity that uses Mellanox ConnectX-3 Pro in the server provides Remote Direct Memory Access (RDMA) for storage traffic. RDMA enables significantly increased throughput and lower latency by performing direct memory transfers between servers. Storage Spaces Direct uses SMB for all intra-node communication and uses RDMA with SMB Direct to enhance performance of the overall infrastructure. The RDMA configuration in Storage Spaces Direct based HCI requires Data Center Bridging (DCB) and Quality of Service (QoS) configured in the host operating system as well as the top of rack network fabric.

For more information on HCI configurations, see the Dell EMC Microsoft Storage Spaces Direct Ready Nodes Solution Brief.

Dell Networking S4048-ON

Dell Networking S4048-ON provides a 10 GbE and L2 and L3 capable network switch for storage, cluster, and client traffic. The redundant switch configuration shown in Figure 1 provides high availability (HA).

If you are connecting the nodes to two separate network switches and implementing switch embedded teaming (SET), both switches require access to all subnets so that failover can occur. DCB must be configured as it provides enhancements to the Ethernet protocol, which improves the functionality of data center networks. To take advantage of the Mellanox RDMA over Converged Ethernet (ROCE)

network adapters, Priority Flow Control (PFC) and Enhanced Transmission Selection (ETS) are required. PFC and ETS are configured on all nodes and all network switches interconnecting the nodes.

For a sample configuration of the Top-Of-Rack (TOR) switches with DCB and other required configuration, see section Sample Switch Configuration.

Dell Networking S3048-ON

Dell Networking S3048-ON is a 1000 BASE-T, L2 and L3 capable switch that provides 48 ports that support 10 MbE/100 MbE/1 GbE and four 10 GbE SFP+ uplinks. In this Ready Nodes configuration, S3048-ON is deployed to support the Out Of Band (OOB) connectivity between the PowerEdge R730xd servers and the Dell Networking S4048-ON switches.

Windows Server 2016

Windows Server 2016 is the latest server operating system offered by Microsoft. This operating system serves as the foundation for this entire deployment because every node uses Windows Server 2016 and its multiple capabilities.

For a list of new features and changes, see https://technet.microsoft.com/en-us/windows-server-docs/get-started/what-s-new-in-windows-server-2016

Storage Spaces Direct

One of the new features of Windows Server 2016 is Storage Spaces Direct. This new storage feature uses the local disks within the nodes to create highly available software defined storage.

There are two different deployment options possible for Storage Spaces Direct. In the first method, the storage and compute cluster are kept separate. This deployment option is known as converged or disaggregated deployment. This method allows for scaling of storage and compute clusters in a manner that is independent of each other. The second deployment option, known as hyper-converged deployment, enables running the virtualization services directly on top of the servers hosting storage spaces direct. This ensures that there is no need to configure and maintain file services separately in a different cluster and therefore reduces the need for additional physical servers.

This deployment guide focuses on the hyper-converged deployment option of the storage spaces direct. For more information about Storage Spaces Direct and these deployment options, see https://technet.microsoft.com/en-us/windows-server-docs/storage/storage-spaces/storage-spaces-direct-overview.

System Center Virtual Machine Manager 2016

Virtual Machine Manager serves as a central point of management for virtualization environments, cloud deployments and more. This deployment guide includes instructions on using VMM to deploy a host cluster and enabling Storage Spaces Direct.

For more information about VMM, see https://technet.microsoft.com/en-us/library/gg610610(v=sc.12).aspx

System Center Operations Manager 2016

System Center Operations Manager (SCOM) is an infrastructure monitoring tool which, among other things, helps manage alerts, warnings and other items through your environment.

Dell EMC Ready Nodes can be monitored using the operations manager management packs associated with the bare metal hardware and Storage Spaces Direct cluster. The cluster operations section in this guide describes how to deploy these management packs and configure monitoring for the bare metal nodes and the Storage Spaces Direct cluster performance monitoring.

For more information, see https://technet.microsoft.com/en-us/library/hh205987(v=sc.12).aspx.

This guide provides the deployment instructions for implementing the Storage Spaces Direct hyper-converged cluster built using the Dell EMC Ready Nodes. The following flowchart provides an overview of these instructions and the flow of deployment instructions.

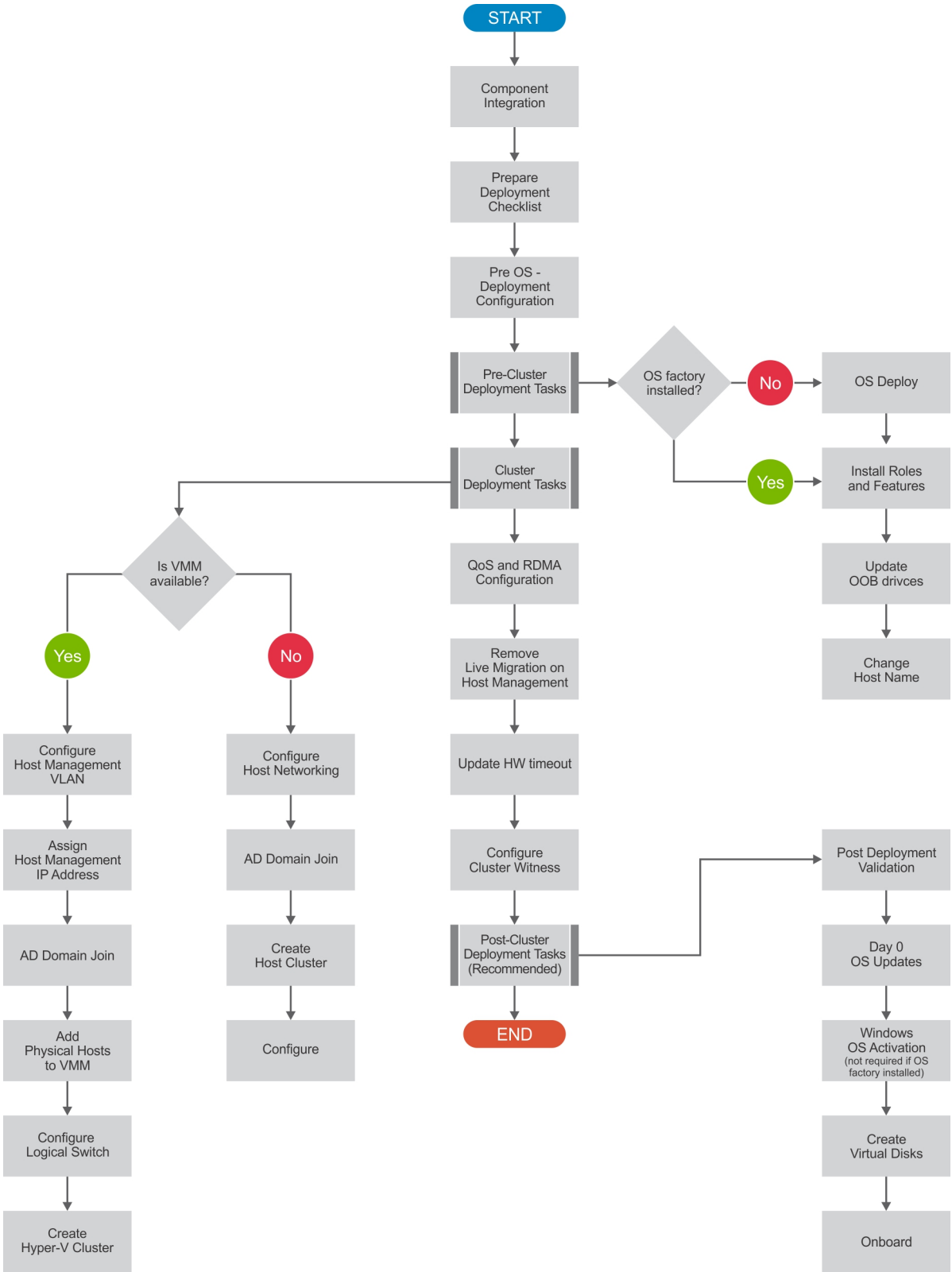

Figure 4. Deployment overview

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Integrating solution components

This section provides recommendations on server and network switch placement in the racks and port mapping on the TOR and OOB switches. The section on Network Architecture and Configuration provides details on configuring the TOR and OOB switches.

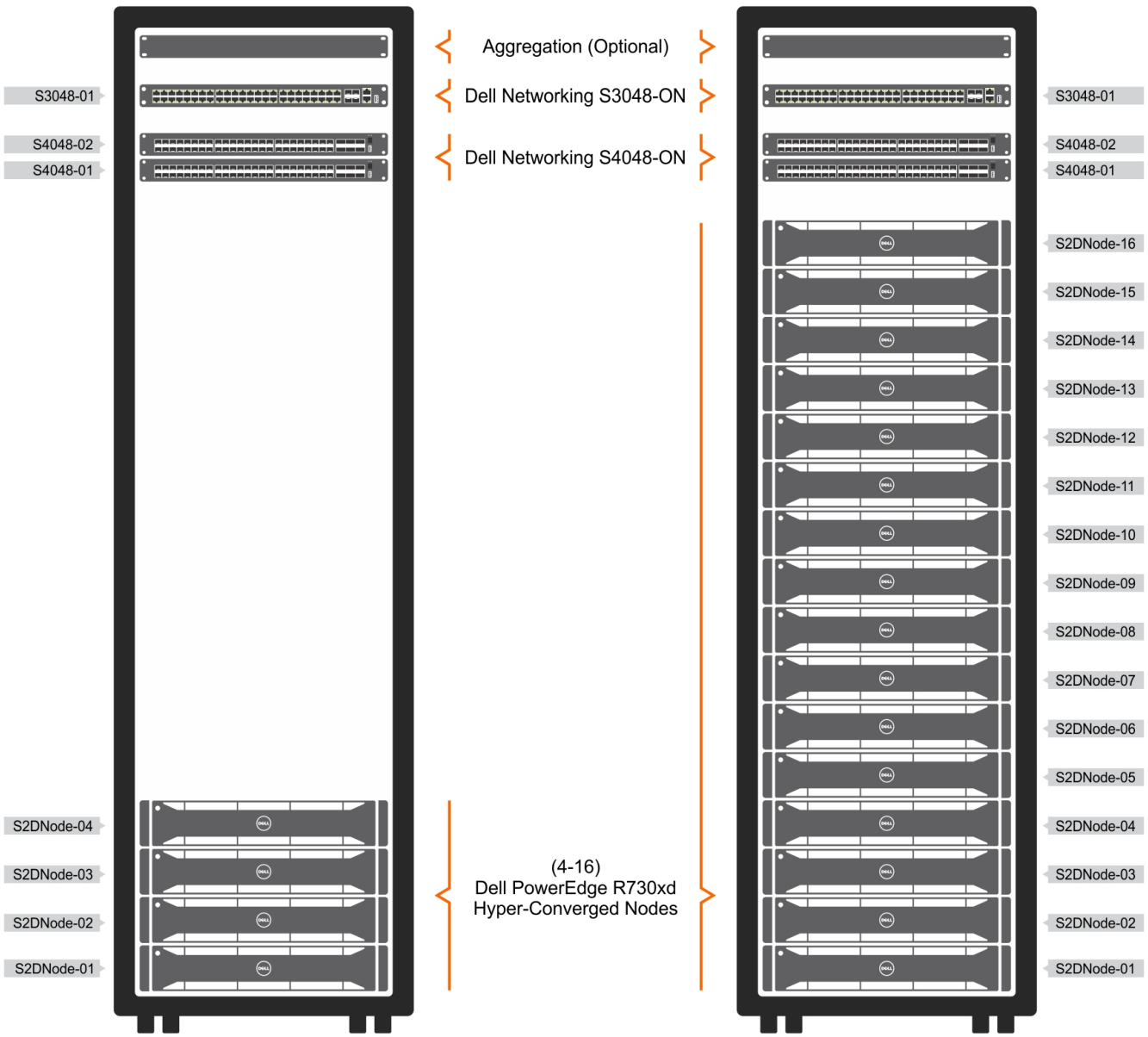

Figure 5. Rack elevation for the 4 node and 16 node HCI configurations

Each PowerEdge R730xd is configured with a Mellanox Connect X-3 Pro network adapter for host management and storage traffic. Each port from this network adapter on each server is connected to a different switch in the redundant top-of-rack network fabric.

Each PowerEdge R730xd server has a dedicated network connection from the Integrated Dell Remote Access Controller (iDRAC) to the Dell Networking S3048-ON switch configured for OOB management.

The following figure illustrates the connection.

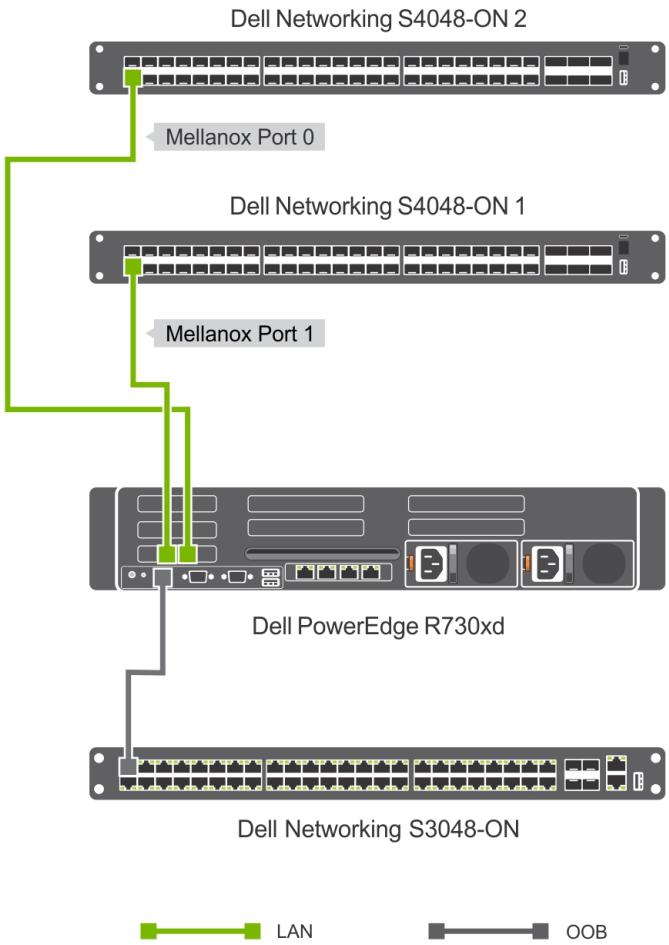

Figure 6. Mellanox and iDRAC connnection

To make network configuration easy to understand and consistent, it is recommended to follow a consistent mapping across the TOR and OOB switch. The following figures illustrate this mapping.

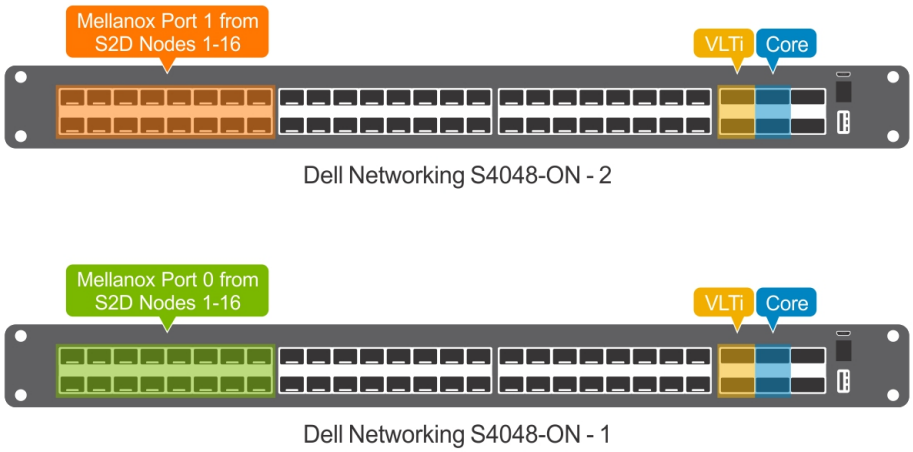

Figure 7. TOR port mapping for PowerEdge R730xd servers

As shown in the figure, port 0 and 1 of the Mellanox adapter from each server are mapped to ports 1-16 on TOR1 and TOR2 respectively. The 40 GbE ports, port 49 and 50 from each TOR are connected together in a Virtual Link Trunk (VLT) for inter-switch connectivity.

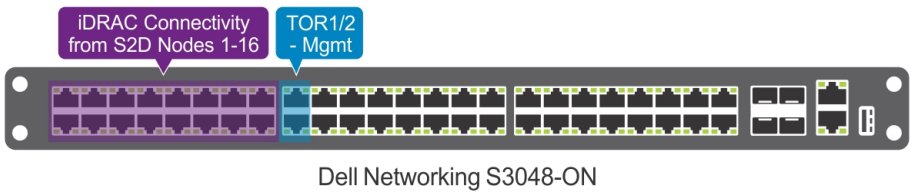

Figure 8. OOB port connectivity from PowerEdge R730xd and Dell Networking S4048-ON

In another optional deployment scenario for the OOB and TOR network fabric, the OOB switch can be uplinked to the TOR switches by using the 10 GbE ports. Doing so enables connectivity to the OOB interfaces of the cluster components through the TOR switch connections. The following figure illustrates this.

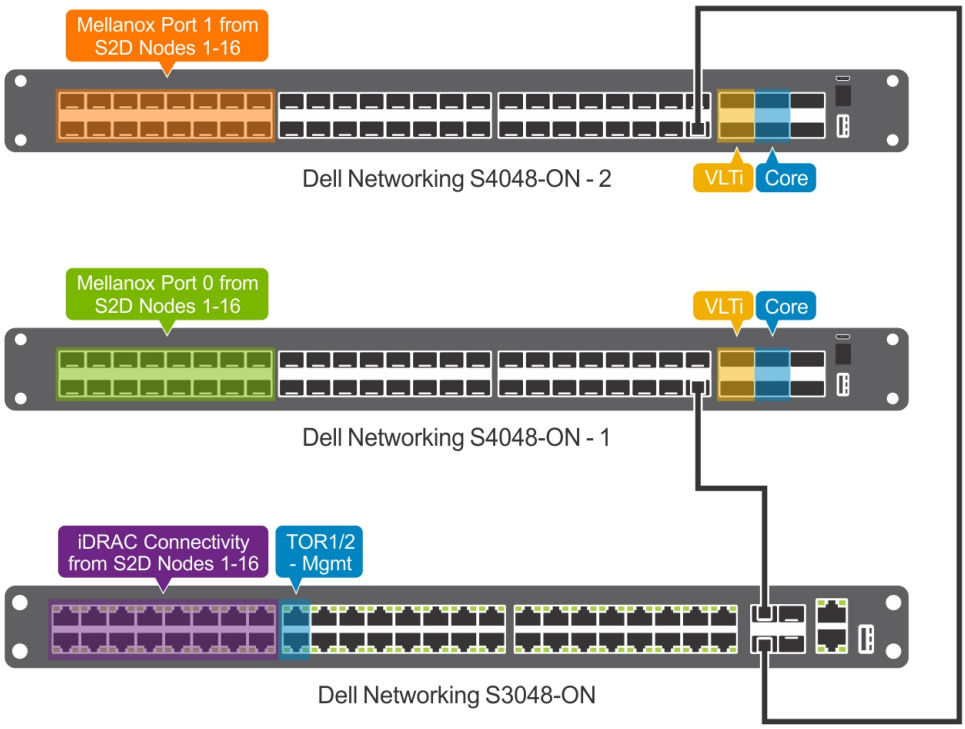

Figure 9. Network connectivity with Dell Networking S3048 (OOB Switch) connecting to Dell Networking S4048

4

Virtualized infrastructure deployment by using Dell EMC Ready Nodes

Dell EMC Ready Nodes for Virtualization described in this guide can be deployed in two different ways.

