Dell EMC Ready Solution for VMware vCloud NFV 3.0 OpenStack Edition Platform

Advantages of Deployment Automation

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White Paper

Abstract

This white paper describes how deployment automation provides advantages beyond mere automated installation for customers who are deploying Ready Solution for VMware vCloud NFV 3.0 OpenStack Edition Platform.

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Executive summary

Business challenge

Deploying the Dell EMC Ready Solution for VMware NFV 3.0 OpenStack Edition Platform previously involved a complex manual process to install and integrate the required software components. Software deployment took 5 days and required adherence to hundreds of pages of instructions. Integration errors were not uncommon.

Deploying and integrating the solution components across many servers can be a complicated and time-consuming process. Deploying vSphere High Availability (HA) involves VM cloning. vSAN and vSphere Distributed Switch (VDS) must be implemented across all servers. Implementation includes creating the data center, vCenter, clusters, and vSAN; adding all the servers to the vSAN; creating all the VDS devices; and adding each server to VDS. vSAN local datastores must be created, which can take away space from the available storage. At times, getting clusters running can be difficult, sometimes taking a week to get them operational. Mistakes can require redoing the entire process.

Some component deployment, although not necessarily difficult, is time-consuming—for example, populating all the host names in Active Directory DNS, creating the port groups across servers and switches, and generating authentication keys. Furthermore, manually deploying such a tightly integrated complex system typically involves multiple individuals and requires a high degree of experience and expertise in the following areas:

- Windows Server
- Linux (CentOS)
- VMware products
- Networking and network protocols
- Switch and router configuration

While deployment guides facilitate the manual installation process and help to minimize issues, automation reduces complexity. For example, automation makes it possible to emulate a vSAN so that local datastores are not required to facilitate installation. In addition, having a repository of all the required component OVA files saves time and ensures consistency.

Solution overview

The Dell EMC Ready Solution for VMware NFV 3.0 OpenStack Edition Platform is a turnkey solution that is optimized to simplify and accelerate production deployments. This fully integrated and validated solution enables Service Providers to immediately launch their own services on top of the NFV Infrastructure (NFVI), minimizing or eliminating the need to apply engineering resources to develop their own infrastructure.

This Ready Solution, which is deployed by Dell EMC Professional Services, combines hardware, software, and Dell EMC engineering to create a more flexible, scalable, and agile platform for Service Providers. It includes open-standards-based Dell EMC cloud infrastructure hardware (compute, networking) and VMware Integrated OpenStack with vSAN storage. The solution also supports the latest Dell EMC PowerEdge servers that are based on Intel Xeon Scalable processors.

This white paper focuses on the new deployment automation capabilities of the Ready Solution, which significantly reduce the deployment timeframe as well as the errors and

complexities that are involved in integration. The new functionality replaces the prior complex process with a single command that results in a fully operational system in less than 5 hours.

Deployment automation advantages, which go beyond installation automation, include:

- Operational efficiencies that are achieved by using deployment implementation tools such as Integrated Dell Remote Access Controller (iDRAC), Open Network Install Environment (ONIE), and zero-touch fabric (ZTF)
- Error reduction resulting from a prebuilt deployment automation OVA and easy-to-use tools that are designed to simplify and scale a system deployment—whether you are deploying 8 or 68 servers
- Complexity reduction through Dell EMC's experience with VMware integration
- Significant deployment-time reduction, which decreases deployment expenditures and hastens the time to revenue generation

Document purpose

This document describes the deployment automation capabilities and benefits of Dell EMC Ready Solution for VMware vCloud NFV 3.0 OpenStack Edition Platform.

Audience

This guide is for Dell EMC Professional Services, Service Providers, and customers.

We value your feedback

Dell EMC and the authors of this document welcome your feedback on the solution and the solution documentation. Contact the Dell EMC Solutions team by email or provide your comments by completing our documentation survey.

