

Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform 13



Dell EMC Service Provider Solutions

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Notes, cautions, and warnings

-  A **Note** indicates important information that helps you make better use of your system.
-  A **Caution** indicates potential damage to hardware or loss of data if instructions are not followed.
-  A **Warning** indicates a potential for property damage, personal injury, or death.

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Chapter 1

Overview

Topics:

- [Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform 13](#)
- [Hardware options](#)
- [Networking and network services](#)
- [Storage considerations](#)
- [Taxonomy](#)

An OpenStack® based cloud is now a common need by many organizations and Dell EMC with Red Hat have worked together to build a jointly engineered and validated edge architecture, using Red Hat OpenStack Platform's Distributed Compute Nodes (DCN) capability, that details software, hardware, and integration points of all solution components. The architecture provides prescriptive guidance and recommendations for:

- Edge compute nodes
- Network design
- Software layout
- Offers suggestion for other system configurations

Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform 13

This reference architecture guide is built on Red Hat OpenStack Platform's (DCN), which is based on the 17th OpenStack release codename Queens. Red Hat OpenStack Platform 13 is a containerized version offering greater scalability, resiliency and user experience.

Red Hat OpenStack Platform 13

The Red Hat OpenStack Platform (RHOSP) provides the foundation to build a private or public Infrastructure-as-a-Service (IaaS) cloud on Red Hat Enterprise Linux Server 7.7. It offers a massively scalable, fault-tolerant platform for the development of cloud-enabled workloads or Telco Cloud for Service Providers.


It is packaged so that available physical hardware can be turned into a private, public, or hybrid cloud platform including:


- High-availability control plane
- Fully distributed object storage
- Persistent block-level storage
- Virtual-machine provisioning engine and image storage
- Authentication and authorization mechanism
- Integrated networking

Distributed Compute Nodes (DCN)

DCN, as part of Red Hat OpenStack Platform 13, leverages OpenStack features like Availability Zones and provisioning over routed L3 networks with Ironic, to enable deployment of compute nodes to remote locations. For example, a service provider may deploy several DCN sites to scale out a virtual Radio Access Network (vRAN) implementation.

DCN has several caveats that must be considered when planning remote compute site deployment(s):

- Only Compute can be run at an edge site, other services such as persistent block storage are not supported at this time
 - Image considerations - Overcloud images for bare-metal provisioning of the remote compute nodes are pulled from the undercloud. Also, instance images for VMs running on edge nodes will initially be fetched from the control plane the first time they are used, subsequent instances will use the locally cached image. Images are large files, implying a fast, reliable connection to the director node and control plane is required.
 - Networking:
 - Latency - a round-trip between the control plane and remote site must be under 100ms or stability of the system could become compromised
 - Drop-outs - If an edge site temporarily loses its connection to the control plane, then no OpenStack control plane API or CLI operations can be executed until connectivity is restored to the site. For example, existing workloads will continue to run, but no new instances can be started until the connection is restored. Any control functions like snapshotting, live migration etc. cannot occur until the link between the central cloud and edge site is restored, as all control features are dependent on the control plane being able to communicate with the edge site.
-  **Note:** Connectivity issues are DCN site specific, losing connection to one DCN site does not affect other DCN sites.
- This guide recommends using Provider networks for DCN workloads at this time. Depending on the type of workloads you are running on the edge nodes, and existing networking policies, there are several ways for configuring instance IP addressing:

- Static IPs using config-drive in conjunction with cloud-init - Utilizing config-drive as the metadata API server leverages the virtual media capabilities of Nova, which means there are no Neutron Metadata agents or DHCP relay required to assign a IP address to edge instances.
- DHCP relay - Forwards DHCP requests to Neutron at central site.
 -  **Note:** A separate DHCP relay instance is required for each provider network.
- External DHCP server at edge site - in this case instance IP addresses are not managed by neutron.
- Inter-compute node awareness - A limitation of Neutron is that it is not able to identify individual compute nodes as remote or local. Therefore each compute node, across all DCN sites, including the central cloud, will have a list of every other compute node. Depending on your networking configuration this can happen by:
 - When using VXLAN - First, the same Neutron networks must be configured at every site, then every Compute node will build a VXLAN tunnel (through the control plane) to all Controllers and compute nodes regardless if they are remote or local.
 - VLAN only - This method requires that identical network bridges and VLANs are used across all sites.

DCN Topology Example

It is possible with DCN to deploy any number of remote compute sites, each with it's own Availability Zone (AZ). Once the site is provisioned, specifying the site's AZ when launching an instance is all that is required to launch an instance, for example:

```
openstack server create --flavor tiny --image cirros \
--network edge-management-vxlan \
--security-group edge-management \
--availability-zone AZ_DCN_2 \
edge_vm_1
```