- Manual OS deployment - A manual method of installation starting from OS deployment to cluster creation.
- Factory OS deployment - Dell PowerEdge R730xd servers can be ordered from the factory with Windows Server 2016 OS pre-installed.

Each of the above mentioned methods have certain deployment prerequisites and pre-deployment configuration that need to be performed including the network switch configuration.

The subsequent sections of this guide describe the deployment prerequisites for each of these methods and also provide details on the supported software and firmware versions.

Topics:

- Deployment prerequisites
- Deployment checklist
- Pre-deployment configuration
- Hyper-converged infrastructure deployment
- Recommended next steps

Deployment prerequisites

This hyper-converged virtualized solution based on Dell EMC Ready Nodes deployment assumes that the management services required for the OS deployment and cluster configuration are present in the existing infrastructure where the Storage Spaces Direct cluster deployment is being done.

The following table describes different management services, their purpose, and applicablility in each of the deployment methods.

Table 2. Management services

Management Service	Purpose	Deployment - Required/Optional
Active Directory	User authentication	Required
Domain Name Service	Name resolution	Required
Windows Software Update Service (WSUS)	Provides local source for Windows Updates	Optional
MS SQL Server	Provides database backend for VMM and SCOM	Optional

System Center VMM	Provides virtualization host and VM management	Optional
System Center Operations Manager	Provides monitoring and reporting services for compute infrastructure	Optional

Software versions

The following table lists the software versions required for the Dell EMC Ready Nodes deployment. The software requirements, like the management services, vary between the deployment methods described above.

Table 3. Software versions

Components	Version
Operating System	Windows Server 2016 Data Center Core
Virtual Machine Manager (where applicable)	SCVMM 2016 with UR 2.1
Operations Manager (where applicable)	SCOM 2016 with UR 2
Active Directory Forest/domain functional level	Windows Server 2012 or above

Dell EMC validated firmware matrix

This Dell EMC Ready Nodes for Storage Spaces Direct is validated and certified with certain firmware versions related to the components in the solution infrastructure. This matrix identifies the Dell EMC validated versions of software and firmware and should be followed for ensuring that the solution infrastructure remains supported and delivers optimal performance.

This support matrix is available at http://en.community.dell.com/TECHCENTER/EXTRAS/M/WHITE_PAPERS/20443714 and gets updated when new revisions of the software and firmware are validated.

Deployment checklist

This section provides a checklist for configuration settings that need to be applied during pre-deployment configuration and deployment of operating system and other software configuration post OS deployment. For example, network switch configuration requires VLAN ID configuration and IP address space used with each VLAN.

Fill in the checklists provided in the subsequent sections before proceeding to the pre-deployment configuration.

The section Sample deployment checklists provides completed examples of these checklists for reference.

Management environment checklist

This Dell EMC Ready Nodes deployment is a brownfield deployment and therefore requires information such as active directory domain FQDN, DNS server addresses, and so on.

The following table captures the necessary inputs as a checklist.

Table 4. Management environment checklist

AD Domain FQDN	
Domain Administrator or equivalent credentials	
VMM Server FQDN (optional)	
VMM Administrator Credentials (Optional)	
DNS Server addresses	
SCOM Server FQDN (optional)	
SCOM Administrator Credentials (optional)	
WSUS Server FQDN (optional)	

Network configuration checklist

Before starting the deployment, identify the IP scope and VLAN information for various traffic classes in the solution infrastructure. The *minimum IP addresses needed* column in the following table can be used to identify the correct scope. The value shown in this column is based on the number of components that require the specified traffic class used in this solution. Ensure that the IP scope selected for the traffic class meets the minimum IP addresses requirement.

The IP Scope and VLAN ID information provided in the below table are only examples and you must choose these values based on existing data center architecture.

Consult with the customer network engineering team for VLAN ID and VLAN IP addresses applicable to your solution.

Table 5. Network configuration

Traffic Class	Purpose	Minimum IP addresses needed	VLAN ID	Tagged/ Untagged	IP address space	VLAN IP Addresses
Out of band	Required for OOB management of server nodes and TOR switches	19		Untagged	/27	
Host Management	Management of cluster and cluster nodes	17		Tagged	/26	TOR1: TOR2:
Storage 1	SMB traffic	16		Tagged	/27	TOR1: TOR2:
Storage 2	SMB Traffic	16		Tagged	/27	TOR1: TOR2:

TOR and OOB switch configuration may also require configuring settings such as hostnames, IP routes, DCB priority settings, and so on. The following table captures this as a checklist.

Table 6. Network configuration checklist

OOB Switch hostname	
TOR1 Switch hostname	
TOR2 Switch hostname	
Enable password	
Additional user/password	
IP route on OOB (if needed)	
IP route on TOR1 / TOR2 (if needed)	
DCB Bandwidth for SMB traffic	

Host OS network checklist

Dell EMC recommends to have consistent host naming and IP addressing across multiple nodes in the virtualized cluster deployment. The host OS network configuration includes naming for the virtual switches and adapters, and assigning host names and IP addresses.

The following table provides the checklist for capturing the host OS network switch and adapter details.

Table 7. Host OS network switch and adapter details

Virtual Switch/Logical Switch Name	
Management Adapter/ Logical & VM Network Name	
Storage 1 Adapter/ Logical and VM Network Name	
Storage 2 Adapter/ Logical and VM Network Name	
Uplink Port Profile Name (VMM Only)	
Management IP Pool range (VMM only)	
Storage1 IP pool range (VMM only)	
Storage2 IP pool range (VMM only)	

For the host OS configuration in any deployment method, static IP address assignment is recommended for all networks. The following table provides the checklist for capturing the details of the host OS network switch and adapter.

Table 8. Host OS network checklist

	Host Name	Management IP	Storage1 IP	Storage2 IP	OOB IP	OOB Host name
Node 1						
Node 2						
Node 3						
Node 4						
Node 5						
Node 6						
Node 7						
Node 8						
Node 9						
Node 10						
Node 11						
Node 12						
Node 13						
Node 14						
Node 15						
Node 16						

Pre-deployment configuration

This section describes the pre-deployment configuration that must be performed before deploying the hyper-converged virtualized solution based on Dell EMC Ready Nodes.

Network switch configuration

When considering the hyper-converged network topology of the Storage Spaces Direct solution, network resiliency is a critical option that is achieved from both a physical and logical standpoint. The Illustrations below are examples of the Dell EMC/Microsoft network design.

NOTE: Management network redundancy is a combination of either iDRAC or OS DNS/IP resolution.

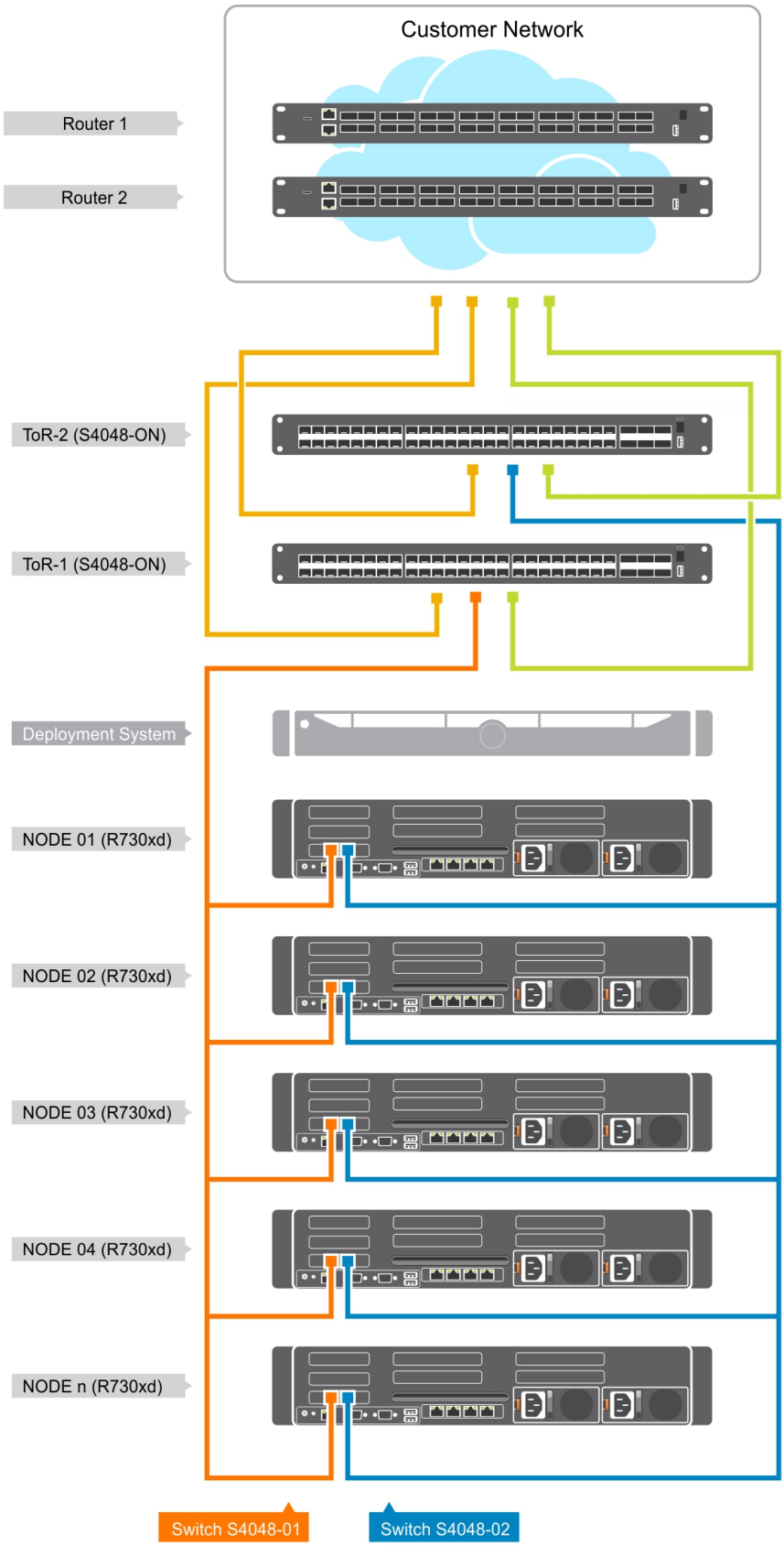

Figure 10. Management connectivity

Dell EMC recommends deploying a network topology that supports a dual control plane while sharing a single Data plane. The Dell EMC proprietary technology is referred to as Virtual Link Trunk (VLT). This technology provides network resiliency for data I/O.

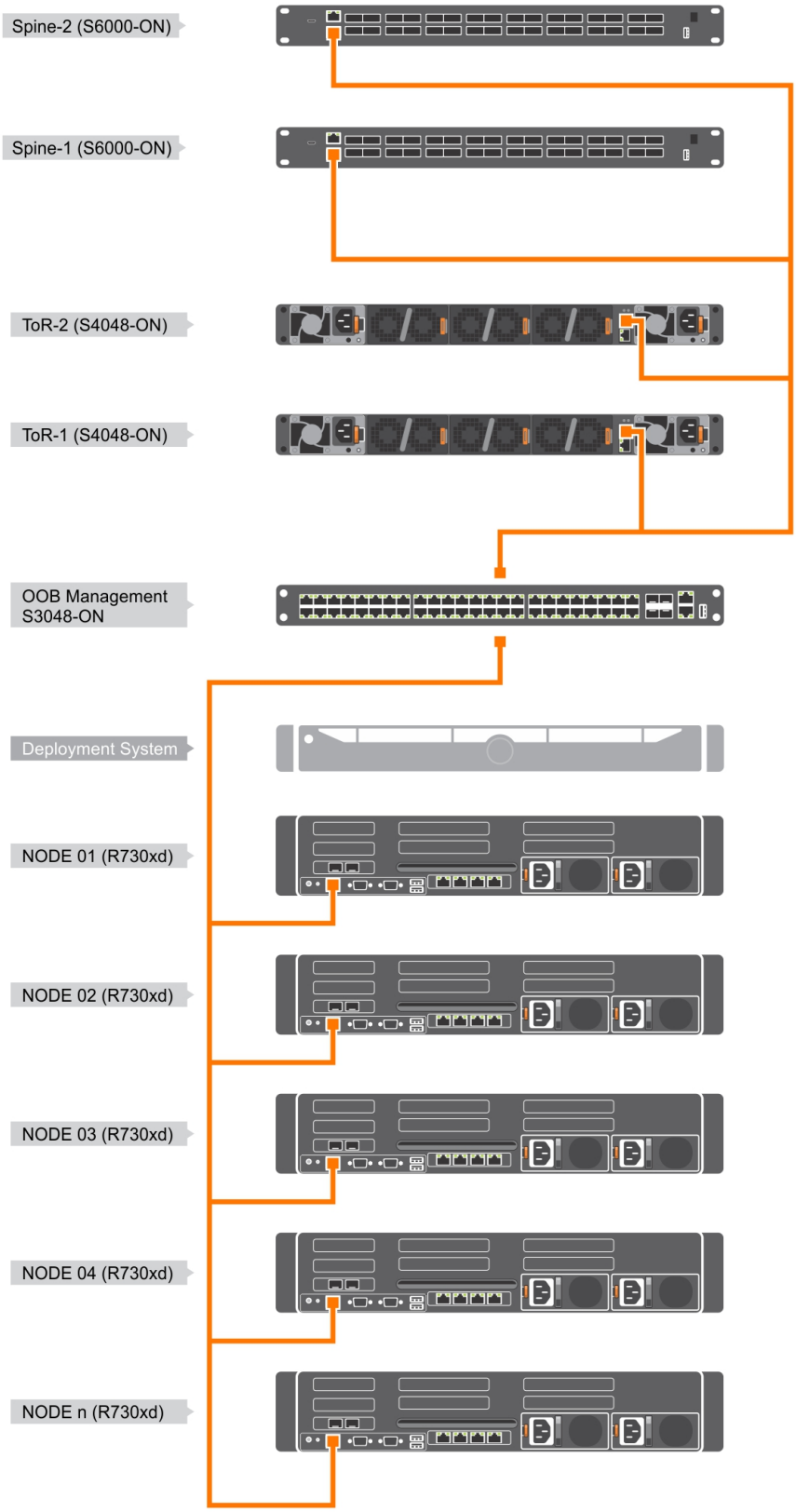

Figure 11. Network connectivity

Table 9. VLT interconnect (VLTi) link example config

Switch 01	Switch 02
interface range fortyGigE 1/49-1/50 no ip address dcb-policy buffer-threshold RDMA dcb-map RDMA no shutdown ! interface Port-channel 100 description VLTi-ToR2 no ip address channel-member fortyGigE 1/49,1/50 no shutdown !	interface range fortyGigE 1/49-1/50 no ip address dcb-policy buffer-threshold RDMA dcb-map RDMA no shutdown ! interface Port-channel 100 description VLTi-ToR2 no ip address channel-member fortyGigE 1/49,1/50 no shutdown !

Table 10. VLT Heart-beat

Switch 01	Switch 02
interface ManagementEthernet 1/1 ip address 172.18.200.1/30 no shutdown !	interface ManagementEthernet 1/1 ip address 172.18.200.2/30 no shutdown !

Table 11. VLT Domain example configuration

Switch 01	Switch 02
vlt domain 1 peer-link port-channel 100 back-up destination 172.18.200.2 primary-priority 1 system mac-address f4:8e:38:51:DE:11 unit-id 0 !	vlt domain 1 peer-link port-channel 100 back-up destination 172.18.200.1 primary-priority 1 system mac-address f4:8e:38:51:DE:11 unit-id 1 !

There are five basic networks needed for a standard Storage Spaces Direct deployment—Switch Management, OOB Management, Host Management, Storage1 and Storage2.

Storage typically has two fault domains, referenced here as DataCenter 1 & 2. Additionally, as the solution deploys RDMA for storage, DCB mapping is required. Listed below is an example RDMA mapping configuration which is common to both VLT Switches.

Table 12. Solution Network VLANs

VLAN NETWORK TYPE	MINIMAL NETWORK MASK	HOST IP ADDRESSES	VLAN ID TAG/UNTAG
Out of band Management	/27 (255.255.255.224)	19	Untagged
Host Management	/26 (255.255.255.192)	62	Tagged
Storage 1(Fault Domain 1)	/27 (255.255.255.224)	30	Tagged

Storage 2(Fault Domain 2)	/27 (255.255.255.224)	30	Tagged

Table 13. RDMA Profile Map with associated RDMA interface configurations

Switch 01	Switch 02
dcb-map RDMA priority-group 0 bandwidth 50 pfc off priority-group 3 bandwidth 50 pfc on priority-pgid 0 0 0 3 0 0 0 0 ! interface TenGigabitEthernet 1/1 description NODE01:NDC1 no ip address mtu 9216 portmode hybrid switchport spanning-tree rstp edge-port bpduguard spanning-tree 0 portfast dcb-policy buffer-threshold RDMA dcb-map RDMA no shutdown	dcb-map RDMA priority-group 0 bandwidth 50 pfc off priority-group 3 bandwidth 50 pfc on priority-pgid 0 0 0 3 0 0 0 0 ! interface TenGigabitEthernet 1/1 description NODE01:NDC2 no ip address mtu 9216 portmode hybrid switchport spanning-tree rstp edge-port bpduguard spanning-tree 0 portfast dcb-policy buffer-threshold RDMA dcb-map RDMA no shutdown

When configuring switch VLT redundant technology, VRRP provides a virtual floating IP address that any node can reference as a Gateway. If any one switch fails, the virtual IP is transferred to the peer switch.

```
S2DR7-S4048.01#show run int vlan 70
!
interface Vlan 70
 description SERVER_MGMT
 ip address 10.128.24.253/26
 tagged TenGigabitEthernet 1/1-1/17,1/45
!
 vrrp-group 70
  description DOT1.GATEWAY
  virtual-address 10.128.24.193
 no shutdown
S2DR7-S4048.01#
```

For a sample configuration of OOB and TOR switches, see section Sample Switch Configuration.

iDRAC configuration

The integrated Dell Remote Access Controller (iDRAC) in Dell PowerEdge servers can be configured to obtain an IP address from DHCP or can be assigned a static IP address. When the OOB network in the environment does not provide DHCP IP addresses, an IPv4 address must be statically configured on each iDRAC network interface manually. This can be done by accessing the physical server console by using KVM and/or other means.

Perform the following steps to configure the IPv4 address for iDRAC. This method can be used for configuring any additional BIOS settings.