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vCloud NFV platform and Ready Solution components

Dell EMC Ready Solution for VMware NFV 3.0 OpenStack Edition Platform includes open standards-based Dell EMC cloud infrastructure hardware (compute, networking) and VMware Integrated OpenStack with vSAN storage. The solution supports the latest PowerEdge servers that are based on Intel Xeon Scalable processors.

The vCloud NFV platform includes:

- VMware vSphere
- VMware vSAN
- VMware NSX
- VMware Integrated OpenStack for the VMware Virtualized Infrastructure Manager (VIM)
- VMware vRealize Operations

Deploying vSphere as host nodes and VMs provides increased performance and security as well as operational advantages. Other capabilities include support for Kubernetes to facilitate adoption of containers.

This Ready Solution incorporates the following components.

Servers:

- Dell EMC PowerEdge R640/R740 server with the Dell EMC PowerEdge HBA330 disk controller based on vSAN Ready Node
- Dell EMC PowerEdge R740xd server with the Dell EMC PowerEdge HBA330 disk controller based on vSAN Ready Node

Network equipment:

- Dell EMC Networking S4048T-ON as a top-of-rack (ToR) switch with OS9
- Dell EMC Networking Z9100-ON or S6010-ON as leaf switches

Software:

- VMware ESXi
- Big Switch Networks (BSN) Big Cloud Fabric (BCF)
- Microsoft Active Directory
- Domain Name System (DNS)
- Network Time Protocol (NTP)
- VMware vCenter Server Appliance
- VMware vSAN
- VMware Network Services Extensions (NSX-T)
- VMware vRealize Log Insight
- VMware vRealize Operations Manager
- VMware Integrated OpenStack
- Kubernetes

Deployment automation overview

Deployment automation components and process

Ready Solution for VMware vCloud NFV 3.0 OpenStack Edition Platform deployment automation includes the following components, enabling streamlined software installation, configuration, and integration:

- **User input file**—The user input file, `USER_INPUT.xlsm`, includes worksheets for specifying the data that is necessary to customize the solution installation. The data is then exported into a .csv file for use with the Orchestrator tool, which deploys, configures, and integrates the software across the servers.
- **Deployment automation OVA file**—The deployment automation OVA file includes all the software packages and tools that are needed to deploy the solution, eliminating the need to download each software component.
- **Orchestrator**—The Orchestrator tool automates the software deployment, configuration, and integration across the Management and Edge/Resource pod servers. Orchestrator enables you to perform each step individually or to perform all steps as one complete process by using a single command.

The following table summarizes the streamlined process for deploying the solution. The major differences between the manual and automated deployment are in steps 1, 4, and 6. The solution's automation tools simplify the process complexities and reduce the time that is required for the pod software deployment.

Table 1. Automated deployment process

Step	Process	Resources
1	Populate the `USER_INPUT.xlsm` file.	`USER_INPUT.xlsm`
2	Deploy the hardware.	• Hardware deployment guide* • Operations guide*
3	Prepare the deployment server.	Software deployment guide*
4	Install the deployment automation OVA VM on the deployment server.	
5	Deploy BCF and configure the leaf switch.	
6	Run the automation Orchestrator.	

* Available at Dell EMC Ready Solution for VMware NFV Platform in the Dell EMC Knowledge Base

Open-source deployment tools

Automating deployment across the diverse components in the solution requires a significant number of tools. The ability to access a wide-ranging library of open-source tools provides increased development speed, quality, and flexibility, enabling customizations to the underlying code where needed and reducing development costs.

For this solution, Dell EMC combined the functionality of multiple open-source automation tools within Orchestrator to replace numerous manual processes involved in the installation, configuration, and integration of the required software components.