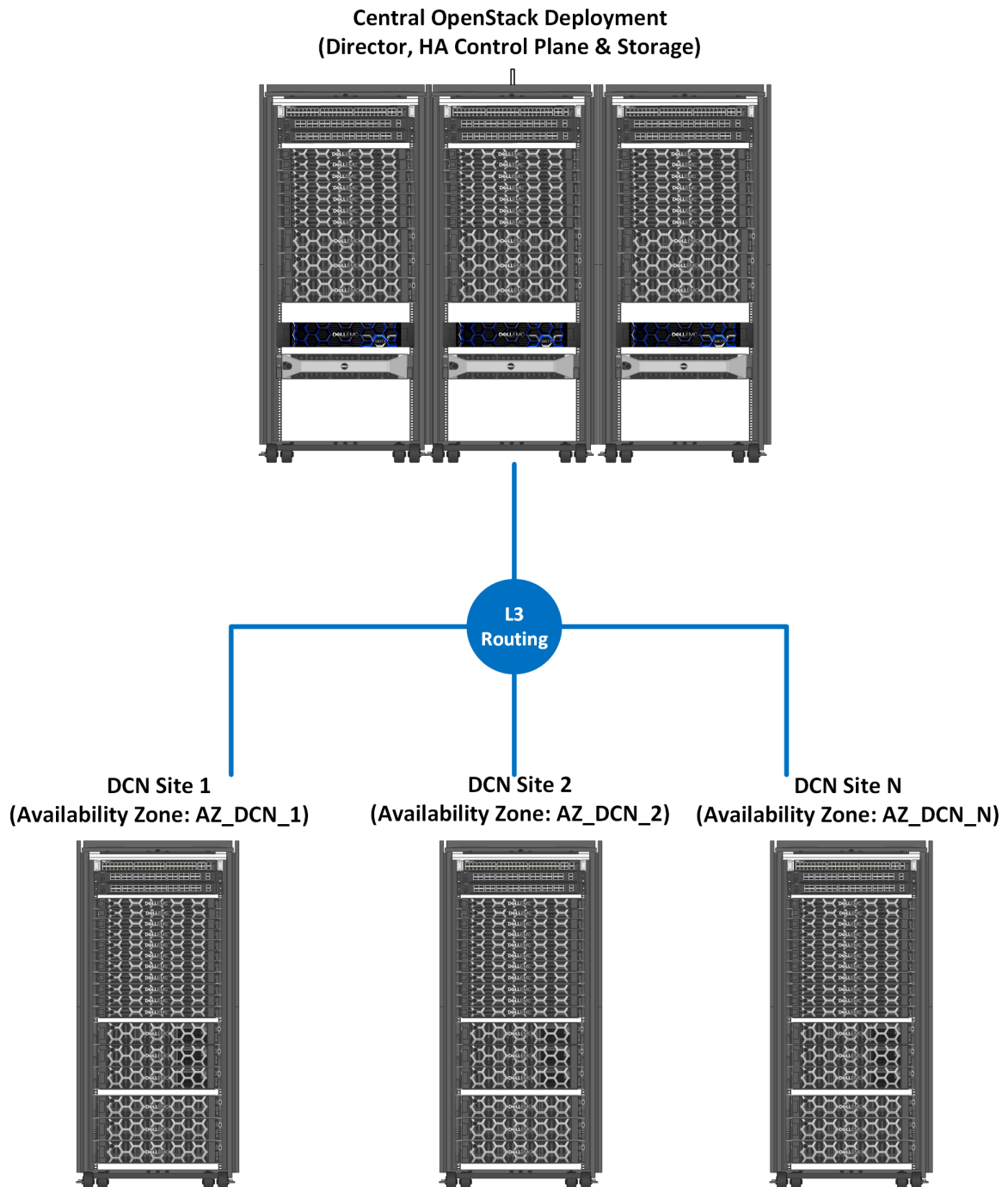


Figure 1: DCN Topology

Key benefits

The Dell EMC Edge Reference Architecture for RHOSP offers several benefits to help service providers and high-end enterprises rapidly implement Dell EMC hardware and Red Hat OpenStack Platform software at the network edge:

- Ready-to-use solution: The reference architecture has been fully engineered, validated, tested by Dell EMC laboratories and documented by Dell EMC. This decreases your investment and deployment risk, and it enables faster deployment time.

- Long lifecycle deployment: PowerEdge R-Series servers, recommended in the architecture, include long-life Intel® Xeon® processors which reduces your investment risk and protects your investment for the long-term.
- World-class professional services: The reference architecture includes Dell EMC professional services that spans consulting, deployment, and design support to guide your deployment needs.
- Customizable solution: The architecture is prescriptive, but it can be customized to address each customer's unique virtual network function (vNF), like virtual Radio Access Network (vRAN) or other edge workload requirements.
- Co-engineered and Integrated: OpenStack depends upon Linux for performance, security, hardware enablement, networking, storage, and other primary services. The Red Hat OpenStack Platform delivers an OpenStack distribution with the proven performance, stability, and scalability of RHEL 7.7 enabling you to focus on delivering the services your customers want, instead of focusing on the underlying operating platform.
- Deploy with confidence, as the Red Hat OpenStack Platform DCN provides hardened and stable branch releases of OpenStack and Linux. The Red Hat OpenStack Platform is a long life release product supported by Red Hat for a three (3) year "production phase" life cycle, well beyond the six-month release cycle of unsupported, community OpenStack. Red Hat OpenStack Platform life cycle support policies can be found at <https://access.redhat.com/support/policy/updates/openstack/platform>
- Take advantage of broad application support. Red Hat Enterprise Linux, running as guest virtual machines, provides a stable application development platform with a broad set of ISV certifications. You can therefore rapidly build and deploy your cloud applications.
- Avoid vendor lock-in by moving to open technologies, while maintaining your existing infrastructure investments.
- Benefit from the world's largest partner ecosystem: Red Hat has assembled the world's largest ecosystem of certified partners for OpenStack compute, storage, networking, ISV software, and services for Red Hat OpenStack Platform deployments. This ensures the same level of broad support and compatibility that customers enjoy today in the Red Hat Enterprise Linux ecosystem.
- Dell EMC is the largest infrastructure provider in the world with all workloads and platforms being validated on it.
- Upgrade of Red Hat OpenStack Platform director-based installations.
- Bring security to the cloud. Rely upon the SELinux military-grade security and container technologies of Red Hat Enterprise Linux to prevent intrusions and protect your data, when running in public or private clouds.

Red Hat OpenStack Platform and DCN Further Reading

For more on Red Hat OpenStack Platform 13 and DCN please see:

- [Red Hat OpenStack Platform 13](#)
- [Deploying Distributed Compute Nodes to Edge Sites](#)
- [Routed L3 Networks \(Spine Leaf Networking\)](#)
- [Scaling the Overcloud](#)

Hardware options

To reduce time spent on specifying hardware for an initial edge deployment, this Architecture Guide offers a full solution using validated Dell EMC PowerEdge server hardware designed to allow a wide range of configuration options, including optimized configurations for edge compute nodes.

Dell EMC recommends starting an edge site deployment using components from this Architecture Guide - Version 1.0 because the hardware and operations processes comprise a flexible foundation upon which to expand as your edge site deployment(s) grow, so your investment is protected.

As noted throughout this Edge Compute Architecture Guide - Version 1.0, Dell EMC constantly adds capabilities to expand this offering, and other hardware may be available at the time of this reading. Please contact your Dell EMC sales representative for more information on new hardware releases.

Networking and network services

Network configuration is based upon using the Neutron-based options supported by the RHOSP code base, and does not rely upon third-party drivers. This reference configuration is based upon the Neutron networking services using the ML2 drivers for OpenVswitch.

Physical networking includes:

- Core and layered networking capabilities
- 10GbE or/and 25GbE networking
- NIC bonding
- Redundant trunking top-of-rack (ToR) switches into core routers

This enables the Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform to operate in a full production environment.

See [Network architecture](#) on page 18 for guidelines. Detailed designs are available through Dell EMC Consulting Services.

Storage considerations

Currently, DCN only supports local storage (ephemeral), where each Compute node will host the ephemeral disks associated with each virtual machine. A destroyed VM also removes the ephemeral disk. With the hardware configuration for the compute nodes (see [Edge compute node configuration with 25GbE networking](#) on page 35) using up to 24 x 600GB disks in a RAID 10, there will be approximately 6.5 TB of storage available.

 **Note:** Future releases of DCN will support persistent volumes.

Taxonomy

The Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform is built using the following core OpenStack components, as delivered in the Red Hat OpenStack Platform. See [Table 1: Deployed core services](#) on page 13.


 **Note:** Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform assumes you already have a full central Red Hat OpenStack Platform 13 deployment running the control plane and all other core services, such as Cinder (block storage), Swift (object storage), Heat (orchestration), Keystone (identity) etc., see: [Dell EMC Ready Architecture for RHOSP](#)

Table 1: Deployed core services

Component	Code name
Compute	Nova
Networking	Neutron
Deployment/management	Tripleo (director)
Orchestration	Heat
Bare-metal provisioning	Ironic

The taxonomy presented in [Figure 2: Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform DCN Taxonomy](#) on page 14 reflects infrastructure components, and OpenStack-specific components, that are under active development by the community, Dell EMC, and Red Hat. The taxonomy reflects that there are two sides for cloud users:

- Dell EMC site-specific infrastructure
- Standards-based API (shown in pink) interactions

The standards-based APIs are the same between all OpenStack deployments, and let customers and vendor ecosystems operate across multiple clouds. The edge site-specific infrastructure combines open and proprietary software, Dell EMC hardware, and operational processes to deliver edge computing resources.