1 Press F2 during the system boot.

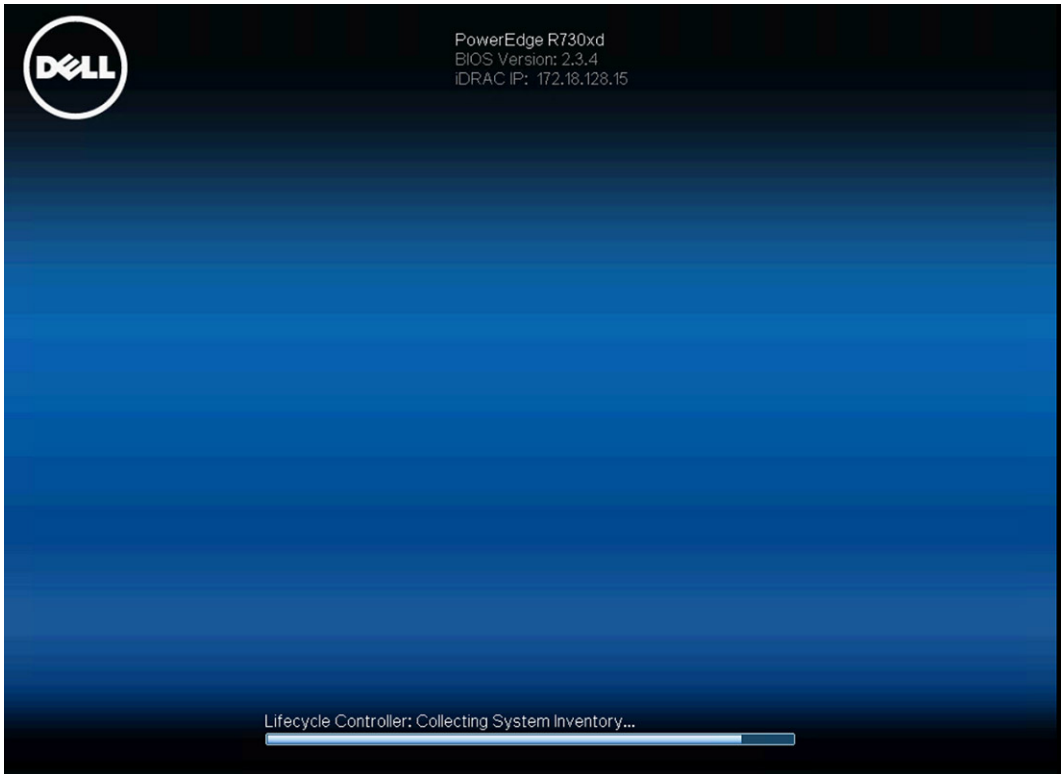

Figure 12. Enter iDRAC

2 Select **iDRAC Settings**.

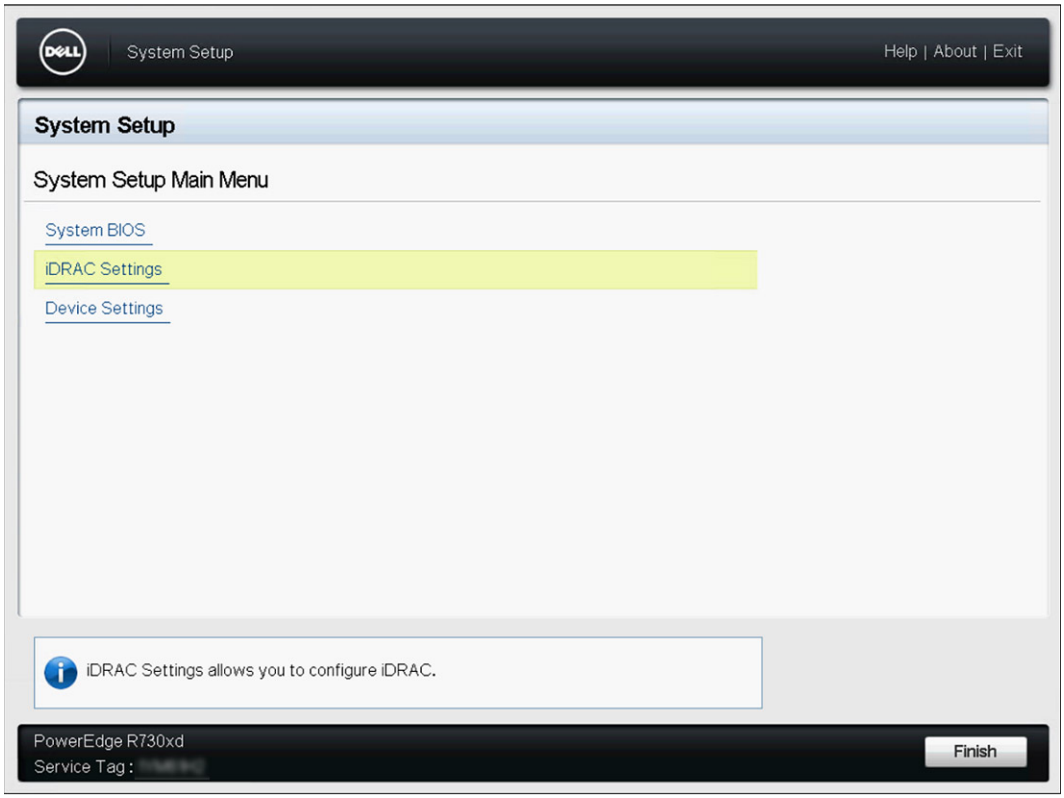

Figure 13. System Setup Main Menu

3 Select **Network**.

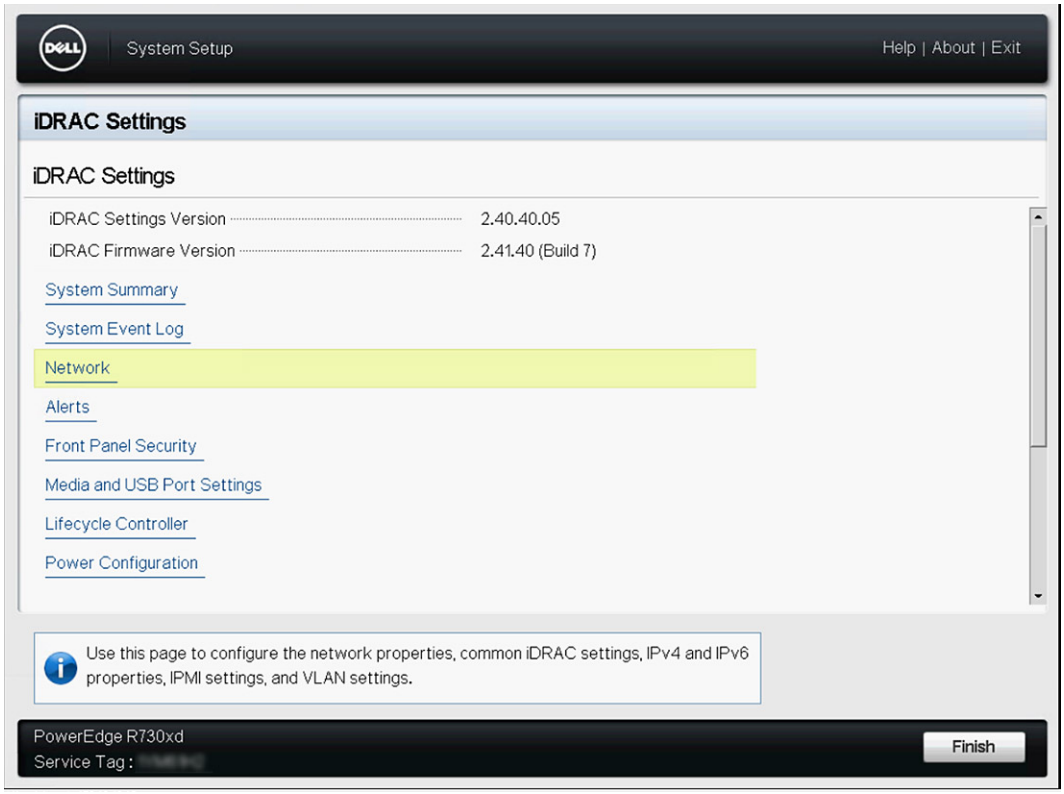

Figure 14. iDRAC Settings

4 In IPV4 Settings, against Enable IPv4, select **Enabled**.

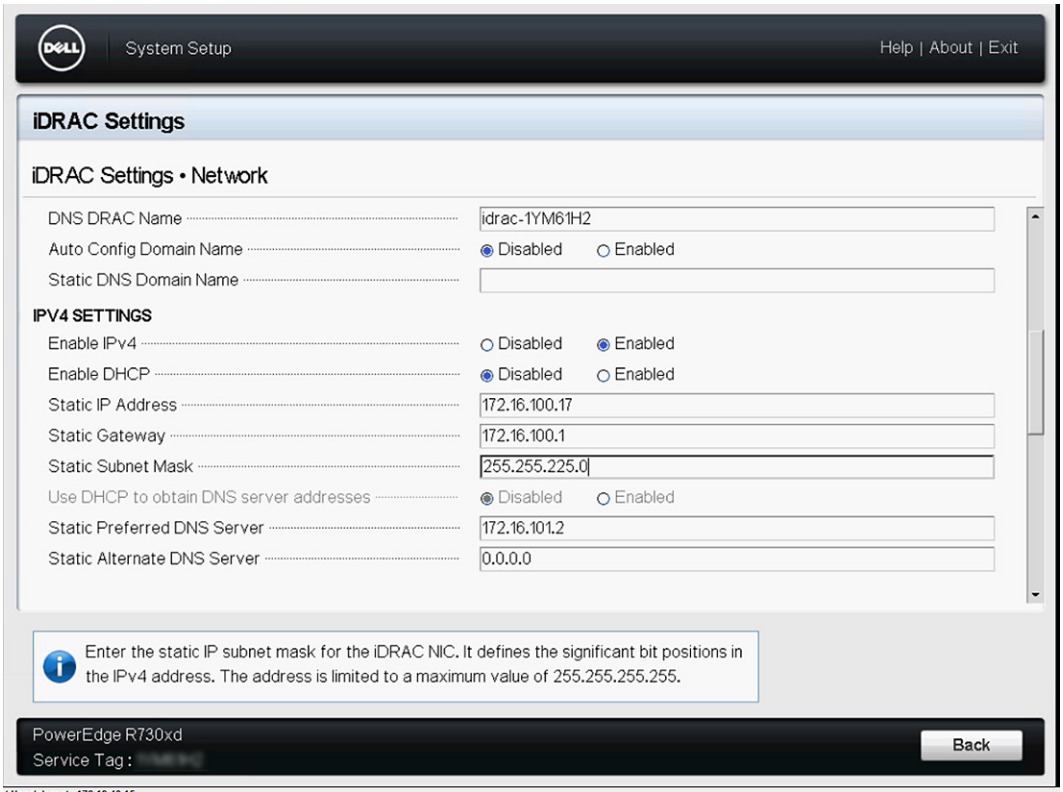

Figure 15. IPv4 Settings

5 Click **Back** and **Finish** to return to the System Setup page.

The following table lists the recommended configuration settings for the iDRAC and their default values. Ensure that these settings are present on every Dell EMC Ready Node's iDRAC configuration.

Table 14. iDRAC Configuration

Network		
Network Settings		
Enable NIC	Enable	Default value
NIC Selection	Dedicated	Default value
Common Settings		
DNS DRAC Name	**iDRAC IP Configuration*	Setting needs to be changed
IPv4 Settings		
Enable DHCP	Disabled	Default value
Static IP Address	**iDRAC IP Configuration*	Setting needs to be changed
Static Gateway	**iDRAC IP Configuration*	Setting needs to be changed
Static Subnet Mask	**iDRAC IP Configuration*	Setting needs to be changed
IPMI Settings		
Enable IPMI Over LAN	Enabled	Setting needs to be changed
User Configuration		

User Name	root	Default value
Change Password	calvin	Default value
Re-enter Password	calvin	Default value
Power Configuration		
Power Supply Policy		
Redundancy Policy	Input Power Redundant	Default value
Hot Spare		
Enable Hot Spare	Enabled	Setting needs to be changed
Primary Power Supply Unit	PSU1	Setting needs to be changed

BIOS configuration

The following table provides a list of BIOS settings that need to be configured on PowerEdge R730xd servers:

Table 15. BIOS configuration settings

Section Setting		**Value**	
System BIOS	**Processor Settings**		
	Virtualization Technology	Enabled	Default value
	Logical Processor	Enabled	Default value
	Boot Settings		
	Boot Mode	UEFI	Setting needs to be changed
	Boot Sequence Retry	Enabled	Default value
	UEFI Boot Settings		
	UEFI Boot Sequence	1.Integrated Storage Controller 1: Windows Boot Manager	Setting needs to be changed
	Integrated Devices		
	SR-IOV Global Engine	Enabled	Setting needs to be changed
	System Profile Settings		
	System Profile	Performance	Setting needs to be changed
	System Security		
	Secure Boot	Enabled	Setting needs to be changed
	Secure Boot Policy	Standard	Default value