Deployment automation advantages

Introduction

Beyond merely providing automated installation, deployment automation provides these advantages:

- Reduced deployment time, speeding NFVI deployment readiness and reducing deployment expenditures.
- Operational efficiencies that reduce errors and complexity. Efficiencies are achieved through deployment implementation automation tools such as iDRAC, ONIE, and ZTF, and through Dell EMC's experience in VMware integration.
- Simplicity and scalability, which are delivered by the prebuilt deployment automation OVA, Orchestrator, and the user input file.

Reduced deployment time

Automated deployment gives Service Providers a faster time to service so that they can use the solution sooner and generate revenue more quickly. Based on internal Dell EMC testing and validation of the manual deployment process, an expert resource required an average of 5 days to deploy the baseline infrastructure of the solution by carefully following approximately 500 pages of detailed steps. At times, manual deployment time went beyond the average of 5 days, depending on the number of production servers being deployed.

With deployment automation, the `USER_INPUT.xlsm` file and prebuilt deployment automation OVA reduce the time that is needed to prepare for the installation. Most significantly, Orchestrator provides automation efficiencies that reduce the 5-day average manual deployment process to less than 5 hours.

Note: In internal testing, deployment time for an eight-server, two-pod configuration, from predeployment validation through deployment of Kubernetes, was less than 5 hours, as shown in Table 3 on page 9.

The process of deploying ESXi to the servers is one example of how automation provides efficiencies. Typical manual deployment of ESXi on a single server takes approximately 30 minutes. That time includes pre-installation selection of options, installation, and post-installation customizations such as licensing, DNS configuration, SSH policy, and firewall rules, including the two required reboots. The total manual ESXi deployment time increases linearly as more servers are added. The time requirements for manual installation and configuration of ESXi equates to 10 hours for a 20-server production deployment, 20 hours for a 40-server production deployment, and 30 hours for a 60-server production deployment. While manually installing ESXi on several servers simultaneously might save time, the time savings is not significant considering the introduction and subsequent necessary correction of human error.

The new deployment automation capability uses iDRAC to enable ESXi deployments to run in parallel, rather than serially, across the pod servers. In our testing, minor variations in the individual deployment times across the eight servers resulted in a combined parallel deployment time of approximately 12 minutes for the ESXi workflow. Thus, automation of parallel deployment does not result in a linear time increase as more servers are added.

Table 2 shows each of the steps in the automated deployment ESXi workflow and the deployment time for each step during our testing. The two reboots—one in step 3 and the other in step 5—consumed more than half of the total average deployment time. Subtracting the time for reboot, the ISO mount and ESXi installation in step 3 were completed in an average time of 4 minutes 36 seconds.

In Table 2:

- In the column headings, *E/R* means Edge/Resource pod server, and *Mgt* means Management pod server.
- Times are shown in minutes:seconds.

Table 2. ESXi workflow: Automated deployment time for eight servers

Workflow step		E/R6	E/R7	E/R8	E/R9	Mgt10	Mgt11	Mgt12	Mgt13	Avg.
1	Create custom ESXi ISO	00:04	00:07	00:08	00:01	00:02	00:08	00:03	00:07	00:05
2	Set boot order: VCD-DVD	00:07	00:08	00:07	00:08	00:08	00:08	00:08	00:08	00:08
3	Reboot (1st); mount ISO on iDRAC; install ESXi	07:42	07:39	07:41	07:41	07:34	07:35	08:13	07:45	07:44
4	Set boot order: SD	00:06	00:06	00:06	00:06	00:06	00:05	00:06	00:05	00:06
5	Reboot (2nd); then reconnect to ESXi host	03:06	03:00	03:06	02:59	03:13	03:14	03:13	03:09	03:08
6	Complete ESXi configuration	00:07	00:07	00:07	00:07	00:07	00:07	00:07	00:07	00:07
	Total time per server	11:12	11:07	11:15	11:02	11:10	11:17	11:50	11:21	11:17

Table 3 shows similar efficiencies that were observed across all the deployment steps. Times are shown in hours:minutes:seconds.