The implementation choices are highly specific to the requirements of each edge site. Many of these choices can be standardized and automated using the tools in this Edge Compute Architecture Guide. Conforming to best practices helps reduce operational risk by leveraging the accumulated experience of Dell EMC, Red Hat and the broader OpenStack community.

Red Hat OpenStack Platform director (Undercloud) is used to deploy the main overcloud and edge sites (DCN). The Undercloud is a single server that runs the Red Hat OpenStack Platform director, which is a subset of OpenStack services used to deploy, manage (hardware and software) and update the Overcloud and DCN sites. In the Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform the OpenStack edge compute servers comprise each edge site's DCN servers.

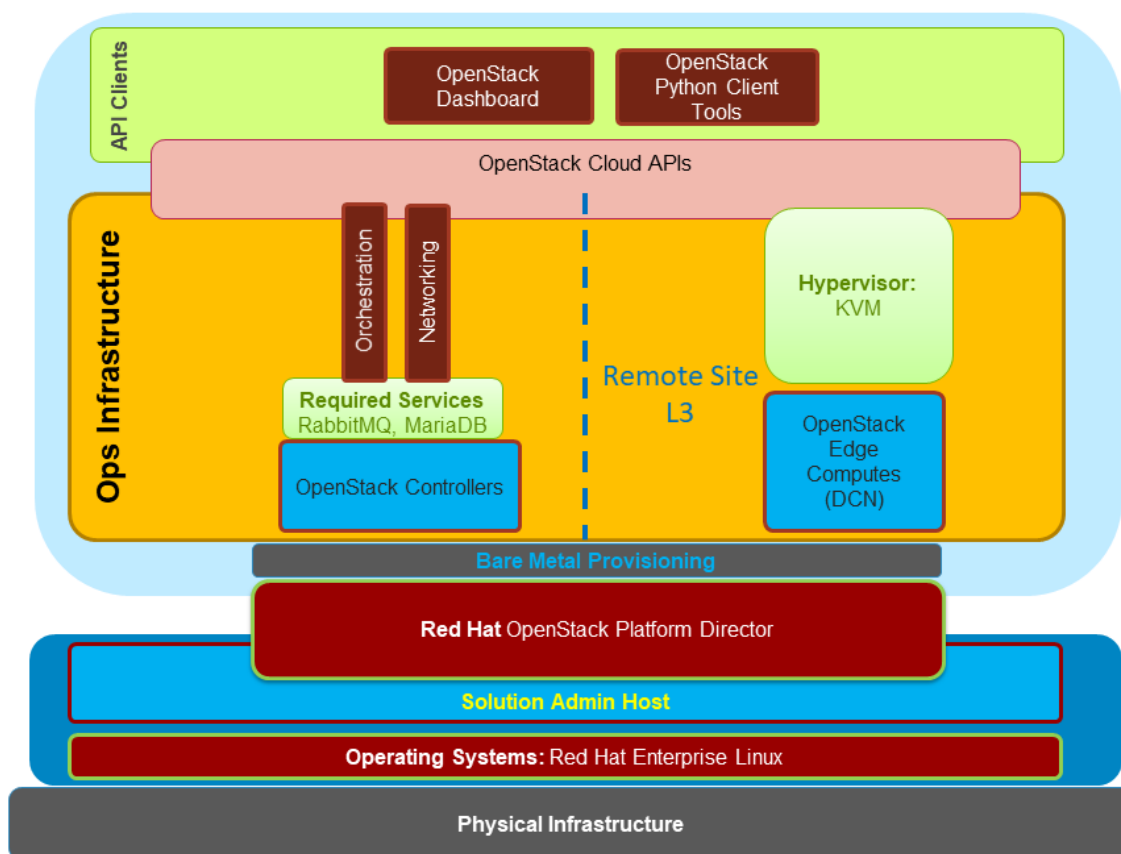


Figure 2: Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform DCN Taxonomy

Chapter 2

Edge compute server options

Topics:

- [Dell EMC PowerEdge R640 server](#)
- [Dell EMC PowerEdge R740 servers](#)
- [Dell EMC PowerEdge R740xd servers](#)
- [Configuration notes](#)

The base validated solution supports the Dell EMC PowerEdge R640, Dell EMC PowerEdge R740xd and Dell EMC PowerEdge R740 server lines.



Note: Please contact your Dell EMC sales representative for detailed parts lists.

Dell EMC PowerEdge R640 server

The Dell EMC PowerEdge R640 is the ideal dual-socket, 1U platform for dense scale-out cloud computing. The scalable business architecture of the Dell EMC PowerEdge R640 is designed to maximize application performance and provide the flexibility to optimize configurations based on the application and use case.

With the Dell EMC PowerEdge R640 you can create an NVMe cache pool and use either 2.5" or 3.5" drives for data storage. Combined with up to 24 DIMM's, 12 of which can be NVDIMM's, you have the resources to create the optimum configuration to maximize application performance in only a 1U chassis. This can simplify and speed-up deployments of the Red Hat OpenStack Platform.

Dell EMC PowerEdge R740 servers

Maximize your application performance with the Dell EMC PowerEdge R740 server, which brings you the perfect balance of accelerator cards, storage and compute resources in a 2U, 2-socket platform. With a wide range of GPU and FPGA options, the Dell EMC PowerEdge R740 has the versatility to adapt to virtually any application and provides the optimum platform for VDI deployments. The Dell EMC PowerEdge R740 offers up to 16 x 2.5" or 8 x 3.5" drives and iDRAC9, so you can scale to meet demands and simplify the entire IT lifecycle.

Dell EMC PowerEdge R740xd servers

The Dell EMC PowerEdge R740xd delivers a perfect balance between storage scalability and performance. The 2U two-socket platform is ideal for software defined storage. The R740xd versatility is highlighted with the ability to mix any drive type to create the optimum configuration of SSD and HDD for either performance, capacity or both.

The Dell EMC PowerEdge R740xd is the platform of choice for software defined storage and is the foundation of Red Hat Ceph Storage for this Architecture Guide - Version 1.0

Configuration notes

This guide contains the full bill of materials (BOM) listing for the Dell EMC PowerEdge R640, Dell EMC PowerEdge R740 and Dell EMC PowerEdge R740xd server configurations as used to support this Architecture Guide.

The Dell EMC PowerEdge R640, Dell EMC PowerEdge R740 and Dell EMC PowerEdge R740xd configurations are used with 10GbE or/and 25GbE networking. To ensure that the network is High Availability (HA) ready, an additional network card is required in each node. This guide outlines the supported cards and includes them as part of the solution.