1 Press F2 during system boot to enter system setup.

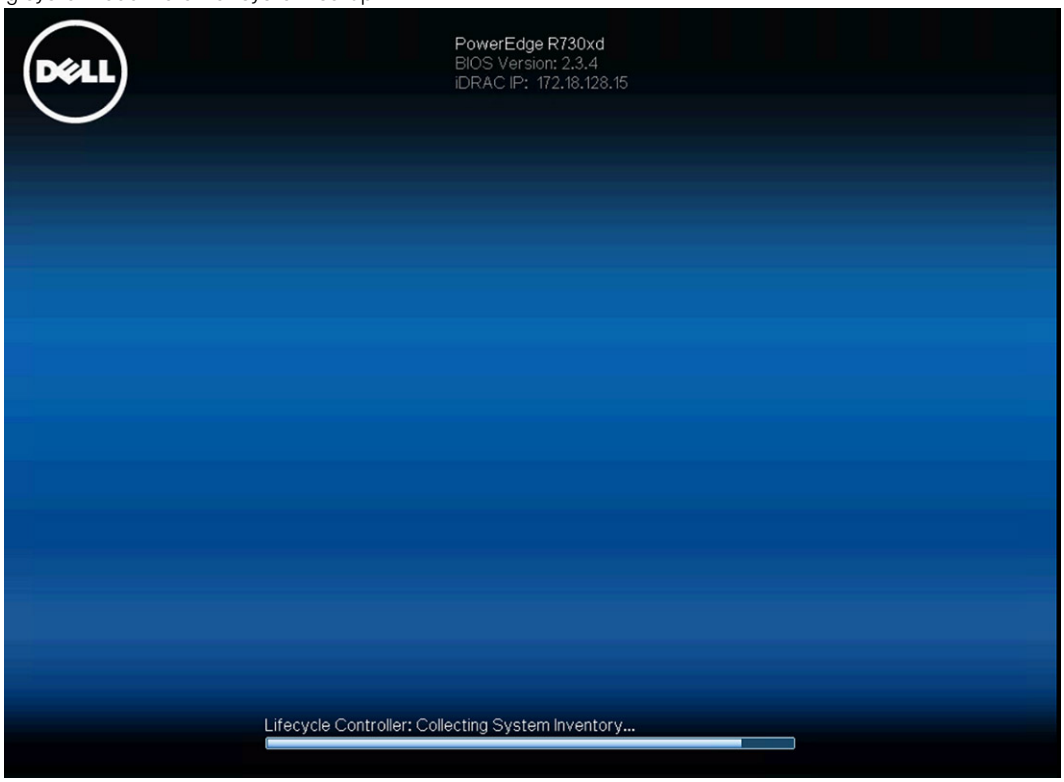

Figure 16. System Setup

2 Click System BIOS and make changes as shown in the BIOS Configuration Settings table.

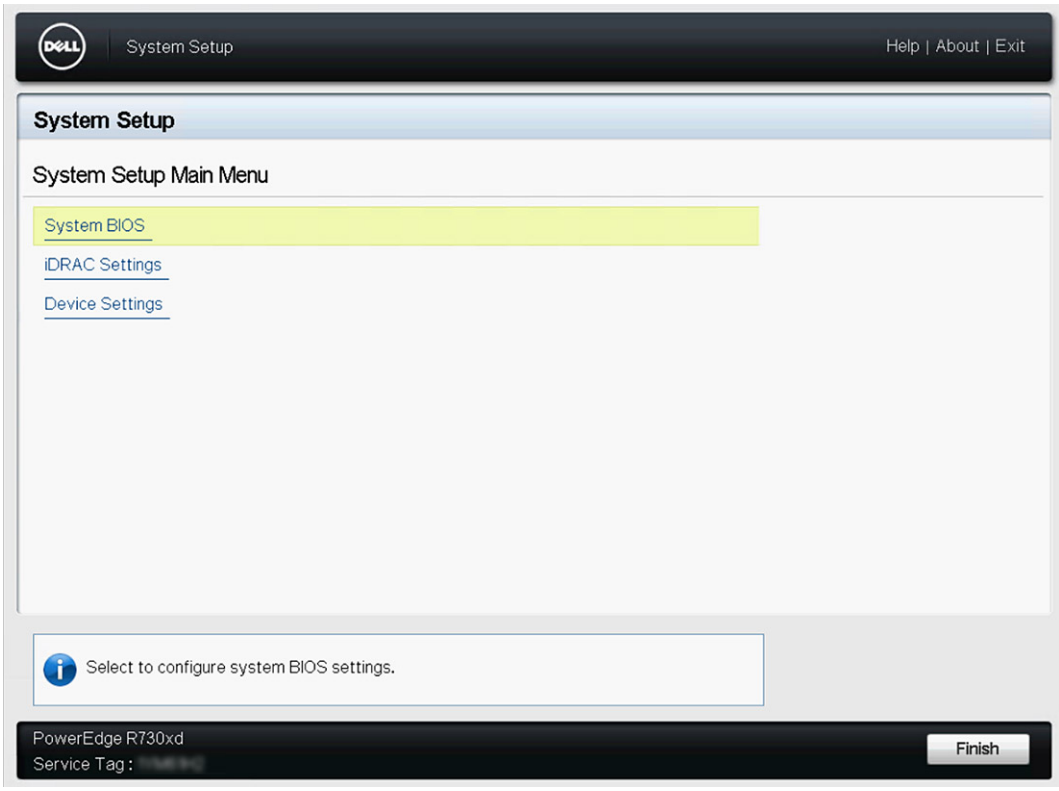

Figure 17. System Setup Main Menu

3 Update the Processor settings as shown in the example below.

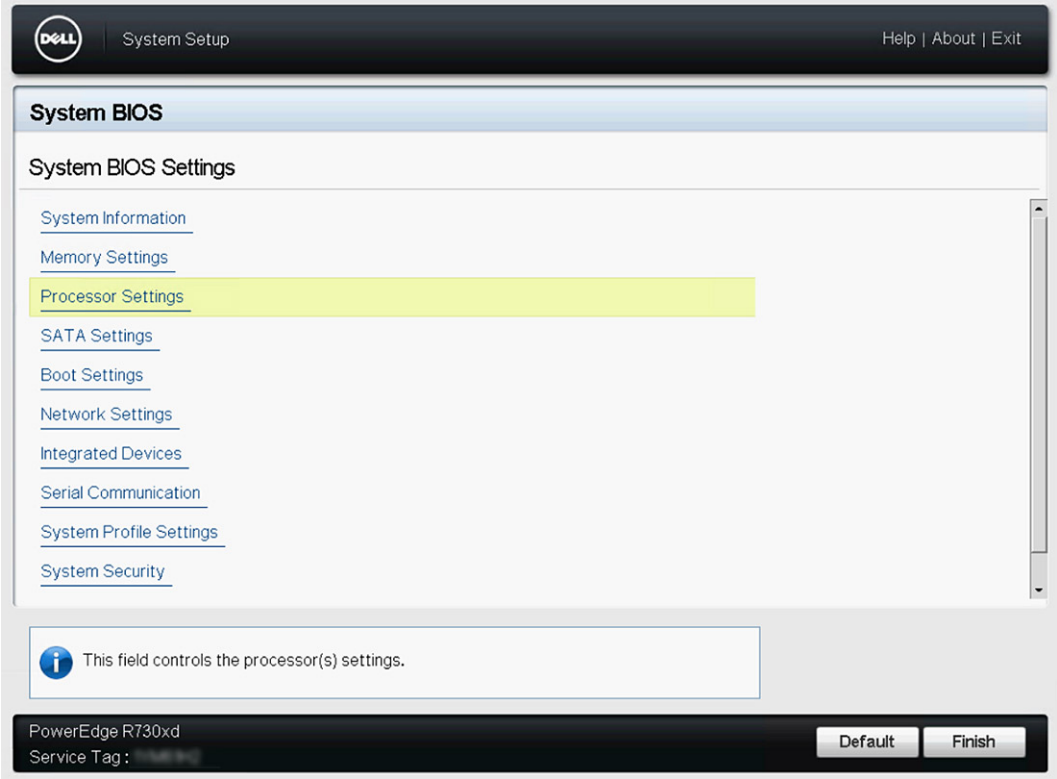

Figure 18. Processor Settings

4 Set the Virtualization Technology option to **Enabled**.

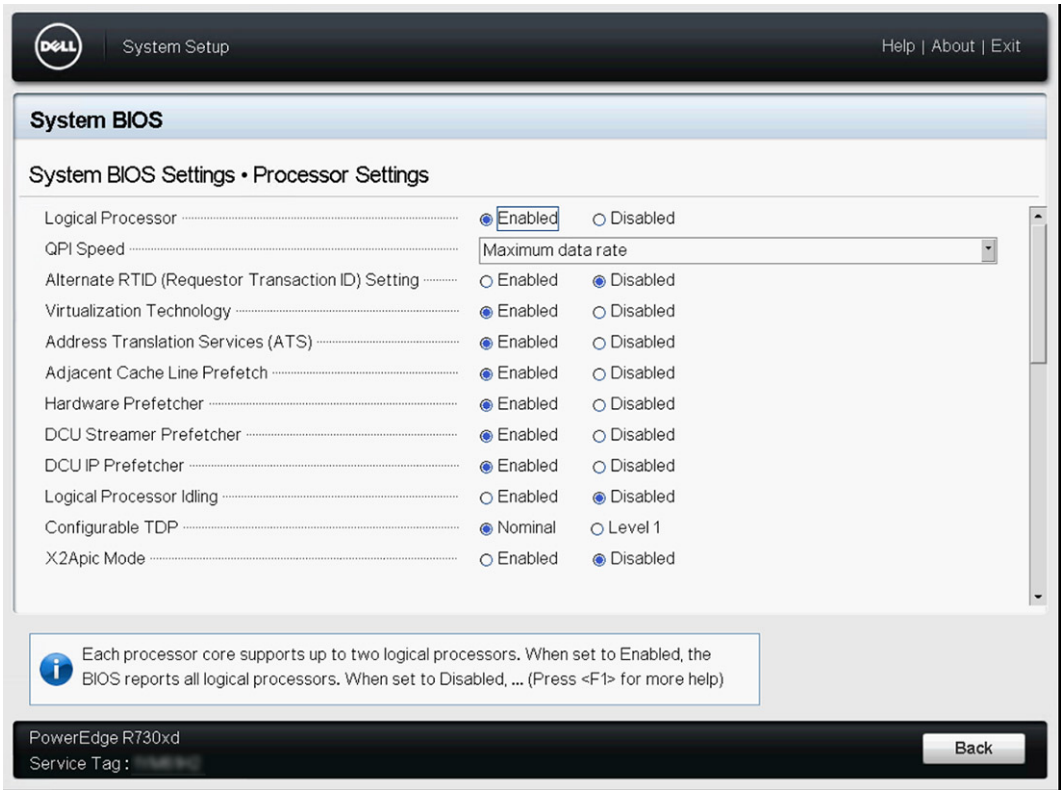

Figure 19. Processor Settings

OS RAID configuration

NOTE: This section is not applicable if you are using a solution with factory installed OS.

The 24 x 2.5" drive chassis and the 12 x 3.5" drive chassis configuration require the OS drives connected to the flex bay to be in a RAID configuration. This is achieved by connecting the OS drives in the flex bay (rear) to PERC H330 RAID Controller. This OS RAID disk configuration is required in all-flash and 12-drive configurations of this Dell EMC Ready Node.

If the virtual disk gets deleted or if a reconfiguration of the virtual disk is required, see section Creating virtual disks of the PERC 9 User's guide. Alternatively, this VD creation can be done from Unified Server Configurator in the Dell Lifecycle Controller.

Firmware baselining

The Dell EMC Ready Node has a supported firmware matrix and the nodes in the HCI cluster must comply with the firmware matrix. It is important to ensure that each server has the right firmware revisions for components used within the server.

This can be verified by using the iDRAC system inventory feature or by using a scripted method such as the RACADM command line interface.

Hyper-converged infrastructure deployment

This section describes the steps involved in installing OS on the bare metal servers and deploying the hyper-converged infrastructure (HCI) with Storage Spaces Direct. PowerShell commands are provided as relevant, to configure cluster deployment from the command line.

Unless mentioned otherwise, the following steps should be performed on each physical node in the infrastructure that will be a part of Storage Spaces Direct HCI.

OS deployment

There are two methods to deploy the operating system:

- Manual OS deployment - A manual method of install from OS deployment to cluster creation.
- Factory OS deployment - Dell EMC Ready Nodes can be ordered from the factory with Windows Server 2016 OS pre-installed.

NOTE: The steps in the subsequent sections are applicable to either full OS or Server Core.

NOTE: In case of a PowerEdge R730xd 16-drive chassis, ensure that the OS is installed on the single OS drive in the flex bay at the rear of the server chassis.

NOTE: In case of a PowerEdge R730xd 24-drive chassis, ensure that the OS is installed on the RAID 1 virtual disk that is created by using the drives in the flex bay at the rear of the server chassis.

Manual OS deployment

Dell Lifecycle Controller and Integrated Dell Remote Access Controller provide various options for one to one http://www.dell.com/support/manuals/us/en/19/idrac8-with-lc-v2.05.05.05/LC_2.05.05.05_UG-v1/Operating-system-deployment?guid=GUID-4289CC05-A6AC-4CAA-9FA2-728DBBE00F71&lang=en-us. This includes manual or unattended installation by using the virtual media and OS deployment feature in the Unified Server Configurator (USC).

The step-by-step procedure on how to deploy operating system is not within the scope of this guide.

The subsequent steps in this guide assume that the Windows Server 2016 Server Core Data Center edition deployment on the physical server is complete and that you have access to the virtual console of the physical server.

Factory installed OS

If the cluster nodes are shipped from Dell EMC factory with pre-installed Windows Server 2016 Data Center edition OEM license, the Out of box experience (OOBE) needs to be completed. This includes the following steps:

- Selecting Language and Locale Settings
- Accepting Microsoft and OEM EULA
- Setting up password for the Local Administrator account
- Updating the OS partition size and shrinking it as needed

The factory installed OEM OS is pre-activated and the Hyper-V role is pre-deployed. Therefore, after the OOBE steps are complete, the post OS deployment steps described in section Install Roles and Features should be performed to complete the cluster deployment and Storage Spaces Direct configuration.

Install roles and features

Windows Server 2016 Storage Spaces Direct hyper-converged Infrastructure (HCI) cluster deployment and configuration requires enabling the following operating system roles and features.

- Hyper-V service (this is not required if the OS is factory installed)
- Failover clustering
- Data center bridging

These features can be enabled using the *Install-WindowsFeature* PowerShell cmdlet.

```
Install-WindowsFeature -Name Hyper-V, Failover-Clustering, Data-Center-Bridging -
IncludeAllSubFeature -IncludeManagementTools –Verbose
```

NOTE: Hyper-V role installation requires a reboot of the system. As the subsequent steps require a reboot as well, they are all combined into a single reboot.

Update Out of Box (OOB) drivers

For certain system components, there may be a need to update the inbox version of the driver to most up-to-date and Dell EMC supported versions listed in the Supported Firmware and Software Matrix.

The following PowerShell command can be used to retrieve a list of all driver versions currently installed on the local system:

```
Get-PnpDevice | Select-Object Name, @{l='DriverVersion';e={(Get-PnpDeviceProperty -InstanceId
$_.InstanceId -KeyName 'DEVPKEY_Device_DriverVersion').Data}} -Unique
```

Before configuring Host Networking , ensure that the OOB drivers are updated. After the required drivers versions are identified, the driver installers can be downloaded from support.dell.com.

Change host name

By default, the OS deployment assigns a random name as the host computer name. For easier identification and uniform configuration, Dell EMC recommends to change the host name to something that is easily identifiable and relevant. This can be done by using the *Rename-Computer* cmdlet.

```
Rename-Computer –NewName S2DNode01 -Restart
```

NOTE: This command induces an automatic restart at the end of rename operation.

Configure firewall

For the cluster operations post deployment and optional monitoring configuration, certain firewall rules have to be enabled on the cluster nodes. For a complete list of ports or firewall rules that need to be enabled, see Appendix B.

For configuring firewall rules at the command prompt, see Network Security cmdlets in Windows PowerShell.

VMM based cluster deployment and configuration

When System Center Virtual Machine Manager is present in the existing data center environment, it is recommended to use VMM networking and deployment artifacts to configure host networking and create and configure a Storage Spaces Direct cluster. The following subsections describe the steps involved in performing these configuration tasks and provide PowerShell commands for each configuration task.

If VMM based deployment of cluster is chosen, configuration tasks in the section *Manual Cluster Deployment and Configuration* can be ignored.

NOTE: Ensure that the prerequisites (listed in the section VMM preparation) for Storage Spaces Direct cluster creation and configuration by using VMM are met before proceeding to the next section.

Configure Host Management VLAN

To be able to join the active directory domain, the physical network adapter must have the tagged VLAN ID from the host management subnet. This can be configured using the following PowerShell command.

```
Set-NetAdapterAdvancedProperty -Name 'SLOT 3' -DisplayName 'VLAN ID' -DisplayValue 102
```

The above command will set the VLAN ID property of the physical network adapter port identified by SLOT 3 as 102.

NOTE: This command must be run on each host that will be a part of the Storage Spaces Direct cluster.

Assign Host Management IP address

After the VLAN ID is assigned, the network adapter port identified as SLOT 3 should be configured with an IP v4 address to be able to communicate with the Active Directory domain controllers and join the domain. Also, the name server configuration must be complete to ensure the domain name resolution works as expected during domain join operation.

```
New-NetIPAddress -InterfaceAlias 'SLOT 3' -IPAddress 172.16.102.51 -DefaultGateway 172.16.102.1
-PrefixLength 24

Set-DnsClientServerAddress -InterfaceAlias 'SLOT 3' -ServerAddresses 172.16.102.202
```

The above command sets the IPv4 addresses of the physical network port identified as SLOT 3 and sets the DNS server address on the same interface for name resolution.

NOTE: This command needs to run on each host that will be a part of the Storage Spaces Direct cluster. For IP address assignment for each host, refer to the deployment checklist.

AD domain join

The cluster nodes must be a part of an Active Directory domain before the cluster creation actions can be performed. This task can be performed by using the *Add-Computer* cmdlet.

See the Deployment checklist for the domain administrator or equivalent credentials needed for the domain join.

NOTE: Connecting to AD directory services by using the host management network may require routing to the AD network. Ensure that this is in place before proceeding to domain join.

```
$credential = Get-Credential
Add-Computer -DomainName S2dlab.local -Credential $credential -Restart
```

NOTE: This command induces an automatic restart at the end of domain join operation. This command needs to be run on each host that will be a part of the Storage Spaces Direct cluster.

NOTE: Optionally, customers may want to add all newly created computer objects from the HCI cluster deployment to a different Organizational Unit (OU) in the AD directory Services. In this case, *-OUPath* parameter can be used along with the *Add-Computer* cmdlet.

Add physical hosts to VMM

The VM hosts that are domain joined can be added to the VMM host group.

NOTE: Commands in this section and subsequent section require the SCVMM PowerShell commands and therefore should be either run directly on the VMM server or with a system that has the SCVMM PowerShell cmdlets installed and has access to the SCVMM server. If running on a remote system with SCVMM PowerShell module, the logged on account on the system must have right authorization perform VMM actions. Also, these commands assume that SCVMM server has network connectivity to the physical hosts over the host management network.

```
$runAsAccount = Get-SCRunAsAccount -Name 'Administrator'
$hostGroup = Get-SCVMHostGroup -Name 'SpacesDirectHosts'
Add-SCVMHost -ComputerName "s2dnode01.s2dlab.local" -RunAsynchronously -VMHostGroup $hostGroup -
Credential $runAsAccount
Add-SCVMHost -ComputerName "s2dnode02.s2dlab.local" -RunAsynchronously -VMHostGroup $hostGroup -
Credential $runAsAccount
Add-SCVMHost -ComputerName "s2dnode03.s2dlab.local" -RunAsynchronously -VMHostGroup $hostGroup -
Credential $runAsAccount
Add-SCVMHost -ComputerName "s2dnode04.s2dlab.local" -RunAsynchronously -VMHostGroup $hostGroup -
Credential $runAsAccount
```

NOTE: This brings all hosts into the VMM for virtualization management.

Configure logical switch on Hyper-V Hosts

As the next step in preparation for the cluster creation and Storage Spaces Direct configuration, the logical switch needs to be deployed with the appropriate VM Network and subnet configurations. The following set of PowerShell commands can be used to perform this configuration.

```
#Job Group GUID
$jobGroup = (New-Guid).Guid

$nodeName = 's2dnode01.s2dlab.local'

# Get Host 's2dnode01.s2dlab.local'
$vmHost = Get-SCVMHost | Where-Object { $_.Name -eq $NodeName }

# Get Host Network Adapter 'Mellanox ConnectX-3 Pro Ethernet Adapter'
$networkAdapter = Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object { $_.ConnectionName
-eq 'SLOT 3' }
$uplinkPortProfileSet = Get-SCUplinkPortProfileSet -Name 'S2D_UPP'
Set-SCVMHostNetworkAdapter -VMHostNetworkAdapter $networkAdapter -UplinkPortProfileSet
$uplinkPortProfileSet -JobGroup $jobGroup

# Get Host Network Adapter 'Mellanox ConnectX-3 Pro Ethernet Adapter #2'
$networkAdapter = Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object { $_.ConnectionName
-eq 'SLOT 3 2' }
Set-SCVMHostNetworkAdapter -VMHostNetworkAdapter $networkAdapter -UplinkPortProfileSet
$uplinkPortProfileSet -JobGroup $jobGroup

$networkAdapter = @()
$networkAdapter += Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object
{ $_.ConnectionName -eq 'SLOT 3' }
$networkAdapter += Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object
{ $_.ConnectionName -eq 'SLOT 3 2' }

$logicalSwitch = Get-SCLogicalSwitch -Name S2dSwitch

#Manegemnt
$vmNetwork = Get-SCVMNetwork -Name 'Management'
$vmSubnet = Get-SCVMSubnet -Name 'Management_0'
New-SCVirtualNetwork -VMHost $vmHost -VMHostNetworkAdapters $networkAdapter -LogicalSwitch
$logicalSwitch -JobGroup $jobGroup -CreateManagementAdapter -ManagementAdapterName "Management"
-ManagementAdapterVMNetwork $vmNetwork -ManagementAdapterVMSubnet $vmSubnet

#Storage1
$vmNetwork = Get-SCVMNetwork -Name 'Storage1'
$vmSubnet = Get-SCVMSubnet -Name 'Storage1_0'
$ipV4Pool = Get-SCStaticIPAddressPool -Name 'Storage1'
New-SCVirtualNetworkAdapter -VMHost $vmHost -Name "Storage1" -VMNetwork $vmNetwork -
```

```
LogicalSwitch $logicalSwitch -JobGroup $jobGroup -VMSubnet $vmSubnet -IPv4AddressType "Static" -
IPv4AddressPool $ipV4Pool -MACAddressType "Static" -MACAddress "00:00:00:00:00:00"

#Storage2
$vmNetwork = Get-SCVMNetwork -Name 'Storage2'
$vmSubnet = Get-SCVMSubnet -Name 'Storage2_0'
$ipV4Pool = Get-SCStaticIPAddressPool -Name 'Storage2'
New-SCVirtualNetworkAdapter -VMHost $vmHost -Name "Storage2" -VMNetwork $vmNetwork -
LogicalSwitch $logicalSwitch -JobGroup $jobGroup -VMSubnet $vmSubnet -IPv4AddressType "Static" -
IPv4AddressPool $ipV4Pool -MACAddressType "Static" -MACAddress "00:00:00:00:00:00"

#Set the host properties
Set-SCVMHost -VMHost $vmHost -JobGroup $jobGroup -RunAsynchronously
```

The above commands need to be executed for each Hyper-V host that will be a part of the cluster and Storage Spaces Direct configuration.

Remove VLAN ID from physical adapter

The following PowerShell command needs to be run on each node that will be a part of the cluster:

```
Set-NetAdapterAdvancedProperty -Name 'SLOT 3' -DisplayName 'VLAN ID' -DisplayValue 0
```

Create Hyper-V cluster

As a final step in creating the cluster using Hyper-V hosts that are in the VMM management scope, a cluster can be created along with the Storage Spaces Direct configuration.

NOTE: Before creating the host cluster, execute the *Get-PhysicalDisk* command on all cluster nodes and verify the output to ensure that all disks are in healthy state and there are equal number of disks per node.

The following PowerShell commands help achieve that:

```
$HostGroup = Get-SCVMHostGroup -Name 'SpacesDirectHosts'
$AdminRunAsAccount = Get-SCRunAsAccount -Name 'Administrator'
$jobGroup = (New-Guid).Guid

# Get Host
's2dnode01.s2dlab.local,s2dnode02.s2dlab.local,s2dnode04.s2dlab.local,s2dnode03.s2dlab.local'
$VMHosts = @()
$VMHosts += Get-SCVMHost | Where-Object { $_.Name -eq 's2dnode01.s2dlab.local' }
$VMHosts += Get-SCVMHost | Where-Object { $_.Name -eq 's2dnode02.s2dlab.local' }
$VMHosts += Get-SCVMHost | Where-Object { $_.Name -eq 's2dnode03.s2dlab.local' }
$VMHosts += Get-SCVMHost | Where-Object { $_.Name -eq 's2dnode04.s2dlab.local' }

$StaticIPAddress = @("172.16.102.55")

Install-SCVMHostCluster -ClusterName "S2DNodeCluster" -JobGroup $jobGroup -RunAsynchronously -
EnableS2D -Credential $AdminRunAsAccount -VMHost $VMHosts -ClusterIPAddress $StaticIPAddress
```

The section Manual Cluster Deployment and Configuration is not needed in the VMM-based deployment of cluster and Storage Spaces Direct configuration. Proceed from section QoS Policy and RDMA Configuration for additional configuration on the cluster nodes.