Table 3. Automated deployment time for eight servers—average run

Process step		Begin timestamp	End timestamp	Length of time
1	Validate predeployment requirements	10:36:10	10:38:02	00:01:52
2	Install and configure ESXi	10:38:02	10:50:05	00:12:03
3	Create vSAN datastore	10:50:05	10:50:59	00:00:55
4	Deploy and configure auxiliary components	10:50:59	11:18:49	00:26:50
5	Deploy and configure vCenter Server Appliance for Management pod	11:18:49	11:37:24	00:18:35
6	Configure virtual network on Management pod	11:37:24	11:51:05	00:13:41
7	Configure vSAN on Management pod	11:51:05	11:53:29	00:02:24
8	Deploy and configure vCenter Server Administrator for Edge/Resource pod	11:53:29	12:12:30	00:19:01
9	Configure virtual network on Edge/Resource pod	12:12:30	12:22:08	00:09:38
10	Configure vSAN on Edge/Resource pod	12:22:08	12:26:08	00:02:00
11	Configure vSphere HA on both Management and Resource pods	12:26:08	12:41:16	00:15:08

Process step		Begin timestamp	End timestamp	Length of time
12	Deploy and validate NSX-T	12:41:16	12:47:48	00:06:32
13	Configure NSX-T	12:47:48	13:04:23	00:16:35
14	Perform post-configuration process on Management pod	13:04:23	13:04:32	00:00:09
15	Perform post-configuration process on Edge/Resource pod	13:04:32	13:06:56	00:02:24
16	Deploy and configure vRealize Log Insight, vRealize Operations Manager, and Integrated OpenStack	13:06:56	14:29:50	01:22:54
17	Deploy Kubernetes	14:29:50	15:13:42	00:43:52
	Total automated deployment time			04:37:32

Operational efficiencies

Deployment automation provides operational efficiencies by reducing errors and complexity, reducing the expertise and knowledge required for solution deployment, and speeding NFVI deployment readiness. Deployment automation for this Ready Solution has been achieved through Dell EMC's experience in VMware Integration and investment in deployment automation tools and processes.

Operational efficiencies through iDRAC

iDRAC9 with Lifecycle Controller, which is embedded in every PowerEdge server, provides functionality that helps IT administrators deploy, update, monitor, and maintain servers without installing additional software. iDRAC functions regardless of operating system or hypervisor presence.

The automated deployment uses the iDRAC Remote Access Controller Admin (RACADM) utility for BIOS configuration, for remote mounting and installation of the ESXi operating system, and to gather system information about the host.

The Auto Config feature in iDRAC9 can be used in conjunction with deployment automation to configure bare-metal servers. Auto Config is a zero-touch mechanism that enables the iDRAC server to remotely import a server configuration profile to apply BIOS, iDRAC, RAID, NIC, FC-HBA, system, and Lifecycle Controller configuration settings. Auto Config can also be used to automatically upgrade each of the components to a specific firmware release—for example, it can automate the platform firmware update of BIOS, iDRAC, NIC, HBA, and system settings for the QLogic NIC, which is currently a manual process.

Operational efficiencies through ONIE and ZTF

In this Ready Solution, ONIE and ZTF automation tools enable operational efficiencies for BCF deployment and leaf switch configuration as follows:

- ONIE facilitates the zero-touch deployment of the BSN Switch Light operating system to the Dell EMC Networking Z9100-ON (or S6010-ON) switches.
- The ZTF feature of BCF enables complete control of the physical Networking Z9100-ON (or S6010-ON) switches within BCF without manual CLI configuration of the switches.

Fabric switches are shipped with an ONIE network-enabled boot image. The user configures the BCF controller with the switch MAC address. Upon boot, each leaf switch gets the Switch Light operating system software from the BCF controller as well as its operating configuration.