 **CAUTION:** You must ensure that the firmware on all servers is up to date. Otherwise, unexpected results may occur.

Table 2: Dell EMC PowerEdge R640/Dell EMC PowerEdge R740/Dell EMC PowerEdge R740xd Tested BIOS and Firmware Versions

Product	Version
BIOS	2.2.11
iDRAC with Lifecycle controller	3.34.34.34
Intel® XXV710 NIC	18.8.9

Product	Version
PERC H730P Mini controller (Dell EMC PowerEdge R640)	25.5.5.0005
PERC H740P Mini controller (Dell EMC PowerEdge R640)	50.5.1-2633
HBA330 Mini (Dell EMC PowerEdge R740xd)	16.17.00.3
BOSS-S1 (Dell EMC PowerEdge R740xd)	2.5.13.3020

Table 3: Dell EMC tested firmware versions

Product	Version
S3048-ON firmware	Dell EMC Networking OS10 Enterprise OS version: 10.4.3.4 Build version: 10.4.3.4.213
S4048-ON firmware (optional)	Dell EMC Networking OS10 Enterprise OS version: 10.4.3.4 Build version: 10.4.3.4.213
S5232F-ON firmware	Dell EMC Networking OS10 Enterprise OS version: 10.4.3.4 Build version: 10.4.3.4.213

Chapter

3

Network architecture

Topics:

- [Network architecture overview](#)
- [Infrastructure layouts](#)
- [Network components](#)

This networking guide supports consistency in rapid deployments through minimal network configuration in an edge computing environment.

Network architecture overview

The Dell EMC Edge Reference Architecture for RHOSP uses the following switches:

- 2 - S5232F-ON as the Top-of-Rack (ToR) switches. ToR switches need to be redundant as they are a critical component for DCN to communicate with the central Overcloud control plane and workload provider network.
- 1 - S3048-ON as the management switch for remote out-of-band provisioning of the physical servers and communicating with the iDRAC.

Infrastructure layouts

The network consists of the following major network infrastructure layouts:

- **Data network infrastructure** - The server NICs and ToR switches.
- **Management network infrastructure** - The BMC management network, consisting of iDRAC ports and the out-of-band management ports the 1-rack unit (RU) S3048-ON switch.

Network components

The data network is primarily composed of the ToR and the aggregation switches. The following component blocks make up this network:


- [Server nodes](#) on page 19
- [Access switch or ToR](#) on page 20
- [Layer-2 and Layer-3 switching](#) on page 20
- [DCN site networks overview](#) on page 25
- [Out of Band Management network](#) on page 20

Server nodes

In order to create a highly-available solution, the network must be resilient to loss of a single network switch, network interface card (NIC) or bad cable. To achieve this, the network configuration uses channel bonding across the servers and switches.

There are several types (or modes) of channel bonding, but only one is recommended for the Solution. The OpenStack edge compute nodes should use:

- 802.3ad or LACP (mode = 4)

 **Note:** Other modes, such as `balance-rr (mode=0)`, `balance-xor (mode=2)`, `broadcast (mode=3)`, `balance-tlb (mode=5)`, and `balance-alb (mode=6)`, are not supported. Please check with your technician for current support status of `active-backup (mode = 1)`.

All nodes' endpoints are terminated to switch ports that have been configured for LACP bonding mode across two S5232F-ON ToR switches for 25GbE/100GbE configured with a Virtual Link Trunking interconnect (VLTi) across them.

Please contact your Dell EMC sales representative for other viable options.

Table 4: Channel bonding modes supported

	Channel bonding type
Node type	802.3ad (LACP mode 4)
OpenStack compute nodes	Yes (solution default)

A single port is an option when bonding is not required. However, it is neither used nor validated in the Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform. The need to eliminate single points of failure is taken into consideration as part of the design, and this option has been eliminated wherever possible.

Please contact your Dell EMC sales representative for other viable options.

Access switch or ToR

Dell EMC's recommended architecture uses VLT for HA between the two ToR switches, which enables the servers to terminate their Link Aggregation Group (LAG) interfaces (or bonds) into two different switches instead of one. This configuration enables active-active bandwidth utilization and provides redundancy within the rack if one ToR switch fails or requires maintenance. Dell EMC recommended ToR switch is:

- 10/25/100GbE connectivity – S5232F-ON

The ToR switches are responsible for providing the different network connections to the OpenStack control plane such as tenant networks and communication between the compute nodes of the DCN deployment.

ToR switches are also configured to enable different network function virtualization (NFV) features such as OVS-DPDK, SR-IOV, DVR, VLAN-Aware VMs etc.

Layer-2 and Layer-3 switching

DCN cluster network access requirements:

- Provisioning servers can happen solely over L3 with the exception that a DHCP relay is required for marshaling DHCP requests to the OpenStack control plane.
- The two network links - Provisioning, and Management - can have uplinks to a gateway device. The Provisioning network can use the Red Hat OpenStack Platform director as a proxy for pulling packages from a subscription server, or a gateway can be added.
- There are many tools available for Out of Band management, (OOB) for the iDRAC, which you can use after first adding the gateway to the network, and then updating the iDRAC.
- The ToR switches are connected to a gateway device, usually a router or firewall. This device will handle routing for all networks external to the DCN site.

Out of Band Management network

The management network for all the servers and switches is aggregated into a Dell EMC Networking S3048-ON switch and it is uplinked to the S5232F-ON switches.

The Out of Band (OOB) management network is used for several functions:

- The highly available software uses it to introspect, provision, reboot and partition servers. For example, OpenStack Ironic leverages the iDRAC for some of the provisioning steps.
- When an uplink to a router is added and the iDRACs configured to use it as a gateway, there are tools for monitoring the servers and gathering metrics on them.



Note: Discussion of this topic is beyond the scope of this document.

Chapter 4

Operational notes

Topics:

- *High availability*
- *Service layout*
- *Deployment overview*

This section provides a basic overview of several important system aspects.

High availability

In order for the solution to be ready for production, different systems need to be fault-tolerant. This Edge Compute Architecture Guide utilizes both hardware-based and software-based redundancy. This includes, but is not limited to:

- Operating systems are hosted on a RAID 10 hard drive set.
- Critical network connections from server to switch utilize network bonding.
- ToR switches are redundant.



Note:

- For external provider networks for VMs running at a DCN site, which are not managed by Neutron, network redundancy will need to be handled by the customer.
- It is assumed that the central cloud control plane has HA enabled according to the Dell EMC Ready Architecture for RHOSP Guide, see: <https://www.dell.com/support/article/us/en/19/sln310368/dell-emc-ready-architecture-for-red-hat-openstack-platform>.

Service layout

During a DCN site deployment, a subset of OpenStack services will be installed each Compute node.

Table 5: Edge compute node services

Hypervisor (KVM)
Nova compute services
Neutron (ovs/ml2 agent)
Heat agent

Deployment overview

This is an overview of the DCN deployment process that can be utilized for planning purposes:

1. Hardware setup:

- Rack and stack
- Cabling
- iDRAC setup
- PXE NIC configuration
- Server BIOS and RAID configuration
- Switch configuration

2. Software setup at each DCN site:

- Install a DHCP relay(s) used to forward DHCP traffic to Neutron running on the central cloud control plane
 - At least one DHCP relay is required for provisioning compute nodes at the DCN site
 - Where the DHCP relay(s) are installed is up to the customer
- Discover edge site nodes
- Import discovered nodes into Red Hat OpenStack Platform director
- Configure Overcloud files for each DCN site
- Provision DCN site
- Validate DCN nodes' networking

3. Environment tests

- Once Red Hat OpenStack Platform director has completed a DCN site deployment, a typical set of validation tasks will include:
 - Create a host aggregate, availability zone and flavor, with the supporting metadata to target the DCN site when launching an instance, for example:

```
$ openstack aggregate create dcn-site-1-agg
$ openstack aggregate add host dcn-site-1-agg dcn-site-1-nova-1
$ openstack aggregate set --zone dcn-site-1-az dcn-site-1-agg
$ openstack aggregate set --property dcn-site-1=true dcn-site-1-agg
```