Manual cluster deployment and configuration

In the absence of VMM 2016 in the existing data center environment, the cluster deployment and Storage Spaces Direct configuration can be done completely in a manual method. The following subsections provide an overview of these configuration tasks and provide PowerShell commands to complete this configuration.

Configure host networking

This section focuses on configuring the host networking such as VM switches, VM network adapters, and other QoS and RDMA configurations.

NOTE: All PowerShell commands in this section must be run at the local console to ensure that there are no failures due to network disconnections during configuration.

VM switch and adapter configuration

For the Windows Server 2016 Storage Spaces Direct HCI cluster deployments, it is necessary that the host OS networking is configured by using a Switch Embedded Team (SET). SET configuration in Windows Server 2016 allows Remote Direct Memory Access (RDMA). It enables virtual adapters with RDMA capability to connect to the same virtual machine switch as the host management and other classes of network traffic.

NOTE: For specifics of configuration such as VM switch name, adapter names and VLAN IDs, see the Deployment checklist

The following figure illustrates this configuration in an Storage Spaces Direct cluster node. This configuration requires the minimum bandwidth mode of the VM switch to be set to *Weight*.

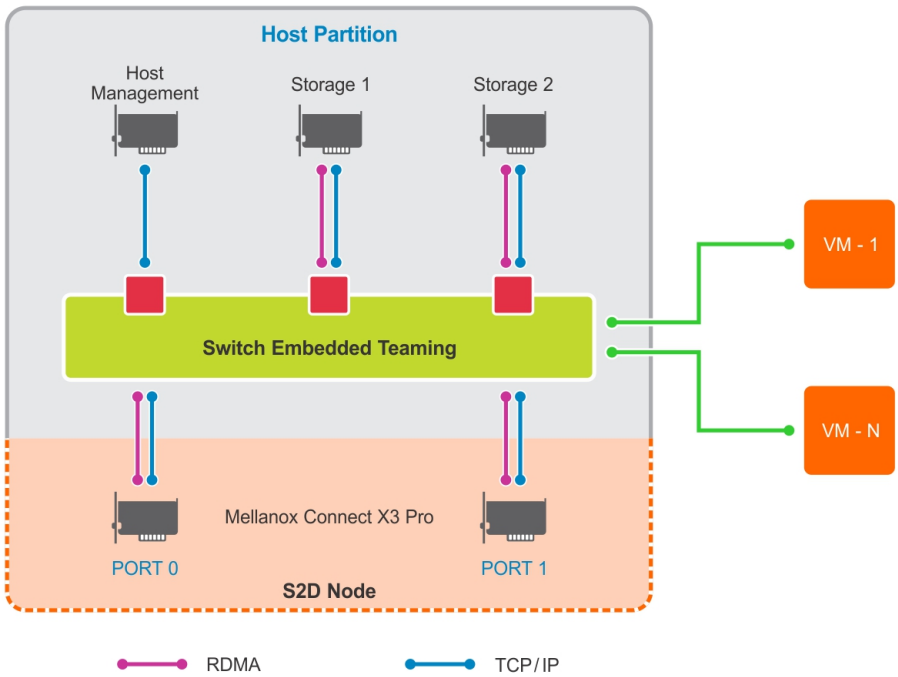

Figure 20. VM Switch and Adapter configuration

The following PowerShell commands can be used to configure the VM switch as a SET team and configure the VM network adapters in the host OS for management, storage 1, and storage 2 traffic.

Perform the following steps to configure the OS network:

1 Run the following command to create a VM switch in the SET configuration by using the physical network ports from the Mellanox network adapter in the system:

```
New-VMSwitch -Name S2DSwitch -AllowManagementOS 0 -NetAdapterName 'SLOT 3','SLOT 3 2' -
MinimumBandwidthMode Weight -Verbose
```

In the above example, the arguments to the *NetAdapterName* parameter represents the physical NIC ports that need to be a part of the SET configuration. These interface names can be retrieved using the *Get-NetAdapter* cmdlet. The minimum Bandwidth Mode set to Weight can be used to shape the VM Network traffic and it is not used for host OS network adapters.

```
PS C:\> Get-NetAdapter
Name                      InterfaceDescription                    ifIndex Status
MacAddress             LinkSpeed
----                      --------------------                    ------- ------
----------             ---------
SLOT 3 2                  Mellanox ConnectX-3 Pro Ethernet A...#2       5 Up           7C-
FE-90-94-3D-A1        10 Gbps
SLOT 3                    Mellanox ConnectX-3 Pro Ethernet Ada...       8 Up           7C-
FE-90-94-3D-A0        10 Gbps
NIC4                      Intel(R) Gigabit 4P I350-t rNDC #2            4 Disconnected
24-6E-96-15-0E-C3          0 bps
NIC3                      Intel(R) Gigabit 4P I350-t rNDC #4           13 Disconnected
24-6E-96-15-0E-C2          0 bps
NIC2                      Intel(R) Gigabit 4P I350-t rNDC               7 Disconnected
24-6E-96-15-0E-C1          0 bps
NIC1                      Intel(R) Gigabit 4P I350-t rNDC #3            9 Disconnected
24-6E-96-15-0E-C0          0 bps
```

The argument “0” to *AllowManagementOS* parameter prevents creation of a VM network adapter in the host operating system.

This command creates a SET with Switch Independent teaming mode and Dynamic load balancing algorithm settings.

2 Run the following command to create and configure the host management network adapter:

```
Add-VMNetworkAdapter -ManagementOS -Name 'Management' -SwitchName S2DSwitch -Passthru | Set-
VMNetworkAdapterVlan -Access -VlanId 102 -Verbose
```

3 Run the following command to add the host OS VM network adapters for Storage 1 and Storage 2 traffic and configure the VLAN IDs:

```
Add-VMNetworkAdapter -ManagementOS -Name 'Storage1' -SwitchName S2DSwitch -Passthru | Set-
VMNetworkAdapterVlan -Access -VlanId 103 -Verbose

Add-VMNetworkAdapter -ManagementOS -Name 'Storage2' -SwitchName S2DSwitch -Passthru | Set-
VMNetworkAdapterVlan -Access -VlanId 104 -Verbose
```

4 After the network adapters are added to the host OS, static IP addresses can be configured. Retrieve the argument for the *InterfaceAlias* parameter by using the *Get-NetAdapter* cmdlet.

```
PS C:\> Get-NetAdapter | Select Name, InterfaceAlias
Name                    InterfaceAlias
----                    --------------
vEthernet (Storage2)    vEthernet (Storage2)
vEthernet (Storage1)    vEthernet (Storage1)
vEthernet (Management)  vEthernet (Management)
SLOT 3 2                SLOT 3 2
SLOT 3                  SLOT 3
NIC4                    NIC4
NIC3                    NIC3
NIC2                    NIC2
NIC1                    NIC1
```

```
#Host Management Adapter
New-NetIPAddress -InterfaceAlias ‘vEthernet (Management)’ -IPAddress 172.16.102.51 -
DefaultGateway 172.16.102.1 -PrefixLength 24 -AddressFamily IPv4 –Verbose

#DNS server address
Set-DnsClientServerAddress -InterfaceAlias ‘vEthernet (Management)’ -ServerAddresses
172.16.102.202
```

```
#Storage 1 Adapter
New-NetIPAddress -InterfaceAlias 'vEthernet (Storage1)' -IPAddress 172.16.103.51 -
PrefixLength 24 -AddressFamily IPv4 -Verbose

#Storage 2 Adapter
New-NetIPAddress -InterfaceAlias 'vEthernet (Storage2)' -IPAddress 172.16.104.51 -
PrefixLength 24 -AddressFamily IPv4 -Verbose
```

In this configuration, default gateway and DNS configuration is required only for the host management network.

The assigned IP address configuration can be verified using the following command:

```
Get-NetIPAddress -InterfaceAlias *vEthernet* -AddressFamily IPv4 | Select InterfaceAlias,
IPAddress
```

AD domain join

The cluster nodes must be a part of an Active Directory domain before the cluster creation actions can be performed. This task can be performed by using the *Add-Computer* cmdlet.

See the Deployment checklist for the domain administrator or equivalent credentials needed for the domain join.

NOTE: Connecting to AD directory services by using the host management network may require routing to the AD network. Ensure that this is in place before proceeding to domain join.

```
$credential = Get-Credential
Add-Computer -DomainName S2dlab.local -Credential $credential -Restart
```

NOTE: This command induces an automatic restart at the end of domain join operation. This command needs to be run on each host that will be a part of the Storage Spaces Direct cluster.

NOTE: Optionally, customers may want to add all newly created computer objects from the HCI cluster deployment to a different Organizational Unit (OU) in the AD directory Services. In this case, *-OUPath* parameter can be used along with the *Add-Computer* cmdlet.

Create host cluster

Before creating a host cluster, Dell EMC recommends to ensure that the nodes that would be a part of the cluster are configured as needed and are ready for the cluster creation. This can be done using the *Test-Cluster* cmdlet.

NOTE: The commands in this section need to be executed on only one node in the infrastructure.

NOTE: Before creating the host cluster, execute the *Get-PhysicalDisk* command on all cluster nodes and verify the output to ensure that all disks are in healthy state and there are equal number of disks per node.

NOTE: Validate that the nodes have homogeneous hardware configuration.

```
Test-Cluster –Node S2DSystem01,S2DSystem02,S2DSystem03,S2DSystem04 –Include 'Storage Spaces
Direct', 'Inventory', 'Network', 'System Configuration'
```

NOTE: The *Test-Cluster* cmdlet generates an HTML report of all validations performed and includes a summary of the validation. Review this report before creating a cluster.

```
New-Cluster –Name S2DSystem –Node S2DSystem01,S2DSystem02,S2DSystem03,S2DSystem04 -
StaticAddress 172.16.102.55 –NoStorage –IgnoreNetwork 172.16.103.0/24, 172.16.104.0/24 -Verbose
```

In the above command, the *StaticAddress* parameter is used to specify an IP address for the cluster in the same IP subnet as the host management network. The *NoStorage* switch parameter specifies that the cluster needs to be created without any shared storage.

NOTE: The *New-Cluster* cmdlet generates an HTML report of all configurations performed and includes a summary of the validation. Review this report before enabling Storage Spaces Direct.

Configuring Storage Spaces Direct

After the cluster creation is complete, the *Enable-ClusterS2D* cmdlet can be used to create the storage spaces direct configuration on the cluster.

This command should not be run in a remote session. Use the local console session for executing this cmdlet.

```
Enable-ClusterS2D –Verbose
```

The *Enable-ClusterS2D* cmdlet generates a HTML report of all configurations performed and includes a summary of the validation. Review this report. This report is typically stored in the local temporary folder on the node where the *Enable-ClusterS2D* cmdlet was run. The path to the cluster report gets shown in the verbose output of the command.

This cmdlet, at the end of the operation, discovers and claims all the available disks into an auto-created storage pool.

The cluster creation can be verified by using any of the following commands:

```
Get-ClusterS2D
Get-StoragePool
Get-StorageSubSystem -FriendlyName *Cluster* | Get-StorageHealthReport
```

QoS Policy and RDMA configuration

Since the Storage Spaces Direct Hyper-Converged Infrastructure uses converged network design, it is important to ensure that the Quality of Service (QoS) policies are configured to prioritize the SMB traffic related to the storage adapters. The QoS configuration in the host OS should match the QoS configuration performed in the network architecture and configuration section.

The following table provides an overview of the QoS priorities and the required state for the set of priorities.

Table 16. QoS priorities

QoS Priority	State
0,1,2,4,5,6,7	Disabled
3	Enabled

The QoS configuration in the host OS includes the following steps:

1. Run the following command to create a new QoS policy with a match condition set to 445. This indicates the TCP port dedicated for Server Message Block traffic:

   ```
   New-NetQosPolicy -Name 'SMB' –NetDirectPortMatchCondition 445 –PriorityValue8021Action 3
   ```

   The argument '3' to the *PriorityValue8021Action* parameter indicates that the IEEE 802.1p value and should match the priority with enabled state as mentioned in the table.

2. Run the following command to map the IEEE 802.1p priority enabled in the system to a traffic class:

   ```
   New-NetQosTrafficClass –Name 'SMB' –Priority 3 –BandwidthPercentage 50 –Algorithm ETS
   ```

   The above command specifies that the transmission algorithm used is Enhanced Transmission Selection (ETS) and the traffic class gets 50% of the bandwidth.

3 Run the following command to configure flow control for the priorities mentioned in the table:

```
Enable-NetQosFlowControl –Priority 3
Disable-NetQosFlowControl –Priority 0,1,2,4,5,6,7
```

4 Run the following command to enable QoS for the Mellanox network adapter ports. The argument for the *InterfaceAlias* can be retrieved using the *Get-NetAdapter* cmdlet.

```
Enable-NetAdapterQos –InterfaceAlias 'SLOT 3', 'SLOT 3 2'
```

5 Run the following command to enable RDMA on the storage virtual adapters in the host OS. The argument to the *Name* parameter can be retrieved using the *Get-NetAdapter* cmdlet.

```
Enable-NetAdapterRDMA -Name 'vEthernet (Storage1)', 'vEthernet (Storage2)'
```

6 Run the following command to map the storage virtual adapters in the host OS to the physical Mellanox ports to ensure that the storage traffic uses these affinity rules and traffic spreads across evenly.

```
Set-VMNetworkAdapterTeamMapping -VMNetworkAdapterName 'Storage1' –ManagementOS –
PhysicalNetAdapterName 'SLOT 3'
```

```
Set-VMNetworkAdapterTeamMapping -VMNetworkAdapterName 'Storage2' –ManagementOS –
PhysicalNetAdapterName 'SLOT 3 2'
```

7 Run the following command to enable RDMA for Live Migration traffic.

```
Set-VMHost –VirtualMachineMigrationPerformanceOption SMB
```

8 Verify the RDMA configuration for the storage adapters using the following command:

```
Get-SmbClientNetworkInterface | Where-Object { $_.FriendlyName -like "*Storage*" }
```

```
PS C:\> Get-SmbClientNetworkInterface | Where-Object { $_.FriendlyName -like "*Storage*" }
Interface Index RSS Capable RDMA Capable Speed   IpAddresses
Friendly Name
--------------- ----------- ------------ -----   -----------
-------------
12              True        True         20 Gbps {fe80::8ded:853e:b6b9:aa25, 172.16.103.52}
vEthernet (Storage1)
16              True        True         20 Gbps {fe80::8494:bdc8:24b0:e5fe, 172.16.104.52}
vEthernet (Storage2)
For each storage network adapter, the “RDMA Capable” should be True.
```

NOTE: With the inbox Mellanox drivers, this value appears as *False*. This can be fixed by installing the updated drivers from Dell.

Remove host management network from Live Migration

After the cluster creation is complete, Live Migration, by default, is configured to use all available networks. It is recommended to disable Live migration on host management network, or in other words, exclude host management network from Live Migration settings.

This can be done by using the following PowerShell commands:

```
$clusterResourceType = Get-ClusterResourceType -Name 'Virtual Machine'

$hostNetworkID = Get-ClusterNetwork | Where-Object { $_.Address -eq '172.16.102.0' } | Select -
ExpandProperty ID

Set-ClusterParameter -InputObject $clusterResourceType -Name MigrationExcludeNetworks -Value
$hostNetworkID
```

In the above command, 172.16.102.0 represents the host management subnet.

Update hardware timeout for Spaces port

NOTE: For performance optimization and reliability, Dell EMC recommends to update the hardware timeout configuration for the Spaces port.

Run the following PowerShell commands on every node in the cluster to update the configuration in the Windows registry:

```
Set-ItemProperty -Path HKLM:\SYSTEM\CurrentControlSet\Services\spaceport\Parameters -Name
HwTimeout -Value 0x00002710 –Verbose

Restart-Computer –Force
```

This command induces a reboot of the node at the end of the registry update. This update should be done on all Storage Spaces Direct Nodes being deployed with this Guide right after initial deployment. Update one node at a time and wait for it to rejoin the cluster.

Configuring cluster witness

Microsoft recommends configuring a cluster witness for a four node Storage Spaces Direct cluster. This is not a mandatory requirement..

Cluster witness configuration helps maintain a cluster or storage quorum when there is a node or network communication failure where nodes continue to operate but can no longer communicate between one another.

Cluster witness can either be a file share or a cloud-based witness.

For information about configuring a file share witness, see https://blogs.msdn.microsoft.com/clustering/2014/03/31/configuring-a-file-share-witness-on-a-scale-out-file-server/.

For information about configuring a cloud-based witness, see https://technet.microsoft.com/en-us/windows-server-docs/failover-clustering/deploy-cloud-witness.

Recommended next steps

After the host cluster creation and enabling Storage Spaces Direct steps are complete, Dell EMC recommends to perform the following steps:

- Post deployment verification: This is recommended to ensure that the infrastructure is functional and ready for operations.
- Day 0 OS updates: This is required because there may be cumulative critical updates to the OS after the general availability.
- OS license activation: By default, the OS is installed in the evaluation mode. This needs to be activated immediately after the OS installation.

  NOTE: The OS license activation step is not required if the OS is factory installed.

5

Dell EMC Ready Nodes operations

The cluster shared volumes can be provisioned by using the storage pool that gets created during the Enable Spaces direct operation.

Topics:

- Post deployment verification
- Day 0 OS updates
- Windows activation
- Creating and managing virtual disks
- Monitoring Storage Spaces Direct cluster in SCOM (optional)
- Optimizing Storage Spaces Direct
- Performing PowerEdge server updates
- Expand cluster
- Performing cluster node recovery

Post deployment verification

After the deployment is complete, it is important to ensure that the cluster and Storage Spaces Direct configuration is functional and ready for operations. The following verification checks are recommended as a part of this.

Cluster Validation

The *Test-Cluster* command can be used to verify that the necessary artifacts required for the cluster functionality are in place.

```
Test-Cluster -Node S2DSystem01,S2DSystem02,S2DSystem03,S2DSystem04 -Include 'Storage Spaces
Direct', 'Inventory', 'Network', 'System Configuration'
```

Day 0 OS updates

Before creating any volumes and deploying any virtualized workloads on the HCI cluster, Dell EMC recommends to perform day 0 updates for the operating system.

In the Server Core operating system, *sconfig* command can be used to enable auto-update for the operating system components. This, however, requires internet connectivity to Windows Update services for downloading and installing applicable updates.

If there is a Windows Software Update Services (WSUS) server in the data center, Group Policy objects can be used to configure the Server Core or Full OS systems in the Storage Spaces Direct HCI cluster to retrieve and download updates from the local WSUS Server.

Since the cluster is operational while performing Day 0 updates, it is recommended to perform cluster-aware updates of the OS. See Cluster-aware updating overview for more information.