As shown in the following figure, the ONIE boot loader sends an ONIE discovery message, to which the BCF controller replies with instructions to download the Switch Light operating system loader. Upon download and reboot, the Switch Light operating system loader sends a ZTF request, to which the BCF controller replies with the Switch Light operating system image, manifest, and startup configuration.

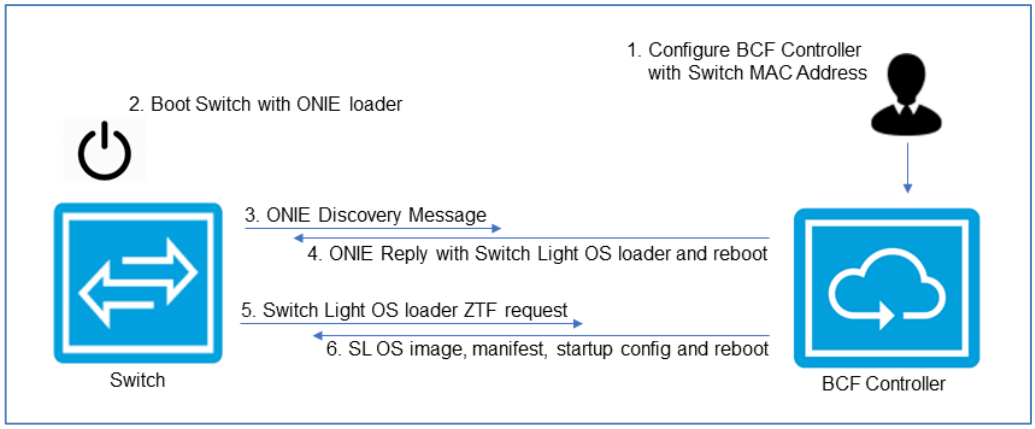
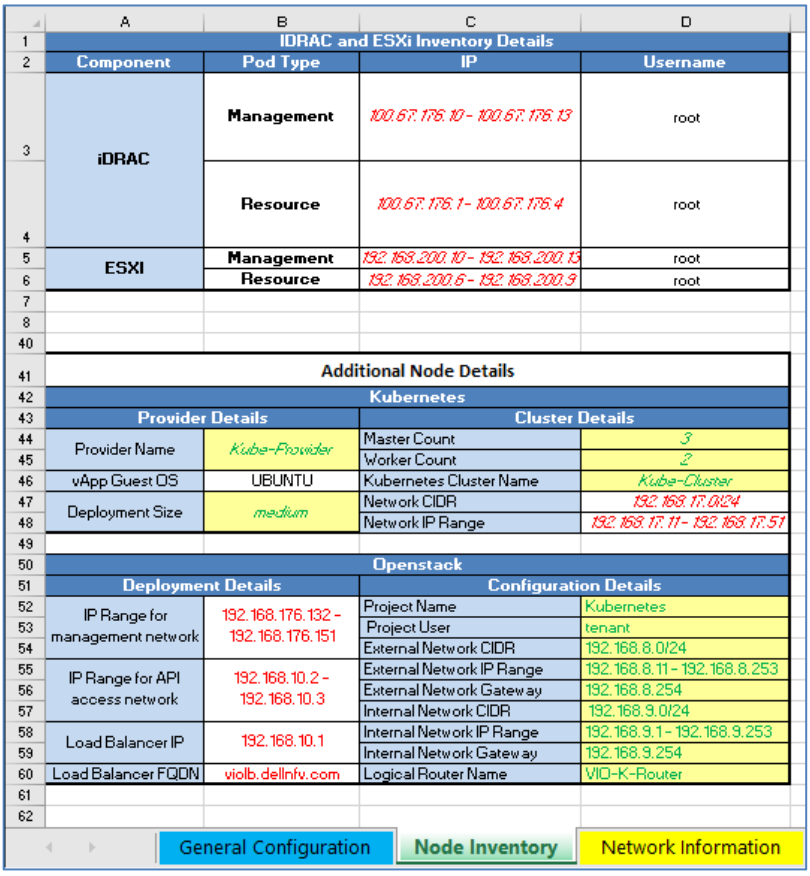


Figure 1. ONIE/ZTF process

This Ready Solution employs a comprehensive prebuilt OVA that includes all the software that is necessary to deploy the platform, enabling consistency across installations. You no longer have to gather the software and build a VM for deployment.