Field	Value
availability_zone	dcn-site-az-1
created_at	2019-10-02T17:22:27.000000
deleted	False
deleted_at	None
hosts	['dcn-site-1-nova-1']
id	1
name	dcn-site-agg-1
properties	dcn-site-1='true'
updated_at	None

```
$ openstack flavor create --property dcn-site-1=true dcn-site-1-flavor
```

Field	Value
id	4bc6c3e7-42be-4620-ae84-819459baf496
name	dcn-site-1-flavor
os-flavor-access:is_public	True
properties	dcn-site-1='true'

- Launch an instance using the new flavor and DCN site provider network, for example:

```
$ openstack server create --flavor dcn-site-1-flavor \
--network dcn-site-1-provider-net dcn-site-1-vm-1 ...
```

Field	Value
flavor	dcn-site-1-flavor (4bc6c3e7-42be-...)
hostId	2ef6c3e7-32ae-2120-ae84-819459baf488
name	dcn-site-1-vm-1
addresses	dcn-site-1-provider-net=192.168.1.123
...	...

- Validate instance is running and that networking and addressing is correct

Chapter

5

Solution architecture

Topics:

- [Solution bundle with 25GbE/100GbE networking overview](#)
- [Solution expansion](#)


This core architecture provides prescriptive guidance and recommendations, jointly engineered by Dell EMC and Red Hat, for deploying Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform version 13 DCN with Dell EMC infrastructure.

The goals are to:

- Provide practical system design guidance and recommended configurations
- Develop sample networking configurations capable of supporting your production system

The development of this architecture builds upon the experience and engineering skills of Dell EMC and Red Hat, and encapsulates best practices developed in numerous real-world deployments. The designs and configurations in this architecture have been tested in Dell EMC and Red Hat labs to verify system functionality and operational robustness.

The solution consists of the components shown in [Figure 3: Edge solution rack layout](#) on page 27, and represents a sample of a single DCN site.

 **Note:** Currently, Red Hat OpenStack Platform 13 supports up to a total of 300 compute nodes across all sites, including the core OpenStack installation, see [Scaling the Overcloud](#)

This guide assumes you have already deployed Red Hat OpenStack Platform 13 following our Dell EMC Ready Architecture for RHOSP 13, and are using this guide to implement DCN sites.

Solution bundle with 25GbE/100GbE networking overview

Since the solution bundle is designed for a production environment, the networking is based upon 25GbE bonds for data networks, and the network switches are configured for HA. The Out of Band Management (iDRAC's) network is not HA, and is 1GbE. The 100GbE networking is used in the solution for the user/tenant traffic.

For basic hardware configuration refer to [Bill of materials](#) on page 34.

DCN site networks overview

Each edge site is configured with the servers internal bridged networks for VM workloads, server management and control plane access. This Edge Compute Architecture Guide implements at a minimum five (5) separate networks:

- **Management/Out of Band (OOB)** - VLAN network for external access to iDRACs. The OpenStack control plane needs direct access to this network for IPMI/WSMAN and other out-of-band operations.
- **Provisioning (Bare Metal) network** - Routed Neutron L3 network that requires a DHCP relay to forward DHCP requests to the central cloud control plane.
- **Private API** - VLAN network used by DCN compute nodes to access the OpenStack control plane messaging system.
- **Tenant network** - VLAN or VXLAN tunnel for accessing VMs from the central cloud and communication between VMs at the DCN site.
- **External network** - Provider network using config-drive and cloud-init for instance metadata (IP address, hostname etc.). This network enables external access to VMs running at the DCN site.

 **Note:** Provider networks can be implemented in a wide variety of ways which is beyond the scope of this document. Please contact Dell EMC for more information.

Node type 802.1q tagging information

The solution is designed with the idea that different network traffic should be segregated from other traffic. This is accomplished by utilizing 802.1q VLAN Tagging for the different segments. The table [Table 6: OpenStack Edge compute network 802.1q tagging](#) on page 25 summarizes this. This segregation is independent of network speed.

Table 6: OpenStack Edge compute network 802.1q tagging

Network	Tagging
iDRAC physical connection to the management/OOB VLAN	Untagged
Provisioning VLAN	Untagged
Tenant network (VLAN/VXLAN)	Tagged
Private API network VLAN	Tagged
Provider network (external access for VMs)	Dependent on type of provider network implementation

Dell EMC Edge Reference Architecture for RHOSP layout

- Network switches:
 - Two (2) Dell EMC Networking S5232F-ON
 - One (1) Dell EMC Networking S3048-ON
- Compute nodes - Up to 20 servers per DCN site, in any combination of:

- Dell EMC PowerEdge R640
- Dell EMC PowerEdge R740
- Dell EMC PowerEdge R740xd

See [Edge compute node configuration with 25GbE networking](#) on page 35 for edge compute node hardware configurations.

Dell Networking S3048-ON

Dell Networking S5232F-ON

Dell Networking S5232F-ON

Solution supports any combination
up to 20 Compute nodes per site
(Dell PowerEdge 640, 740, 740xd)