Windows activation

When the Server Core operating system is installed using the retail or volume licensing media, the OS license needs to be activated. On the Server Core OS, this can be done by using either the *sconfig* tool or the *slmgr* command.

NOTE: Windows activation is not required if the OS is factory installed.

For OS license activation by using *slmgr*, see https://technet.microsoft.com/en-us/library/dn502540(v=ws.11).aspx.

For OS license activation by using sconfig command, see https://technet.microsoft.com/en-us/windows-server-docs/get-started/sconfig-on-ws2016.

See the Microsoft documentation on using KMS for volume activation of Windows OS in the data center.

Creating and managing virtual disks

Cluster creation and enabling Storage Spaces Direct configuration on the cluster creates only a storage pool and does not provision any virtual disks in the storage pool. The New-Volume cmdlet can be used to provision new virtual disks and in turn provision them as the cluster shared volumes for the Storage Spaces Direct HCI cluster.

The number, size, and the tiers in each of the volumes to be created are dependent on the infrastructure and customer requirements. For general guidance on volume creation in Storage Spaces Direct, see https://technet.microsoft.com/en-us/windows-server-docs/storage/storage-spaces/create-volumes

Monitoring Storage Spaces Direct cluster in SCOM (optional)

If the existing management infrastructure includes System Center Operations Manager, the HCI cluster can be added to the management groups to enable monitoring of bare metal servers and the Storage Spaces Direct cluster performance and alerts.

Monitoring Storage Spaces Direct cluster

Monitoring a Windows Server 2016 based cluster and Storage Spaces Direct performance requires the following management packs:

Table 17. Management packs

Management pack name	Version	Download location
SC Management Pack for Windows Server 2016.msi	10.0.8.0	https://www.microsoft.com/en-us/download/details.aspx?id=54303
SC Management Pack for Cluster 2016.msi	10.0.6.0	https://www.microsoft.com/en-us/download/details.aspx?id=48256
Microsoft System Center 2016 MP for Storage Spaces Direct.msi	10.0.40.0	https://www.microsoft.com/en-us/download/details.aspx?id=54700

NOTE: An older version of System Center Management Pack for the Windows Server 2016 Operating System comes bundled with SCOM 2016 RTM install. This can be upgraded to the latest version using *Updates and Recommendations* workspace under Administration Pane -> Management Packs in the SCOM console. This lists all updates available for any of the installed management packs.

NOTE: Instructions for installing System Center Management Pack for Windows Server Failover Cluster and System Center Management Pack for Microsoft Windows Server 2016 Storage Spaces Direct are available along with management pack download.

Post installation, the management packs need to be imported. For information on importing SCOM management packs, see How to Import an Management Pack in Operations Manager 2007.

Before the Storage Spaces Direct cluster nodes can be monitored, they need to be discovered as agent managed systems. This process involves installing the agents on the nodes that need to monitored. The push method of installing agents using the SCOM discovery wizard, by default, uses the management server action account specified during SCOM deployment. Therefore, ensure that this account has local administrative privileges on the target nodes.

Run as Profile and Run as Accounts

The SCOM monitoring processes on the target nodes use an agent action account associated with a Run As profile for monitoring and collecting management data. Each management pack requires these accounts with certain privileges. The following table lists the Run As Account requirements for the management packs to monitor Windows Server 2016 and Storage Spaces Direct cluster performance.

Table 18. Management packs

Management pack name	Run As Profile and Run As Account Requirements
System Center Management Pack for the Windows Server 2016 Operating System	NA
System Center Management Pack for Windows Server Failover Cluster	When using low privilege account, *Windows Cluster Action Account* Run As profile must have administrative credentials to access the cluster. Microsoft recommends that this account is configured for more secure distribution.
System Center Management Pack for Microsoft Windows Server 2016 Storage Spaces Direct	*Microsoft Storage Library: RunAs Account* Run As Profile requires a Run As account with Cluster Administrator privileges. Microsoft recommends that this account is configured for more secure distribution.

Dell EMC recommends using more secure distribution of cluster administrator credentials to the managed nodes. For the Run As Profiles that are configured with more secure credential distribution, the credentials must then be manually distributed to the target nodes where needed. Follow the steps listed below to enable secure distribution of Run As Account credentials to target nodes.

1. Open the Operations Manager console and click **Administration**.
2. In the Administration Pane, click **Accounts** under **Run As Configurations**.
3. Double-click the Run As Account that needs secure distribution.
4. Select the **Distribution** tab.
5. Click **More Secure**.
6. Click **Add** and then click **Search**.
7. Select the target node(2) to which the credentials must be distributed. Click **Add** and click **OK.**
8. Click **Apply** and **OK**.

Discovering Windows Server 2016 Cluster Nodes

The SCOM discovery wizard can be used to perform node discovery and Microsoft monitoring agent install. For the Storage Spaces Direct cluster discovery and monitoring, the agent on the nodes should be configured as proxy. Follow the steps listed below to enable the agent proxy setting on all agents participating in a Windows Failover Cluster.

1 Open the Operations Manager console and click **Administration**.
2 In the Administration Pane, click **Agent Managed**.
3 Double-click an agent in the list.
4 Select the **Security** tab.
5 Select the option **Allow this agent to act as a proxy and discover managed objects on other computers**.
6 Repeat steps 3 through 5 for each agent that is installed on a clustered server.

After the cluster node and cluster discovery is complete, the cluster view under **Monitoring Pane** -> **Microsoft Windows Cluster** -> **Clusters** gets updated.

NOTE: It may take up to 24 hours for this view to get generated completely.

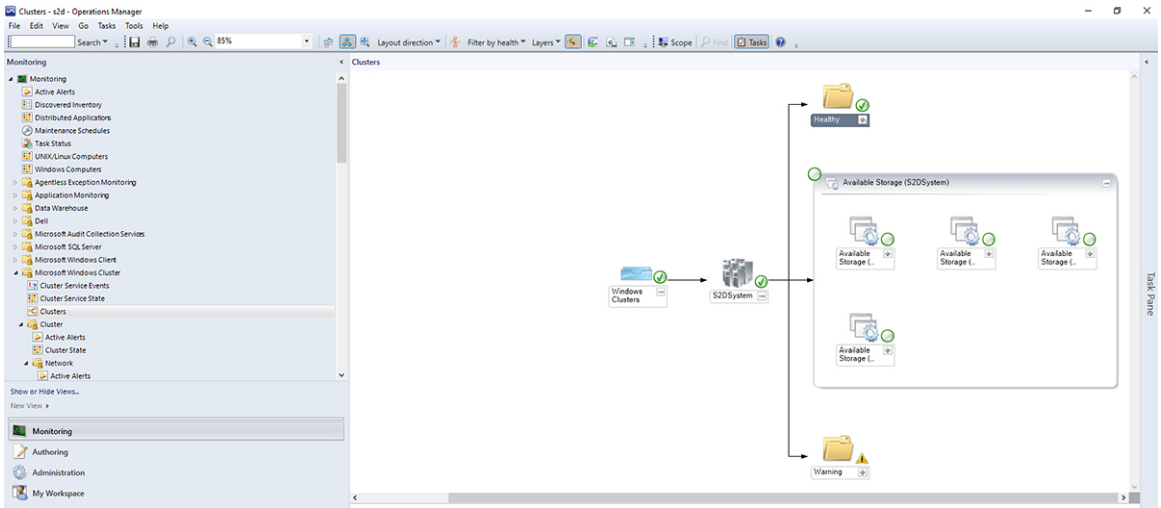

Figure 21. Discovered Windows Failover Cluster in SCOM 2016

After the Windows failover cluster is discovered, the Storage Spaces Direct management pack can be used to monitor the storage subsystems and performance of Storage Spaces Direct cluster and cluster disks.

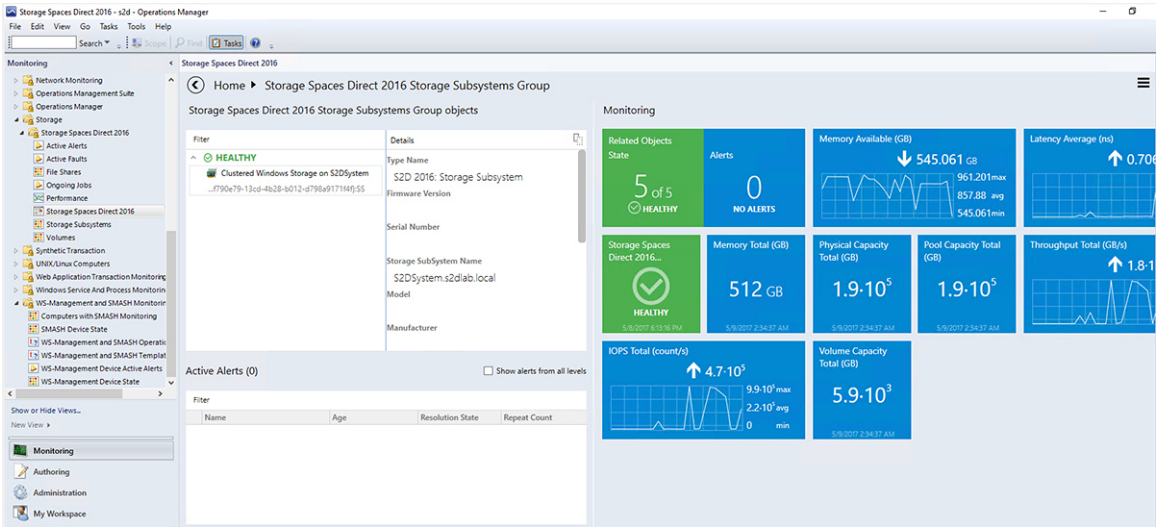

Figure 22. Cluster level health view in SCOM

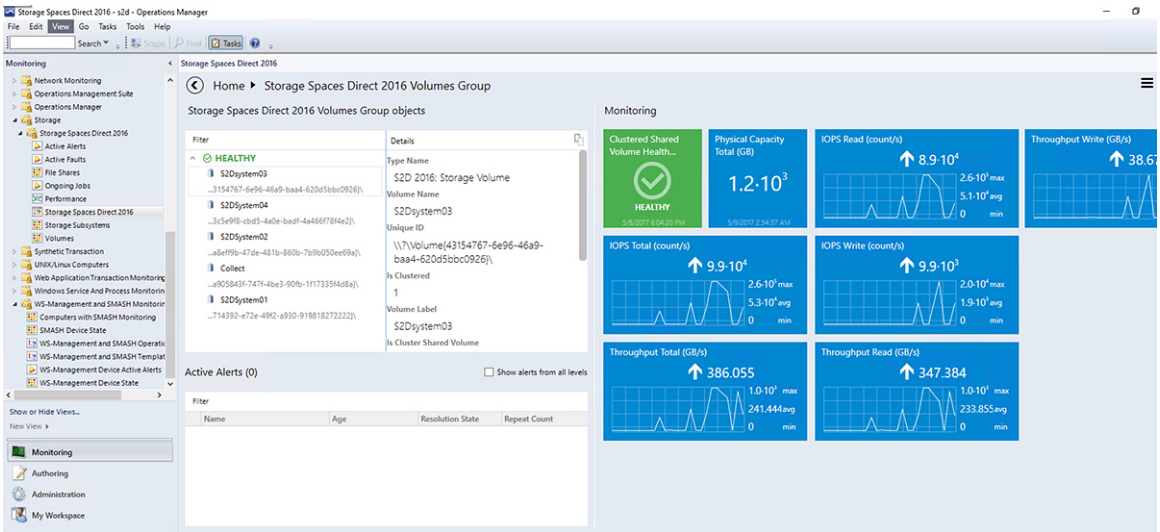

Figure 23. CSV-level health view in SCOM

Optimizing Storage Spaces Direct

During ongoing cluster operations, distribution of data within the storage pool may become unbalanced. Additionally, as storage devices are added or removed from the pool, optimizing the existing data to use the new disks results in better storage efficiency and performance across the pool.

NOTE: Optimization is resource-intensive, and it is automatically run every day by updating the heat map. Running extra optimizations on demand may add additional strain on the system.

You can run a storage pool optimize operation on demand by using the *Optimize-StoragePool* cmdlet.

Performing PowerEdge server updates

PowerEdge server component firmware upgrades can be performed by using the integrated Dell Remote Access Controller (iDRAC) firmware update features. These device updates by using iDRAC interfaces should be done in a non-destructive way. Therefore, Dell EMC recommends to migrate all cluster roles from the cluster node that needs to be updated.

See the Updating Device Firmware section of the iDRAC documentation for information and methods to perform firmware updates.

Expand cluster

Expanding cluster compute or storage capacity is one of the tasks performed during cluster operations. This section provides instructions on these tasks.

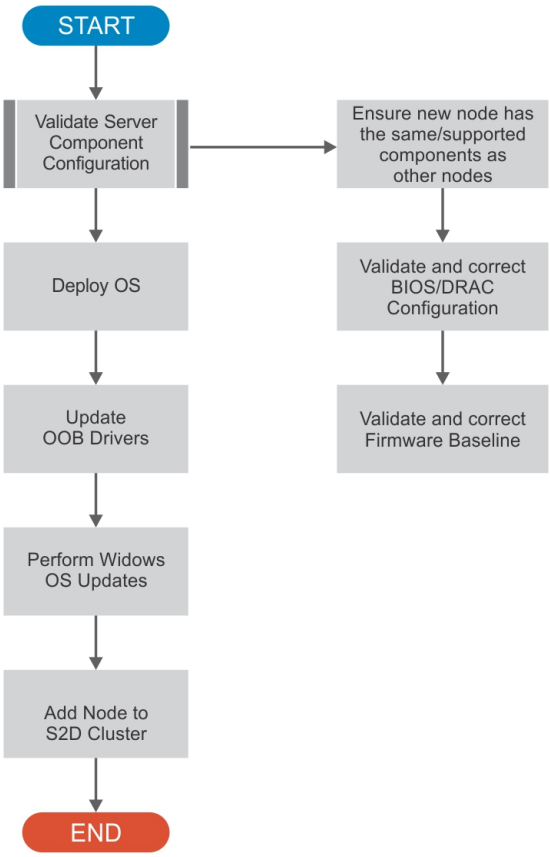

Figure 24. Expanding cluster compute

Adding server nodes and drives

Before adding new server nodes into a HCI cluster, complete the following requirements:

1 Verify that the drives are of the same configuration as the current nodes on the cluster. In short, it should have the same number of drives, and also the different tiers (SSD, NVM, HDD) should be the same size drive as the node in use.

2 Apply the BIOS configuration to the node and configure iDRAC.

To configure the node, the OS deployment and node network configuration can be done by using the steps mentioned in the section Hyper-converged Infrastructure Deployment.

The PowerShell commands in the following sections should not be executed again as the cluster is already created, Storage Spaces direct already enabled, and the management network already excluded:

- Configuring Storage Spaces Direct
- Create Host Cluster
- Remove Host Management Network from Live Migration

3 Verify that the nodes are compliant with the firmware baseline.

4 Update the hardware timeout configuration for the Spaces port.

5 After the node is configured, update Windows to bring the node to the same level as the cluster.

> **NOTE: Before adding the node to the existing cluster, execute the *Get-PhysicalDisk* command on the new node and verify the output to ensure that all disks are in healthy state and there are equal number of disks as the other cluster node.**

6 If the initial cluster creation and Storage Spaces Direct configuration was done manually, follow the procedure at https://technet.microsoft.com/EN-US/WINDOWS-SERVER-DOCS/STORAGE/STORAGE-SPACES/ADD-NODES to manually add the node to the cluster. If the initial cluster creation and Storage Spaces Direct configuration was done using System Center VMM, the following commands can be run on the VMM server to add the new node into the existing cluster:

```
#Job Group GUID
$jobGroup = (New-Guid).Guid
$nodeName = 'win16s2d-04.test.lab'
# Get Host 'win16s2d-04.test.lab'
$vmHost = Get-SCVMHost | Where-Object { $_.Name -eq $NodeName }

# Get Host Network Adapter 'Mellanox ConnectX-3 Pro Ethernet Adapter'
$networkAdapter = Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object { $_.ConnectionName
-eq 'SLOT 3' }
$uplinkPortProfileSet = Get-SCUplinkPortProfileSet -Name 'S2D_UPP'
Set-SCVMHostNetworkAdapter -VMHostNetworkAdapter $networkAdapter -UplinkPortProfileSet
$uplinkPortProfileSet -JobGroup $jobGroup


# Get Host Network Adapter 'Mellanox ConnectX-3 Pro Ethernet Adapter #2'
$networkAdapter = Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object { $_.ConnectionName
-eq 'SLOT 3 2' }
Set-SCVMHostNetworkAdapter -VMHostNetworkAdapter $networkAdapter -UplinkPortProfileSet
$uplinkPortProfileSet -JobGroup $jobGroup

$networkAdapter = @()
$networkAdapter += Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object
{ $_.ConnectionName -eq 'SLOT 3' }
$networkAdapter += Get-SCVMHostNetworkAdapter -VMHost $vmHost | Where-Object
{ $_.ConnectionName -eq 'SLOT 3 2' }

$logicalSwitch = Get-SCLogicalSwitch -Name S2dSwitch

#Management
$vmNetwork = Get-SCVMNetwork -Name 'Management'

$vmSubnet = Get-SCVMSubnet -Name 'Management_0'
New-SCVirtualNetwork -VMHost $vmHost -VMHostNetworkAdapters $networkAdapter -LogicalSwitch
$logicalSwitch -JobGroup $jobGroup -CreateManagementAdapter -ManagementAdapterName "Management"
-ManagementAdapterVMNetwork $vmNetwork -ManagementAdapterVMSubnet $vmSubnet


#Storage1
$vmNetwork = Get-SCVMNetwork -Name 'Storage1'
$vmSubnet = Get-SCVMSubnet -Name 'Storage1_0'
$ipV4Pool = Get-SCStaticIPAddressPool -Name 'Storage1-IPpool'
New-SCVirtualNetworkAdapter -VMHost $vmHost -Name "Storage1" -VMNetwork $vmNetwork -
LogicalSwitch $logicalSwitch -JobGroup $jobGroup -VMSubnet $vmSubnet -IPv4AddressType "Static" -
IPv4AddressPool $ipV4Pool -MACAddressType "Static" -MACAddress "00:00:00:00:00:00"
```

```
#Storage2
$vmNetwork = Get-SCVMNetwork -Name 'Storage2'
$vmSubnet = Get-SCVMSubnet -Name 'Storage2_0'
$ipV4Pool = Get-SCStaticIPAddressPool -Name 'Storage2-ippool'
New-SCVirtualNetworkAdapter -VMHost $vmHost -Name "Storage2" -VMNetwork $vmNetwork -
LogicalSwitch $logicalSwitch -JobGroup $jobGroup -VMSubnet $vmSubnet -IPv4AddressType "Static" -
IPv4AddressPool $ipV4Pool -MACAddressType "Static" -MACAddress "00:00:00:00:00:00"

#Set the host properties
Set-SCVMHost -VMHost $vmHost -JobGroup $jobGroup -RunAsynchronously
```

Extending volumes

Volumes created in Spaces Direct storage pools can be resized using the *Resize-VirtualDisk* cmdlet. For information and for the commands used to perform this task, see https://technet.microsoft.com/en-us/windows-server-docs/storage/storage-spaces/resize-volumes.