The `USER_INPUT.xlsm` file, as shown in the following figure, enables you to quickly enter all the necessary values that are associated with the variables for automated deployment. The spreadsheet has tabbed worksheets for ease of use.



	A	B	C	D
1	IDRAC and ESXi Inventory Details			
2	Component	Pod Type	IP	Username
3	iDRAC	Management	100.67.176.10 - 100.67.176.13	root
4		Resource	100.67.176.1 - 100.67.176.4	root
5	ESXI	Management	192.168.200.10 - 192.168.200.13	root
6		Resource	192.168.200.6 - 192.168.200.9	root
7				
8				
40				
41	Additional Node Details			
42	Kubernetes			
43	Provider Details		Cluster Details	
44	Provider Name	Kube-Provider	Master Count	3
45			Worker Count	2
46	vApp Guest OS	UBUNTU	Kubernetes Cluster Name	Kube-Cluster
47	Deployment Size	medium	Network CIDR	192.168.17.0/24
48			Network IP Range	192.168.17.11 - 192.168.17.51
49				
50	Openstack			
51	Deployment Details		Configuration Details	
52	IP Range for management network	192.168.176.132 - 192.168.176.151	Project Name	Kubernetes
53			Project User	tenant
54			External Network CIDR	192.168.8.0/24
55	IP Range for API access network	192.168.10.2 - 192.168.10.3	External Network IP Range	192.168.8.11 - 192.168.8.253
56			External Network Gateway	192.168.8.254
57			Internal Network CIDR	192.168.9.0/24
58	Load Balancer IP	192.168.10.1	Internal Network IP Range	192.168.9.1 - 192.168.9.253
59			Internal Network Gateway	192.168.9.254
60	Load Balancer FQDN	violb.dellnfv.com	Logical Router Name	VIO-K-Router
61				
62				

Figure 2. `USER_INPUT.xlsm` file

You can easily scale the two-pod, 8-server automated deployment to a 68-server deployment (4-server Management pod and 64-server Edge/Resource pod) by modifying IP address ranges on the Node Inventory and Network Information tabs of the spreadsheet. On those tabs, specify the increased IP address range or ranges for the iDRAC and the increased IP address range or ranges to be used in deploying ESXi hosts, OpenStack, Kubernetes, and other management networks.

Conclusion

The deployment automation feature of this Ready Solution is based on Dell EMC's experience with VMware integration, a comprehensive prebuilt OVA, and tools such as iDRAC, ONIE, ZTF, Orchestrator, and the `USER_INPUT.xlsm` file. The automation feature simplifies the solution deployment process, reducing errors, complexities, time, and costs.

Deployment automation gives Service Providers a quicker path to revenue generation, replacing the previous 5-day manual deployment of eight servers with a single command that initiates an automated deployment that takes less than 5 hours. The power and benefits of deployment automation increase as the number of servers in the deployment increases.

References

Dell EMC documentation

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

- Dell EMC Ready Solution for VMware NFV Platform
- Dell EMC iDRAC9

Big Switch Network documentation

The following BSN web pages provides additional and relevant information:

- Dell EMC (information about Big Switch Network's partnership with Dell EMC)
- 3 Things to Know About Big Cloud Fabric ZTF – Auto Configuration, Auto Scaling & Auto Upgrade
- Data Center Network Transformation Sign 2: Core and Pod Design

Other documentation

The following ONIE and Open Compute Project web pages provides additional and relevant information:

- Open Network Install Environment
- Open Compute Project: Networking/ONIE