PowerEdge R640

PowerEdge R740

PowerEdge R740xd

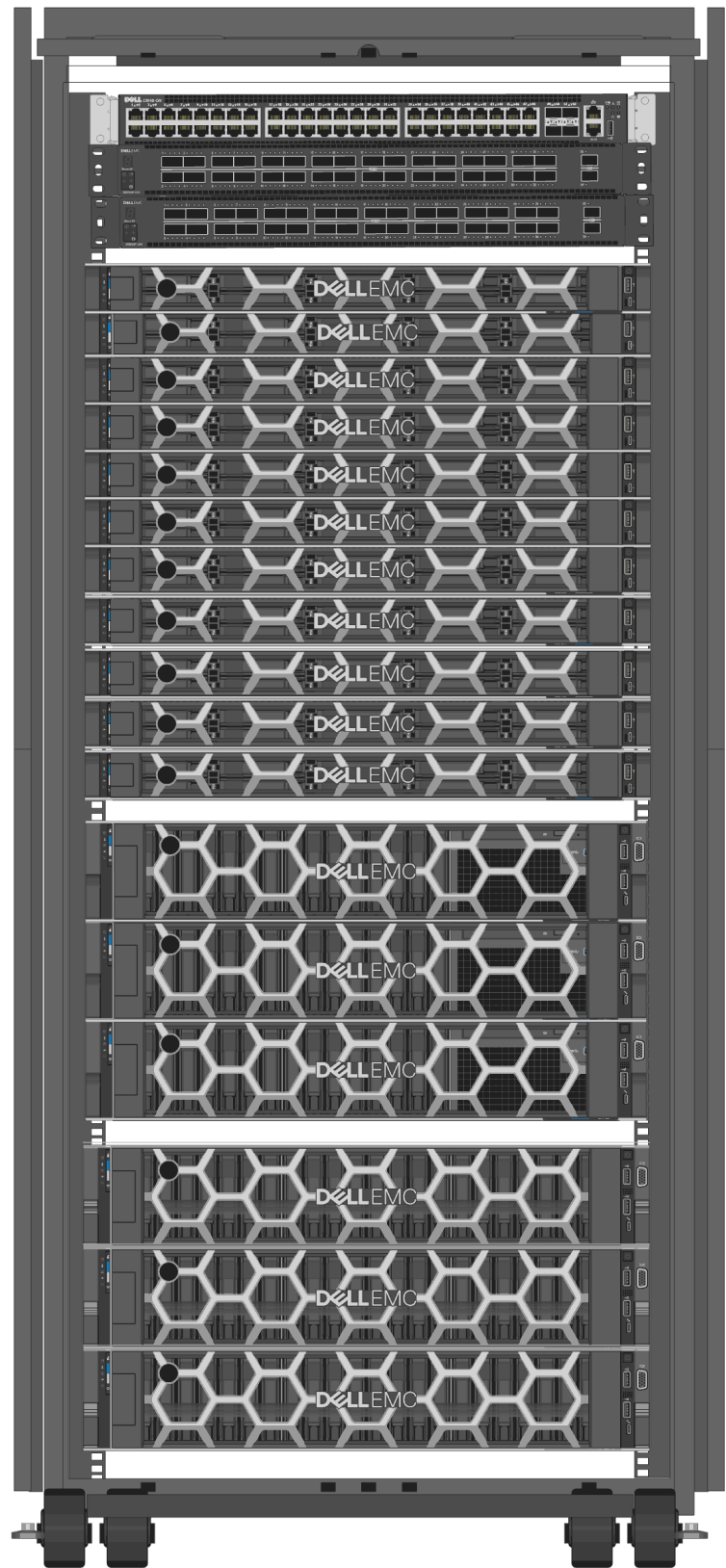


Figure 3: Edge solution rack layout

Solution bundle 25GbE/100GbE network configuration

The network for the Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform has been designed to support production-ready servers with a highly available network configuration.

The basic logical network for a single DCN site will look like :

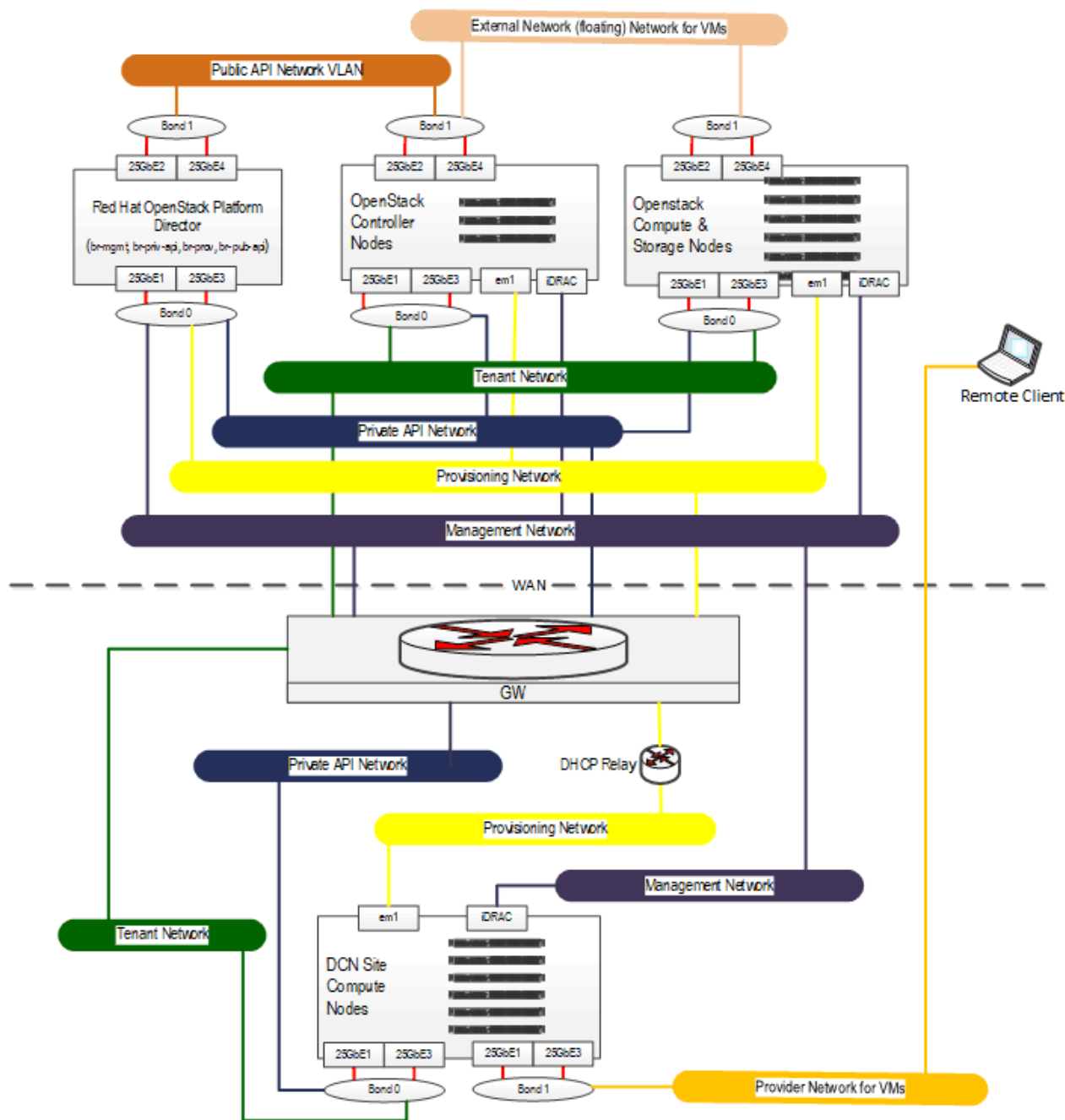


Figure 4: 25GbE/100GbE cluster network logical architecture for DCN

Solution expansion

The Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform can be expanded by:

- Adding compute nodes to an existing DCN site deployment(s). No more than 20 compute nodes per site are supported at this time.
- Deploy additional DCN site(s)



Note: Currently, Red Hat OpenStack Platform 13 supports a up to a total of 300 compute nodes across all sites, including the core OpenStack installation. For other expansion details, please speak with your Dell EMC sales representative.

Chapter

6

Professional services

Topics:

- [Consulting services](#)

Dell EMC Professional Services understands the complexity and challenges in an accelerated deployment, integration and operations of Red Hat OpenStack Platform. At the core, the challenges are not solely dealing with new technology – but it also includes people and process changes needed to be successful. Over the years Dell EMC Consulting has led hundreds of successful cloud implementations.

Dell EMC's Consulting is well equipped in tackling the challenges in implementing and integrating Red Hat OpenStack Platform and network functions virtualization infrastructure, (NFVi) technologies. Furthermore, Dell EMC has a robust, comprehensive portfolio focused on Red Hat OpenStack Platform based solutions that have evolved from our heritage in enterprise cloud solutions – and is specifically tailored to the unique and demanding Telco/Cloud service provider requirements for NFVi implementations. The figure below details the core service from the Dell EMC Services portfolio that our customers can leverage to support Red Hat OpenStack Platform and NFVi initiatives.