Performing cluster node recovery

In case of a cluster node failure, node OS recovery should be done in a systematic manner to ensure that the node is brought up with configuration consistent with other cluster nodes. The following sections provide details about OS recovery and post OS recovery configuration that is needed to bring the node into an existing Storage Spaces Direct cluster.

OS Recovery using manual deployment

For manually deployed nodes, the OS recovery on the node can be done by using any of the methods that were used for OS deployment.

NOTE: If the Ready Nodes configuration deployed a RAID disk for the OS, ensure that the RAID disk is re-initialized before attempting a recovery.

NOTE: Before performing OS recovery on the failed node, ensure that the node is evicted from the existing cluster and VMM host groups (if the node was managed using VMM). Ensure that the computer account and DNS entries related to the node are deleted from Active Directory and DNS.

After the OS deployment is complete, follow the steps below to bring the node into an existing Storage Spaces Direct cluster:

1. Update OOB Drivers
2. Configure host networking
3. Change host name
4. AD Domain Join
5. Qos Policy and RDMA configuration
6. Configure firewall
7. Day 0 OS updates
8. Add Server Nodes to the cluster

After the node is added to the existing Storage Spaces Direct cluster, the optional configuration described in section Dell EMC Ready Nodes Operations can be performed to enable monitoring and management of the recovered Storage Spaces Direct node by using System Center OM.

Factory OS using recovery media

For the factory installed OEM license of the operating system, it is recommended to use the OS recovery media shipped with the PowerEdge server. Using this media for OS recovery ensures that the OS stays activated after the recovery. Using any other OS media will

trigger the need for activation post OS deployment. OS deployment using the recovery media is same as either retail or other OS media based installation.

NOTE: If the Ready Node configuration from the factory included RAID disk for the OS, ensure that the RAID disk is re-initialized before attempting a recovery. Since the node was a part of an Storage Spaces Direct cluster, the disks on the node that were a part of the storage pool must be re-initialized or cleaned as well. This can be done post OS recovery.

NOTE: Before performing OS recovery on the failed node, ensure that the node is evicted from the existing cluster and VMM host groups (if the node was managed using VMM). Ensure that the computer account and DNS entries related to the node are deleted from Active Directory and DNS.

After the OS deployment using the recovery media is complete, perform the following steps to bring the node into an existing Storage Spaces Direct cluster:

After the OS deployment is complete, follow the steps below to bring the node into an existing Storage Spaces Direct cluster:

1 Update OOB Drivers
2 Configure host networking
3 Change host name
4 Join AD Domain
5 Configure QoS policy and RDMA
6 Configure firewall
7 Complete Day 0 OS updates
8 Add Server Nodes to the cluster

After the node is added to the existing Storage Spaces Direct cluster, the optional configuration described in section Dell EMC Ready Nodes Operations can be performed to enable monitoring and management of the recovered Storage Spaces Direct node by using System Center OM.

6

Deployment services

Issues that arise during installation and configuration are not covered even if you have purchased Dell ProSupport or ProSupport Plus, as support for installation and configuration issues come under a separate paid services package. When you call in with a installation and configuration issue, Dell Tech Support will route you to your Account Manager in Dell EMC Sales. The Account Manager will then help you in purchasing the onsite deployment services package.

7

Additional resources

- iDRAC documentation
- PowerEdge R730xd documentation
- Supported firmware and software matrix
- Storage Spaces Direct overview
- Dell EMC Hyper-converged infrastructure

A

Sample switch configuration

S3048 - OOB Management

```
IDENTIFICATION / CREDENTIALS
!NOTE: Switch Hostname
hostname S2D-S3048.0
!
!NOTE:  CONFIGURE SECURITY ACCESS LEVELS
enable password 0 ChangeMe
username admin password 0 ChangeMe privilege 15
ip ssh server enable
!
!******NOTE: OPTIONAL, TELNET CONVENIENT - NOT SECURE
ip telnet server enable
line console 0
 password ChangeMe
!
!----------------------------------------------------------------------
!NOTE: HOST MGMT INTERFACE - SWITCHPORT CONFIGURATION
interface range GigabitEthernet 1/1-1/16,1/45-1/48
 no ip address
 switchport
 spanning-tree 0 portfast
 no shutdown
!
!----------------------------------------------------------------------
!NOTE: MANAGEMENT-SWITCH-TO-SWITCH LINKS
!NOTE: For some Customers like DoD the OOB switch is "isolated"
interface range TenGigabitEthernet 1/51-1/52
 no ip address
 port-channel-protocol LACP
  port-channel 1 mode active
 no shutdown
!
interface Port-channel 1
 no ip address
 switchport
 no shutdown
!
!----------------------------------------------------------------------
!VLAN NETWORK CONFIGURATIONS
interface Vlan 5
 description Switch MGMT vlan
 no ip address
 tagged Port-channel 1
 untagged GigabitEthernet 1/45-1/48
no shutdown
!
interface Vlan 6
 description BMC MGMT vlan
 no ip address
 tagged Port-channel 1
 untagged GigabitEthernet 1/1-1/16
 no shutdown
!
!----------------------------------------------------------------------
!NOTE:  LLDP enabled for debugging capabilities
protocol lldp
 advertise dot1-tlv port-protocol-vlan-id port-vlan-id
 advertise dot3-tlv max-frame-size
```

```
 advertise management-tlv management-address system-capabilities system-description system-name
 advertise interface-port-desc
!
-----------------------------------------------------------------------
!NOTE: INTERFACE DESCRIPTORS
interface GigabitEthernet 1/1
 description NODE01:BMC
!
interface GigabitEthernet 1/2
 description NODE02:BMC
!
interface GigabitEthernet 1/3
 description NODE03:BMC
!
interface GigabitEthernet 1/4
 description NODE04:BMC
!
interface GigabitEthernet 1/5
 description NODE05:BMC
!
interface GigabitEthernet 1/6
 description NODE06:BMC
!
interface GigabitEthernet 1/7
 description NODE07:BMC
!
interface GigabitEthernet 1/8
 description NODE08:BMC
!
interface GigabitEthernet 1/9
 description NODE09:BMC
!
interface GigabitEthernet 1/10
 description NODE10:BMC
!
interface GigabitEthernet 1/11
 description NODE11:BMC
!
interface GigabitEthernet 1/12
 description NODE12:BMC
!
interface GigabitEthernet 1/13
 description NODE13:BMC
!
interface GigabitEthernet 1/14
 description NODE14:BMC
!
interface GigabitEthernet 1/15
 description NODE15:BMC
!
interface GigabitEthernet 1/16
 description NODE16:BMC
!
interface GigabitEthernet 1/45
 description AGG1:Port:MGMT
!
interface GigabitEthernet 1/46
 description AGG2:Port:MGMT
!
interface GigabitEthernet 1/47
 description TOR1:Port:MGMT
!
interface GigabitEthernet 1/48
 description TOR2:Port:MGMT
!
interface TenGigabitEthernet 1/51
 description Uplink to TOR1Te48
!
interface TenGigabitEthernet 1/52
```

```
 description Uplink to TOR2Te48
!
```

S4048-1

```
IDENTIFICATION / CREDENTIALS
!NOTE: Switch Hostname
hostname S2D-TOR1
!
!NOTE:  CONFIGURE SECURITY ACCESS LEVELS
enable password 0 ChangeMe
username admin password 0 ChangeMe privilege 15
ip ssh server enable
!
!******NOTE: OPTIONAL, TELNET CONVENIENT - NOT SECURE
ip telnet server enable
line console 0
 password ChangeMe
!
-------------------------------------------------------------------------
!NOTE: CONFIGURE SWITCH VLT
!******VLTi - STATIC AGGREGATE PORTS
interface range fortyGigE 1/49-1/50
 no ip address
 dcb-map RDMA
 no shutdown
!
interface Port-channel 100
 description VLTi-ToR2
 no ip address
 channel-member fortyGigE 1/49,1/50
 no shutdown
!
!******VLT HEART-BEAT CONFIGURATION
interface ManagementEthernet 1/1
 ip address 172.18.200.1/30
 no shutdown
!
!******VLT DOMAIN CONFIGURATION
vlt domain 1
 peer-link port-channel 100
 back-up destination 172.18.200.2
 primary-priority 1
 system mac-address f4:8e:38:51:DE:11
 unit-id 0
!
-------------------------------------------------------------------------
!NOTE: CUSTOMER UPLINK Can be any open FortyGig or TenGig Port/s
!NOTE: Refer to your NPE for best approach specific to the customer site
-------------------------------------------------------------------------
!NOTE: SERVER HOST/NODE INTERFACE CONFIGURATIONS
!****** Enable DCB, MAP RDMA Policy to Eth Interfaces
dcb enable
!
dcb-map RDMA
 priority-group 0 bandwidth 50 pfc off
 priority-group 3 bandwidth 50 pfc on
 priority-pgid 0 0 0 3 0 0 0 0
!
interface range TenGigabitEthernet 1/1-1/16
 no ip address
 portmode hybrid
 switchport
 spanning-tree rstp edge-port bpduguard
 spanning-tree 0 portfast
 dcb-policy buffer-threshold RDMA
 dcb-map RDMA
 no shutdown
!
```

```
-----------------------------------------------------------------------
!NOTE: MANAGEMENT SWITCH-TO-SWITCH LINKS
!NOTE: For some Customers like DoD the OOB switch is "isolated"
interface TenGigabitEthernet 1/48
 no ip address
 port-channel-protocol LACP
  port-channel 1 mode active
 no shutdown
!
interface Port-channel 1
 description To BMCTe51
 no ip address
 switchport
 vlt-peer-lag port-channel 1
 no shutdown
-----------------------------------------------------------------------
!VLAN NETWORK CONFIGURATIONS
!******VRRP USED AS FLOWTING VIRTUAL GATEWAY IP PER BCAST DOMAIN
interface Vlan 50
 ip address 10.128.4.37/29
 tagged Port-channel 1
 vrrp-group 50
  virtual-address 10.128.4.33
 no shutdown
!
interface Vlan 60
 ip address 10.128.4.93/27
 tagged Port-channel 1
 vrrp-group 60
  virtual-address 10.128.4.65
 no shutdown
!
interface Vlan 70
 ip address 10.128.4.253/26
 tagged TenGigabitEthernet 1/1-1/16
 vrrp-group 70
  virtual-address 10.128.4.193
 no shutdown
!
interface Vlan 80
 ip address 10.128.4.125/27
tagged TenGigabitEthernet 1/1-1/16
 vrrp-group 80
  virtual-address 10.128.4.97
 no shutdown
!
interface Vlan 90
 ip address 10.128.4.156/27
 tagged TenGigabitEthernet 1/1-1/16
 vrrp-group 90
  virtual-address 10.128.4.129
 no shutdown
!
interface Vlan 150
 ip address 10.128.25.253/24
 tagged TenGigabitEthernet 1/1-1/16
 vrrp-group 150
  virtual-address 10.128.25.1
 no shutdown
!
-----------------------------------------------------------------------
!NOTE:  DEFINE DEFAULT-GATEWAY
management route 0.0.0.0/0 10.128.4.33
!
-----------------------------------------------------------------------
!NOTE:  LLDP enabled for debugging capabilities
protocol lldp
 advertise dot1-tlv port-protocol-vlan-id port-vlan-id
 advertise dot3-tlv max-frame-size
```

```
 advertise management-tlv management-address system-capabilities system-description system-name
 advertise interface-port-desc
!
-----------------------------------------------------------------------
!NOTE: INTERFACE DESCRIPTORS
interface TenGigabitEthernet 1/1
 description NODE01:NDC1
!
interface TenGigabitEthernet 1/2
 description NODE02:NDC1
!
interface TenGigabitEthernet 1/3
 description NODE03:NDC1
!
interface TenGigabitEthernet 1/4
 description NODE04:NDC1
!
interface TenGigabitEthernet 1/5
 description NODE05:NDC1
!
interface TenGigabitEthernet 1/6
 description NODE06:NDC1
!
interface TenGigabitEthernet 1/7
 description NODE07:NDC1
!
interface TenGigabitEthernet 1/8
 description NODE08:NDC1
!
interface TenGigabitEthernet 1/9
 description NODE09:NDC1
!
interface TenGigabitEthernet 1/10
 description NODE10:NDC1
!
interface TenGigabitEthernet 1/11
 description NODE11:NDC1
!
interface TenGigabitEthernet 1/12
 description NODE12:NDC1
!
interface TenGigabitEthernet 1/13
 description NODE13:NDC1
!
interface TenGigabitEthernet 1/14
 description NODE14:NDC1
!
interface TenGigabitEthernet 1/15
 description NODE15:NDC1
!
interface TenGigabitEthernet 1/16
 description NODE16:NDC1
!
interface Range TenGigabitEthernet 1/47-1/48
 description Link to BMC_Switch
!
interface fortyGigE 1/53
 description To ToR2:p53
!
interface fortyGigE 1/54
 description To ToR2:p54
!
interface Vlan 50
 description SWITCH_MGMT
!
interface Vlan 60
 description BMC_OOB_MGMT
!
interface Vlan 70
```

```
 description SERVER_MGMT
!
interface Vlan 80
 description STORAGE01
!
interface Vlan 90
 description STORAGE02
!
interface Vlan 150
 description TENANT_NET
```

S4048-2

```
IDENTIFICATION / CREDENTIALS
!NOTE: Switch Hostname
hostname R7-S4048.2
!
!NOTE:  CONFIGURE SECURITY ACCESS LEVELS
enable password 0 ChangeMe
username admin password 0 ChangeMe privilege 15
ip ssh server enable
!
!******NOTE: OPTIONAL, TELNET CONVENIENT - NOT SECURE
ip telnet server enable
line console 0
 password ChangeMe
!
-----------------------------------------------------
!NOTE: CONFIGURE SWITCH VLT
!******VLTi - STATIC AGGREGATE PORTS
interface range fortyGigE 1/49-1/50
 no ip address
 dcb-map RDMA
 no shutdown
!
interface Port-channel 100
 description VLTi-ToR2
 no ip address
 channel-member fortyGigE 1/49,1/50
 no shutdown
!
!******VLT HEART-BEAT CONFIGURATION
interface ManagementEthernet 1/1
 ip address 172.18.200.2/30
 no shutdown
!
!******VLT DOMAIN CONFIGURATION
vlt domain 1
 peer-link port-channel 100
 back-up destination 172.18.200.1
 primary-priority 2
 system mac-address f4:8e:38:51:DE:11
 unit-id 1
!
-----------------------------------------------------
!NOTE: CUSTOMER UPLINK Can be any open FortyGig or TenGig Port/s
!NOTE: Refer to your NPE for best approach specific to the customer site
-----------------------------------------------------------------------
!NOTE: SERVER HOST/NODE INTERFACE CONFIGURATIONS
!****** Enable DCB, MAP RDMA Policy to Eth Interfaces
dcb enable
!
dcb-map RDMA
 priority-group 0 bandwidth 50 pfc off
 priority-group 3 bandwidth 50 pfc on
 priority-pgid 0 0 0 3 0 0 0 0
!
interface range TenGigabitEthernet 1/1-1/16
 no ip address
```

```
 portmode hybrid
 switchport
 spanning-tree rstp edge-port bpduguard
 spanning-tree 0 portfast
 dcb-policy buffer-threshold RDMA
 dcb-map RDMA
 no shutdown
!
-----------------------------------------------------
!NOTE: MANAGEMENT SWITCH-TO-SWITCH LINKS
!NOTE: For some Customers like DoD the OOB switch is "isolated"
interface TenGigabitEthernet 1/48
 no ip address
 port-channel-protocol LACP
  port-channel 1 mode active
 no shutdown
!
interface Port-channel 1
 description To BMCTe52
 no ip address
 switchport
 vlt-peer-lag port-channel 1
 no shutdown
-----------------------------------------------------
!VLAN NETWORK CONFIGURATIONS
!******VRRP VIRTUAL GATEWAY IP PER BCAST DOMAIN
interface Vlan 50
 ip address 10.128.4.38/29
 tagged Port-channel 1
 vrrp-group 50
  virtual-address 10.128.4.33
 no shutdown
!
interface Vlan 60
 ip address 10.128.4.94/27
 tagged Port-channel 1
 vrrp-group 60
  virtual-address 10.128.4.65
 no shutdown
!
interface Vlan 70
 ip address 10.128.4.254/26
 tagged TenGigabitEthernet 1/1-1/16
 vrrp-group 70
  virtual-address 10.128.4.193
 no shutdown
!
interface Vlan 80
 ip address 10.128.4.126/27
 tagged TenGigabitEthernet 1/1-1/16
 vrrp-group 80
  priority 10
  virtual-address 10.128.4.97
 no shutdown
!
interface Vlan 90
 ip address 10.128.4.157/27
 tagged TenGigabitEthernet 1/1-1/16
 vrrp-group 90
  priority 10
  virtual-address 10.128.4.129
 no shutdown
!
interface Vlan 150
 ip address 10.128.25.254/24
 TenGigabitEthernet 1/1-1/16
 vrrp-group 150
  virtual-address 10.128.25.1
 no shutdown
```

```
!
-----------------------------------------------------
!NOTE:  DEFINE DEFAULT-GATEWAY
management route 0.0.0.0/0 10.128.4.33
!
-----------------------------------------------------
!NOTE:  LLDP enabled for debugging capabilities
protocol lldp
 advertise dot1-tlv port-protocol-vlan-id port-vlan-id
 advertise dot3-tlv max-frame-size
 advertise management-tlv management-address system-capabilities system-description system-name
 advertise interface-port-desc
!
-----------------------------------------------------
!NOTE: INTERFACE DESCRIPTORS
interface TenGigabitEthernet 1/1
 description NODE01:NDC1
!
interface TenGigabitEthernet 1/2
 description NODE02:NDC1
!
interface TenGigabitEthernet 1/3
 description NODE03:NDC1
!
interface TenGigabitEthernet 1/4
 description NODE04:NDC1
!
interface TenGigabitEthernet 1/5
 description NODE05:NDC1
!
interface TenGigabitEthernet 1/6
 description NODE06:NDC1
!
interface TenGigabitEthernet 1/7
 description NODE07:NDC1
!
interface TenGigabitEthernet 1/8
 description NODE08:NDC1
!
interface TenGigabitEthernet 1/9
 description NODE09:NDC1
!
interface TenGigabitEthernet 1/10
 description NODE10:NDC1
!
interface TenGigabitEthernet 1/11
 description NODE11:NDC1
!
interface TenGigabitEthernet 1/12
 description NODE12:NDC1
!
interface TenGigabitEthernet 1/13
 description NODE13:NDC1
!
interface TenGigabitEthernet 1/14
 description NODE14:NDC1
!
interface TenGigabitEthernet 1/15
 description NODE15:NDC1
!
interface TenGigabitEthernet 1/16
 description NODE16:NDC1
!
interface Range TenGigabitEthernet 1/47-1/48
 description Link to BMC_Switch
!
interface fortyGigE 1/53
 description To ToR2:p53
!
```

```
interface fortyGigE 1/54
 description To ToR2:p54
!
interface Vlan 50
 description SWITCH_MGMT
!
interface Vlan 60
 description BMC_OOB_MGMT
!
interface Vlan 70
 description SERVER_MGMT
!
interface Vlan 80
 description STORAGE01
!
interface Vlan 90
 description STORAGE02
!
interface Vlan 150
 description TENANT_NET
```

B

Firewall port requirements

Table 19. Firewall port requirements

Source	Target	Protocol	Port	Comment
Any	Domain Controllers	TCP/UDP	53	DNS
		TCP/UDP	88	Kerberos
		UDP	123	NTP
		TCP	135	RPC, EMP
		UDP	137	NetLogon, NetBIOS Name Resolution
		UDP	138	DFSN, NetLogon, NetBIOS, Datagram Service
		TCP	139	DSFN, NetBIOS Session Service, NetLogon
		TCP/UDP	389	LDAP
		TCP/UDP	445	SMB, CIFS, SMB2, DFSN, LSARPC, NbtSS, NetLogonR, SAMR, SrvSvc
		TCP/UDP	464	Kerberos change/set password
		TCP	636	LDAP (SSL)
		TCP	3268	Global Catalog
		TCP	3269	Global Catalog (SSL)
		TCP	5722	RPC, DFSR (SYSVOL)
		TCP	9389	SOAP
		TCP	1025:5000	RPC, DCOM, EPM, DRSUAPI, NetLogon, SamR, FRS (2003)
		UDP	1025:5000	DCOM, RPC, EPM (2003)
		TCP	49152:65535	RPC, DCOM, EPM, DRSUAPI, NetLogonR, SamR, FRS (2008)
		UDP	49152:65535	DCOM, RPC, EPM (2008)
Local Subnet	All Hosts and VMs	UDP	137:138	Allow Name/Share Resolution

Source	Target	Protocol	Port	Comment
		TCP	139	Allow Name/Share Resolution
Any	Console VM	TCP	3389	Remote Desktop
WSUS (on VMM VM)	Any	TCP	80	SWUS Updates (HTTP)
		TCP	443	SWUS Updates (HTTPS)

C

Sample deployment checklists

Table 20. Sample checklist

Fields	Values
AD Domain FQDN	S2dlab.local
Domain Administrator or equivalent credentials	Username: S2dlab\administrator Password: <DO NOT WRITE IT DOWN>
DNS Server addresses	dns.s2dlab.local
VMM Server FQDN	vmm.s2dlab.local
VMM Administrator Credentials	Username: S2dlab\vmmadmin Password: <DO NOT WRITE IT DOWN>
SCOM Server FQDN	scom.s2dlab.local
SCOM Administrator Credentials	Username: S2dlab\scomadmin Password: <DO NOT WRITE IT DOWN>
WSUS Server FQDN (if needed)	wsus.s2dlab.local

Table 21. Sample checklist

Traffic Class	Purpose	Minimum IP addresses needed	VLAN ID	Tagged / Untagged	IP address space	VLAN IP Addresses
Out of band	Required for OOB management of server nodes and TOR switches	18	100	Untagged	/27	OOB: 172.16.100.1
Host Management	Management of cluster and cluster nodes	17	102	Tagged	/27	TOR1: NA TOR2: NA
Storage 1	SMB traffic	16	103	Tagged	/27	TOR1: NA TOR2: NA
Storage 2	SMB Traffic	16	104	Tagged	/27	TOR1: NA TOR2: NA

Table 22. Sample checklist

Fields	Values
OOB Switch hostname	S2D-OOB
TOR1 Switch hostname	S2D-TOR1
TOR2 Switch hostname	S2D-TOR2
Enable password	<DO NOT WRITE IT DOWN>
Additional user/password	NA
IP route on OOB (if needed)	NA
IP route on TOR1 / TOR2 (if needed)	NA
DCB Bandwidth for SMB traffic	50%

Table 23. Sample checklist

Fields	Values
Virtual Switch/Logical Switch Name	S2DSwitch
Management Adapter/Logical and VM Network Name	Management
Storage 1 Adapter/Logical and VM Network Name	Storage1
Storage 2 Adapter/ Logical and VM Network Name	Storage2
Uplink Port Profile Name (VMM Only)	S2D_UP
Management IP Pool range (VMM only)	172.16.102.0/27
Storage1 IP pool range (VMM only)	172.16.103.0/27
Storage2 IP pool range (VMM only)	172.16.104.0/27

Table 24. Sample checklist

	Host Name	Management IP	Storage1 IP	Storage2 IP	OOB IP	OOB Host name
Node 1	S2DNode01	172.16.102.51	172.16.103.51	172.16.104.51	172.16.100.51	S2D-DRAC-1
Node 2	S2DNode02	172.16.102.52	172.16.103.52	172.16.104.52	172.16.100.52	S2D-DRAC-2
Node 3	S2DNode03	172.16.102.53	172.16.103.53	172.16.104.53	172.16.100.53	S2D-DRAC-3
Node 4	S2DNode04	172.16.102.54	172.16.103.54	172.16.104.54	172.16.100.54	S2D-DRAC-4
Node 5	S2DNode05	172.16.102.55	172.16.103.55	172.16.104.55	172.16.100.55	S2D-DRAC-5
Node 6	S2DNode06	172.16.102.56	172.16.103.56	172.16.104.56	172.16.100.56	S2D-DRAC-6

	Host Name	Management IP	Storage1 IP	Storage2 IP	OOB IP	OOB Host name
Node 7	S2DNode07	172.16.102.57	172.16.103.57	172.16.104.57	172.16.100.57	S2D-DRAC-7
Node 8	S2DNode08	172.16.102.58	172.16.103.58	172.16.104.58	172.16.100.58	S2D-DRAC-8
Node 9	S2DNode09	172.16.102.59	172.16.103.59	172.16.104.59	172.16.100.59	S2D-DRAC-9
Node 10	S2DNode10	172.16.102.60	172.16.103.60	172.16.104.60	172.16.100.60	S2D-DRAC-10
Node 11	S2DNode11	172.16.102.61	172.16.103.61	172.16.104.61	172.16.100.61	S2D-DRAC-11
Node 12	S2DNode12	172.16.102.62	172.16.103.62	172.16.104.62	172.16.100.62	S2D-DRAC-12
Node 13	S2DNode13	172.16.102.63	172.16.103.63	172.16.104.63	172.16.100.63	S2D-DRAC-13
Node 14	S2DNode14	172.16.102.64	172.16.103.64	172.16.104.64	172.16.100.64	S2D-DRAC-14
Node 15	S2DNode15	172.16.102.65	172.16.103.65	172.16.104.65	172.16.100.65	S2D-DRAC-15
Node 16	S2DNode16	172.16.102.66	172.16.103.66	172.16.104.66	172.16.100.66	S2D-DRAC-16

D

VMM preparation

If System Center Virtual Machine Manager (VMM) is used for creating and configuring Microsoft Storage Spaces Direct Cluster, VMM needs to be prepared to ensure that the uplink port profile, logical networks, logical switch, physical computer profile, and so on.

This section covers the steps involved in preparing VMM for cluster creation. For configuration specifics, see the Deployment checklist section.

Topics:

- Create VMM host group
- Add Run as account for cluster creation
- VMM logical network details
- Create and configure logical and VM networks
- Create IP address pools
- Create an uplink port profile
- Create a logical switch

Create VMM host group

A new VM host group must be created to add the newly deployed Hyper-V cluster nodes. This can be done by using the *New-SCHostGroup* cmdlet.

```
New-SCVMHostGroup -Name SpacesDirectHosts
```

You can verify the host group creation by using the *Get-SCVMHostGroup* cmdlet.

```
PS C:\> Get-SCVMHostGroup -Name SpacesDirectHosts
AllowUnencryptedTransfers : False
CreationDate              : 3/30/2017 1:41:54 PM
Creator                   : S2DLAB\Administrator
Description               :
ID                        : ed4e638e-77e3-48f5-859f-7caef0c94915
InheritNetworkSettings    : True
IsFullyCached             : True
IsRoot                    : False
MarkedForDeletion         : False
ModificationDate          : 3/30/2017 1:41:54 PM
ModifiedBy                : S2DLAB\Administrator
Name                      : SpacesDirectHosts
ParentHostGroup           : All Hosts
Path                      : All Hosts\SpacesDirectHosts
ServerConnection          :
Microsoft.SystemCenter.VirtualMachineManager.Remoting.ServerConnection
```

Add Run as account for cluster creation

When using VMM for cluster creation and configuration, a run as account is needed for joining the computers to the domain.

NOTE: PowerShell Commands in this section and the subsequent sections for VMM preparation require System Center VMM PowerShell module. Ensure that the system where these commands are being run has access to the VMM server and has the VMM PowerShell module installed.

```
$credential = Get-Credential -Message 'Enter Domain Administrator Credentials'
New-SCRunAsAccount -Name Administrator -Credential $credential
```

The account creation can be verified using the *Get-SCRunAsAccount* cmdlet.

```
PS C:\> Get-SCRunAsAccount -Name Administrator
Name                  : Administrator
UserName              : administrator
Domain                : s2dlab
Enabled               : True
IsBuiltIn             : False
GrantedToList         : {}
UserRoleID            : 75700cd5-893e-4f68-ada7-50ef4668acc6
UserRole              : Administrator
Owner                 : S2DLAB\Administrator
ObjectType            : RunAsAccount
Accessibility         : Public
IsViewOnly            : False
Description           :
AddedTime             : 3/30/2017 1:31:02 PM
ModifiedTime          : 3/30/2017 1:31:02 PM
MostRecentTask        : Create new RunAs Account
ServerConnection      : Microsoft.SystemCenter.VirtualMachineManager.Remoting.ServerConnection
ID                    : 82f86a32-3708-404e-bdd1-6ad5c82a74aa
MarkedForDeletion     : False
IsFullyCached         : True
MostRecentTaskIfLocal : Create new RunAs Account
```

VMM logical network details

For creating VMM logical networks and VM networks, and assigning IP Pools, there are certain settings that the PowerShell cmdlets would require. Commands in the subsequent sections use the details defined in the following PowerShell hashtable for configuration.

```
$logicalNetworks = @(
    #Management Network
    @{
        Name   = 'Management'
        Subnet = "172.16.102.0/24"
        VLANID = 102
        IsManagement = $true

        #Used for IP Pool
        StartIP = '172.16.102.51'
        EndIP = '172.16.102.100'
        DNSServer = '172.16.102.202'
        DNSSuffix = 'S2dlab.local'
        GatewayAddress = '172.16.102.1'
    },
    #Storage 1 Network
    @{
        Name   = 'Storage1'
        Subnet = "172.16.103.0/24"
        VLANID = 103
        IsManagement = $false

        #Used for IP Pool
        StartIP = '172.16.103.51'
        EndIP = '172.16.103.100'
    },
    #Storage 2 Network
    @{
        Name   = 'Storage2'
        Subnet = "172.16.104.0/24"
```

```
        VLANID = 104
        IsManagement = $false

        #Used for IP Pool
        StartIP = '172.16.104.51'
        EndIP = '172.16.104.100'
    }
)
```

Create and configure logical and VM networks

For Storage Spaces Direct HCI cluster deployment and configuration, three logical network definitions, which are host management, Storage 1, and Storage 2 networks, must be created in VMM. These logical networks should be created as VLAN-based independent networks. The Deployment Checklist section captures the necessary settings that are needed for creating these logical networks.

For VMM to create and configure the network adapters in the host OS, VM networks must be created and associated with the right logical network and the network site mapped as VM subnet in the VMM fabric.

```
$hostGroup = Get-SCVMHostGroup -Name 'SpacesDirectHosts'

foreach ($logicalNet in $logicalNetworks)
{
    #VLAN-based independent logical network
    $logicalNetwork = New-SCLogicalNetwork -Name $logicalNet.Name -
LogicalNetworkDefinitionIsolation $true -EnableNetworkVirtualization $false -UseGRE $false -
IsPVLAN $false
    $subnetVlan = New-SCSubnetVLan -Subnet $logicalNet.Subnet -VLanID $logicalNet.VLANID
    $logicalNetDefinition = New-SCLogicalNetworkDefinition -Name "$($logicalNet.Name)_0" -
LogicalNetwork $logicalNetwork -VMHostGroup $hostGroup -SubnetVLan $subnetVlan -
RunAsynchronously

    #Create VM Network
    $vmNetwork = New-SCVMNetwork -Name $logicalNet.Name -LogicalNetwork $logicalNetwork -
IsolationType "VLANNetwork"
    $vmSubnet = New-SCVMSubnet -Name "$($logicalNet.Name)_0" -LogicalNetworkDefinition
$logicalNetDefinition -SubnetVLan $subnetVlan -VMNetwork $vmNetwork
}
```

The creation of logical networks can be verified by using the Get-ScLogicalNetwork cmdlet.

```
PS C:\> foreach ($logicalNet in $logicalNetworks) { Get-SCLogicalNetwork -Name $logicalNet.Name
| Select Name, IsLogicalNetworkDefinitionIsolated }
Name       IsLogicalNetworkDefinitionIsolated
----       ----------------------------------
Management                                True
Storage1                                  True
Storage2                                  True
```

The creation of VM Networks can be verified by using the Get-SCVMNetwork cmdlet.

```
Name       LogicalNetwork
----       --------------
Management Management
Storage1   Storage1
Storage2   Storage2
```

Create IP address pools

As a part of the Storage Spaces Direct cluster creation and configuration, VMM creates the network adapters in the host OS for management, Storage 1, and Storage 2, VMM assigns IP addresses for each VM adapter in the management OS. You must supply the

necessary IP address for each subnet as an IP address pool in VMM. VMM retrieves the IP address from the pool and configures the addresses on each VM network adapter in the management OS.

```
foreach ($logicalNet in $logicalNetworks)
{
    # Get Logical Network
    $logicalNetwork = Get-SCLogicalNetwork -Name $logicalNet.Name

    # Get Logical Network Definition
    $logicalNetworkDefinition = Get-SCLogicalNetworkDefinition -Name "$($logicalNet.Name)_0"

    $gateway = @()
    if ($logicalNet.GatewayAddress)
    {
        $gateway += New-SCDefaultGateway -IPAddress $logicalNet.GatewayAddress -Automatic
    }

    New-SCStaticIPAddressPool -Name "$($logicalNet.Name)-IPPool" -LogicalNetworkDefinition
$logicalNetworkDefinition `
                              -Subnet $logicalNet.Subnet -IPAddressRangeStart
$logicalNet.StartIP `
                              -IPAddressRangeEnd $logicalNet.EndIP -DefaultGateway $gateway `
                              -DNSServer $logicalNet.DNSServer -DNSSuffix "" -DNSSearchSuffix
$logicalNet.DNSSuffix -RunAsynchronously
}
```

Verify the IP pool creation using the Get-SCStaticIPAddressPool cmdlet.

```
PS C:\> foreach ($logicalNet in $logicalNetworks)
>> {
>>     Get-SCStaticIPAddressPool -Name "$($logicalNet.Name)-IPPool" | Select Name,
IPAddressRange*
>> }
>>

Name              IPAddressRangeStart IPAddressRangeEnd
----              ------------------- -----------------
Management-IPPool 172.16.102.51       172.16.102.100
Storage1-IPPool   172.16.103.51       172.16.103.100
Storage2-IPPool   172.16.104.51       172.16.104.100
```

Create an uplink port profile

The Storage Spaces Direct HCI cluster requires a Switch Embedded Team (SET) configuration for which VMM should have an uplink port profile created with relevant configurations such as teaming mode set to Switch Independent and Load Balancing algorithm set to Host Default. The network configuration in the uplink port profile should have the relevant network sites selected as support networks. For example, this network should include all logical networks created in the section Create and configure logical and VM networks.

```
$definition = @()
foreach ($logicalNet in $logicalNetworks)
{
    $definition += Get-SCLogicalNetworkDefinition -Name "$($logicalNet.Name)_0"
}
New-SCNativeUplinkPortProfile -Name "S2D_UPP" -Description "Uplink Port profilea" -
LogicalNetworkDefinition $definition -EnableNetworkVirtualization $false -
LBFOLoadBalancingAlgorithm "HostDefault" -LBFOTeamMode "SwitchIndependent" -RunAsynchronously
```

The creation of uplink port profile can be verified using the *Get-SCNativeUplinkPortProfile* cmdlet.

```
PS C:\> Get-SCNativeUplinkPortProfile -Name S2D_UPP
Name                        : S2D_UPP
Description                 : Uplink Port profilea
EnableNetworkVirtualization : False
LogicalNetworkDefinitions   : {Storage2_0, Management_0, Storage1_0}
LBFOLoadBalancingAlgorithm  : HostDefault
LBFOTeamMode                : SwitchIndependent
```

```
ServerConnection             :
Microsoft.SystemCenter.VirtualMachineManager.Remoting.ServerConnection
ID                           : b4508131-16a7-4ad3-90c7-e82a78943f57
IsViewOnly                   : False
ObjectType                   : NativeUplinkPortProfile
MarkedForDeletion            : False
IsFullyCached                : True
```

Create a logical switch

After the VMM networking artifacts such as logical networks, VM networks, IP address pools, and uplink port profile are created, a logical switch must be configured. A logical switch combines all the other networking artifacts into a deployable entity. When performing a bare metal deployment, VMM uses the logical switch definition to identify the configuration required for the target host networking.

```
$logicalSwitch = New-SCLogicalSwitch -Name "S2DSwitch" -Description "" -EnableSriov $false -
SwitchUplinkMode "EmbeddedTeam" -MinimumBandwidthMode "Weight"

# Get Native Uplink Port Profile
$nativeUppVar = Get-SCNativeUplinkPortProfile -Name 'S2D_UPP'
$uppSetVar = New-SCUplinkPortProfileSet -Name "S2D_UPP" -LogicalSwitch $logicalSwitch -
NativeUplinkPortProfile $nativeUppVar -RunAsynchronously

foreach ($logicalNet in $logicalNetworks)
{
    # Get VM Network
    $vmNetwork = Get-SCVMNetwork -Name $logicalNet.Name

    # Get VMSubnet
    $vmSubnet = Get-SCVMSubnet -Name "$($logicalNet.Name)_0"

    # Get Static IP Address Pool
    $ipV4Pool = Get-SCStaticIPAddressPool -Name "$($logicalNet.Name)-IPPool"
    New-SCLogicalSwitchVirtualNetworkAdapter -Name $logicalNet.Name -UplinkPortProfileSet
$uppSetVar -RunAsynchronously -VMNetwork $vmNetwork -VMSubnet $vmSubnet -
IsUsedForHostManagement $logicalNet.IsManagement -IPv4AddressType "Static" -IPv6AddressType
"Dynamic" -IPv4AddressPool $ipV4Pool
}
```

To get the details of the new logical switch, use the Get-ScLogicalSwitch cmdlet.

```
PS C:\> Get-SCLogicalSwitch -Name S2dSwitch
Name                         : S2DSwitch
Description                  :
EnableSriov                  : False
MinimumBandwidthMode         : Weight
UplinkMode                   : EmbeddedTeam
VirtualSwitchExtensions      : {}
ManagedByMSNetworkController : False
EnablePacketDirect           : False
ServerConnection             :
Microsoft.SystemCenter.VirtualMachineManager.Remoting.ServerConnection
ID                           : 9efe8634-5eed-4ddb-a141-753ddca21790
IsViewOnly                   : False
ObjectType                   : LogicalSwitch
MarkedForDeletion            : False
IsFullyCached                : True
```