Consulting services

Consulting Services Portfolio

Dell EMC Consulting Services

Dell EMC Consulting Portfolio for Dell EMC Ready Architecture for Red Hat OpenStack Platform

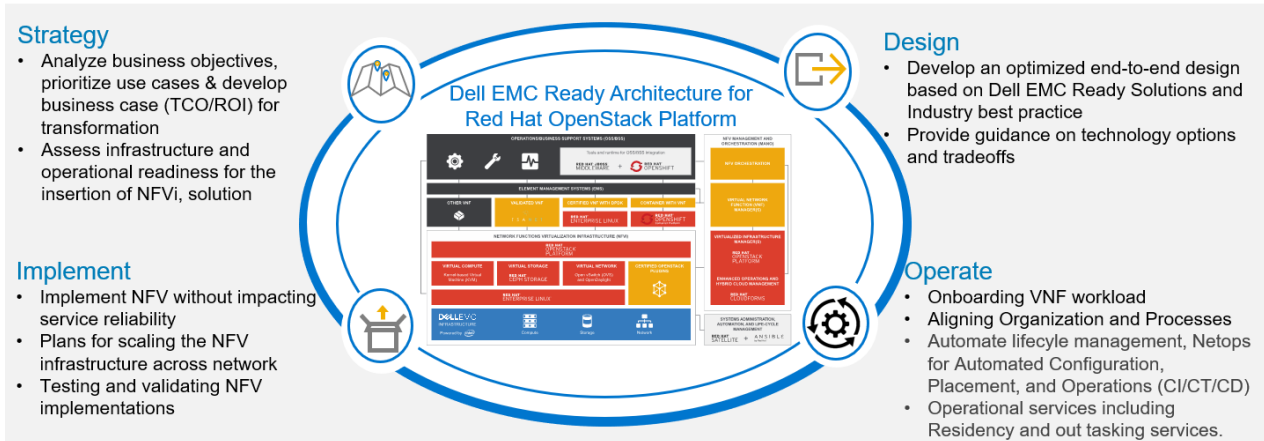


Figure 5: Dell EMC Services for RHOSP and NFVi Ready Architecture

- Dell EMC Red Hat OpenStack Platform, NFVi Strategy Workshop – Dell EMC NFV/SDN/Openstack workshop is intended to help customers who are starting their cloud transformation journey to develop a comprehensive NFV, RHOSP adoption strategy.

It helps customers prioritize the use cases based on business drivers, understand the technology and platform choices such as VMware VIO, Red Hat, etc., identify infrastructure virtualization opportunities, develop strategic roadmap for implementation phases.

This includes understanding current state, understand requirements, GAP analysis and collaborative services to define technology, process implementation paths to ensure successful transformation.

- Dell EMC Red Hat OpenStack Platform, NFVi Business Advisory – This service is intended to help customers develop a business case to adopt NFV based business drivers. It helps to demonstrate to senior management the benefits of moving towards a shared NFV, RHOSP cloud infrastructure. This services includes an independent and collaborative review of the business objectives to develop a comprehensive business case for the transformation including the Total cost of ownership/ Return on Investment financial model.
- Dell EMC Red Hat OpenStack Platform, NFVi Design Services – Dell EMC will help the customers develop a Low Level Design (LLD) and High Level Design (HLD) based on customer requirements and use cases. Dell EMC consultants will work with the customer to gather data, use cases and plans for the OpenStack, NFVI deployment.

Based on that, the team will help develop the end-to-end design that can be used for implementation of the RHOSP ready architecture leveraging JetPack automation.

- Dell EMC Red Hat OpenStack Platform, NFVi Implementation Services – Dell EMC Edge Reference Architecture for RHOSP and solutions offer a risk free option for our customers.

To ensure faster time to value Dell EMC Implementation services provide on or off-site infrastructure planning and implementation of the RHOSP ready architecture leveraging JetPack automation.

- Dell EMC Red Hat OpenStack Platform, NFVi Residency/Operate Services – Dell EMC will help customers operate the new cloud infrastructure by providing resources as on-site/off-site residents. These residents will manage the lifecycle of the cloud and also assist with automation and onboarding of workload to the OpenStack cloud.

To engage Dell EMC consulting services, please contact your Dell EMC sales representative or [send an email](#).

Appendix

A

Update history

Table 7: Edge Compute Architecture Guide update history

Version	Comments
1.0	Initial release

Appendix

B

Bill of materials

Topics:

- [*Bill of Materials for Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform DCN*](#)
- [*Subscriptions and network switches in the solution*](#)

This guide provides Bill of material information necessary to purchase the proper hardware to deploy the Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform.



Note: For cable, racks, power please contact your Dell EMC support representative.

Bill of Materials for Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform DCN

Up to 20 Dell EMC PowerEdge R-Series compute servers are supported per DCN site in any combination of the following:

- Dell EMC PowerEdge R640
- Dell EMC PowerEdge R740
- Dell EMC PowerEdge R740xd

Edge compute node configuration with 25GbE networking

Table 8: Compute node Dell EMC PowerEdge R640

Platform	Dell EMC PowerEdge R640
CPU	Intel® Xeon® Gold 6230 CPU @ 2.10GHz
RAM (minimum)	192GB DDR-4 2933 MHz
LOM	1 x Intel® X710 10GbE SFP+
Add-in network	2 x Intel® XXV710 DP 25GbE DA/SFP+ Adapter
Disk	8 x 600GB 10k SAS 12Gbps
Storage controller	PERC H740 Mini controller
RAID	RAID 10


Table 9: Compute node Dell EMC PowerEdge R740


Platform	Dell EMC PowerEdge R740
CPU	Intel® Xeon® Gold 6230 CPU @ 2.10GHz
RAM (minimum)	192GB DDR-4 2933 MHz
LOM	1 x Intel® X710 10GbE SFP+
Add-in network	2 x Intel® XXV710 DP 25GbE DA/SFP+ Adapter
Disk	8 x 600GB 10k SAS 12Gbps
Storage controller	PERC H740 Mini controller
RAID	RAID 10

Table 10: Compute node Dell EMC PowerEdge R740xd

Platform	Dell EMC PowerEdge R740xd
CPU	Intel® Xeon® Gold 6230 CPU @ 2.10GHz
RAM (minimum)	192GB DDR-4 2933 MHz
LOM	1 x Intel® X710 10GbE SFP+
Add-in network	2 x Intel® XXV710 DP 25GbE DA/SFP+ Adapter
Disk*	8-24 x 600GB 10k SAS 12Gbps

Platform	Dell EMC PowerEdge R740xd
Storage controller	PERC H740 Mini controller
RAID	RAID 10

 **Note:** * When choosing Dell EMC PowerEdge R740xd as compute nodes, all nodes must have the same number of disks.


 **Note:** Be sure to consult your Dell EMC account representative before changing the recommended hardware configurations.

Subscriptions and network switches in the solution

A Dell EMC sales representative will determine the correct software subscriptions needed for the Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform and Dell EMC Networking OS10 subscriptions.

Required subscriptions:

- Red Hat OpenStack Platform
- Dell EMC Networking OS10
- Red Hat Satellite - optional

 **Note:** Please contact your Dell EMC sales representative.

Dell EMC Networking S3048-ON switch

Table 11: S3048-ON switch

Product	Description
S3048-ON	48 line-rate 1000BASE-T ports, 4 line-rate 10GbE SFP+ ports (1 qty)
Redundant power supplies	AC Power Supply or DC Power Supply
Fans	Fan Module I/O Panel to PSU Airflow or Fan Module PSU to I/O Panel Airflow
Validated operating systems	Dell EMC Networking OS10

Dell EMC Networking S4048-ON optional switch

Table 12: S4048-ON switch

Product	Description
S4048-ON	48x 10GbE SFP+, 6x QSFP+ (1 qty) - optional

Product	Description
Redundant power supplies	AC Power Supply or DC Power Supply
Fans	Fan Module I/O Panel to PSU Airflow or Fan Module PSU to I/O Panel Airflow
Validated operating systems	Dell EMC Networking OS10

Dell EMC Networking S5232F-ON switch

Table 13: S5232F-ON

Product	Description
S5232F-ON	100GbE, 40GbE, and 25GbE (2 qty)
Redundant power supplies	AC Power Supply or DC Power Supply
Fans	Fan Module I/O Panel to PSU Airflow or Fan Module PSU to I/O Panel Airflow
Validated operating systems	Dell EMC Networking OS10

Appendix

C

References

Topics:

- [To learn more](#)

Additional information found at <https://www.dell.com/support/article/us/en/19/sln310368/dell-emc-ready-architecture-for-red-hat-openstack-platform?lang=en> or by e-mailing openstack@dell.com.

For more on Red Hat OpenStack Platform 13 and DCN, please see:

- [Red Hat OpenStack Platform 13](#)
- [Deploying Distributed Compute Nodes to Edge Sites](#)
- [Routed L3 Networks \(Spine Leaf Networking\)](#)
- [Scaling the Overcloud](#)



Note: If you need additional services or implementation help, please contact your Dell EMC sales representative.

To learn more

For more information on the Dell EMC Network Edge Reference Architecture for Red Hat OpenStack Platform, visit <https://www.dell.com/support/article/us/en/19/sln310368/dell-emc-ready-architecture-for-red-hat-openstack-platform?lang=en>.

For more information on Dell EMC Service Provider Solutions, visit <https://www.dell.com/en-us/service-providers/index.htm>

Glossary

API

Application Programming Interface is a specification that defines how software components can interact.

BMC/iDRAC Enterprise

Baseboard management controller. An on-board microcontroller that monitors the system for critical events by communicating with various sensors on the system board, and sends alerts and log events when certain parameters exceed their preset thresholds.

BOSS

The Boot Optimized Storage Solution (BOSS) enables customers to segregate operating system and data on server-internal storage. This is helpful in the Hyper-Converged Infrastructure (HCI) and Software Defined Storage (SDS) arenas, to separate operating system drives from data drives, and implement hardware RAID mirroring (RAID1) for OS drives.

CDH

Cloudera Distribution for Apache Hadoop

Cloud computing

See <http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf>

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Cluster

A set of servers dedicated to OpenStack that can be attached to multiple distribution switches.

Control Plane

The cloud control plane provides the central management system for OpenStack deployments. Cloud controllers are mission critical and should be clustered for high-availability. The cloud controller manages authentication and the message bus for all service intercommunication.

The control plane manages the following services:

- Databases providing authentication and persistence for OpenStack services
- Message queue services
- Conductor services
- Proxy requests to a database
- Authentication and authorization
- Image-management services

- Scheduling services
- The OpenStack dashboard (Horizon)
- RESTful API endpoints that OpenStack services expose for consumption

Compute node

The hardware configuration that best supports the hypervisor server or Nova compute roles.

DCN

Red Hat's edge computing offering based on OpenStack.

DevOps

Development Operations (DevOps) is an operational model for managing data centers using improved automated deployments, shortened lead times between fixes, and faster mean time to recovery. See <https://en.wikipedia.org/wiki/DevOps>.

DIMM

Dual In-line Memory Module

DNS

The domain name system (DNS) defines how Internet domain names are located, and translated into Internet Protocol (IP) addresses.

Edge Computing

A distributed computing model that brings computing power closer to the location where it is needed, to improve network latency and reduce data plane backhaul.

FQDD

A fully qualified device descriptor (FQDD) is a method used to describe a particular component within a system or subsystem, and is used for system management and other purposes.

FQDN

A fully qualified domain name (FQDN) is the portion of an Internet Uniform Resource Locator (URL) that fully identifies the server to which an Internet request is addressed. The FQDN includes the second-level domain name, such as "dell.com", and any other levels as required.

GUI

Graphical User Interface - A visual interface for human interaction with the software, taking inputs and generating easy to understand visual outputs.

Hypervisor

Software that runs virtual machines (VMs).

IaaS

Infrastructure as a Service.

Infrastructure node

Systems that handle the control plane and deployment functions.

ISV

Independent Software Vendor.

JBOD

Just a Bunch of Disks

LAG

Link Aggregation Group.

LOM

LAN on motherboard.

LVM

Logical Volume Management

ML2

The Modular Layer 2 plug-in is a framework that allows OpenStack to utilize different layer 2 networking technologies.

NFS

The Network File System (NFS) is a distributed filesystem that allows a computer user to access, manipulate, and store files on a remote computer, as though they resided on a local file directory.

NIC

Network Interface Card

Node

One of the servers in the cluster.

NUMA

Non-Uniform Memory Access

Overcloud

The functional cloud that is available to run guest VMs and workloads.

Pod

An installation comprised of three racks, and consisting of servers, storage, and networking.

RAN

RAN - Radio Access Network. Part of a mobile telecommunication system that implements radio access technology.

REST

REST - Representational State Transfer (also ReST). Relies upon stateless, client-server, cacheable communications protocol to access the API.

RHOSP

Red Hat OpenStack Platform

RPC

Remote Procedure Call

SAH

The Solution Admin Host (SAH) is a physical server that supports VMs for the Undercloud machines needed for the cluster to be deployed and operated.

SDS

Software-defined storage (SDS) is an approach to computer data storage in which software is used to manage policy-based provisioning and management of data storage, independent of the underlying hardware.

SDN

Software-defined Network (SDN) is where the software will define, create, use and destroy different networks as needed.

Stamp

A stamp is the collection of all servers and network switches in the solution.

Storage Node

The hardware configuration that best supports SDS functions such as Red Hat Ceph Storage.

ToR

Top-of-rack switch/router.

U

U used in the definition of the size of server, example 1U or 2U. A "U" is a unit of measure equal to 1.75 inches in height.

Undercloud

The Undercloud is the system used to control, deploy, and monitor the Overcloud - it is a single node OpenStack deployment completely under the administrators control. The Undercloud is *not* HA configured.

VLT

A Virtual Link Trunk (VLT) is the combined port channel between an attached device (ToR switch) and the VLT peer switches.

VLTi

A Virtual Link Trunk Interconnect (VLTi) is an interconnect used to synchronize states between the VLT peer switches. Both endpoints must be the same speed, i.e. 40Gb → 40Gb; 1G interfaces are not supported.

VM

Virtual Machine - a simulation of a computer system.

vRAN

Virtual Radio Access Network - A Radio Access Network (RAN) implemented as software vs a solely hardware-based solution.