

Dell OpenStack™-Powered Cloud Solution Deployment Guide

OpenStack Version Grizzly

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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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OpenStack™ Deployment Procedure

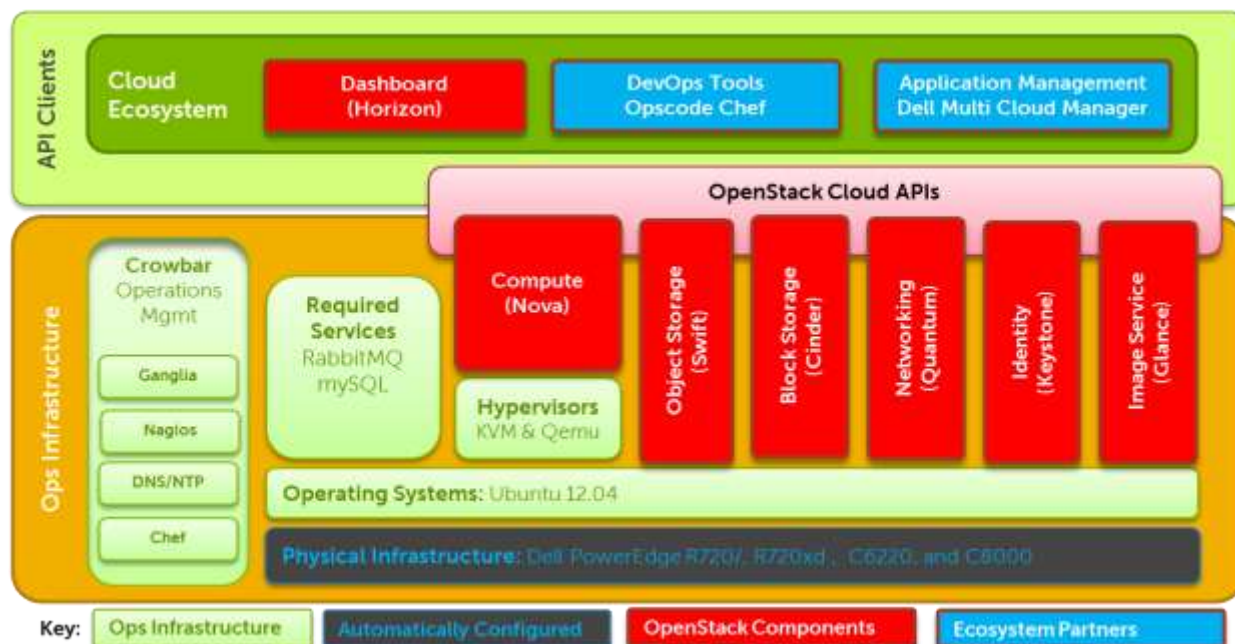
This guide provides the information necessary to deploy the Dell™ OpenStack™-Powered Cloud Solution. It is intended to be used in conjunction with the *Dell™ OpenStack™-Powered Cloud Solution Reference Architecture Guide*, the *Dell™ OpenStack™-Powered Cloud Solution Barclamp User's Guide*, and the *Dell Crowbar Framework User's Guide*.

Deployment consists of the following steps:

- Site preparation and hardware installation
- Administration node setup, including network configuration and Crowbar installation
- OpenStack deployment using Crowbar

When the deployment is complete, the complete Dell™ OpenStack™-Powered Cloud Solution will be installed, as shown in Figure 1: OpenStack™ Solution Taxonomy.

Figure 1: OpenStack™ Solution Taxonomy



Site Preparation and Hardware Installation

Hardware Setup

All systems should be installed and cabled according the physical configurations detailed in the *Dell™ OpenStack™-Powered Cloud Solution Reference Architecture Guide*.

Estimate the electrical power and cooling usage using the Dell Energy Smart Solution Advisor: http://www.dell.com/content/topics/topic.aspx/global/products/pedge/topics/en/config_calculator?c=us&cs=555&l=en&s=biz

You can use this tool to plan the appropriate power distribution unit (PDU) and ensure the cooling is adequate.

Bootstrap Node

The initial setup of the administration node will require a temporary bootstrap node, such as a laptop. The administration node will also need a keyboard and monitor (or KVM connection) during initial installation.

The bootstrap node will be used to perform the initial PXE boot of the administration node. It must have VMware Player installed to start the bootstrap process, and will be connected to the administration node via a crossover network cable.

Administration Node

The hardware on the admin node should be configured as follows:

- **Boot sequence:** BIOS is set to boot from local disk. Note that this is the “normal” operating setting, but for its initial setup boot, the admin node will need to boot from network in order to bootstrap the installation from the VMware Player image running on the bootstrap node.
- **RAID controller:** All disks should be in a RAID 10 configuration.

BMC and networking settings for the nodes are configured using Crowbar. No manual steps are required.

Switch Configuration

The network switches should be configured appropriately before beginning the installation. The installation process does not configure the switches. A typical configuration using Dell™ PowerConnect™ 6248 switches is included in Default Switch Configuration.

If the network configuration differs from the standard one described in the reference architecture, this configuration must be updated.

Additional Site Preparation

Solution deployment may need additional preparation.

The reference architecture does not specify any firewalls or load-balancers—if these are required, they should be configured at this time. OpenStack Networking provides firewall capabilities.

Also, a bastion host, installed behind appropriate site-specific security systems, can be used to access the administration node and cloud remotely. Direct access to the admin, internal, and external networks should not be configured without appropriate security procedures.

Administration Node Setup

The admin node must be configured first. Installing the admin node involves installing the base operating system, optionally customizing the Crowbar configuration (primarily the networking configuration), and installing Crowbar itself.

Once configured, Crowbar running on the admin node is used to configure and deploy the rest of the solution, and to provide ongoing operations management. The admin node manages all the cluster compute and storage nodes. It assigns the other nodes IP addresses, PXE boots them, configures them, and provides them the necessary software for their roles. To provide these services, the admin node runs the services listed in Table 1: Management Services on Admin Node. The admin node must be the only DHCP server visible to the compute and storage nodes.

Table 1: Management Services on Admin Node

Crowbar Server	Manages all nodes, supplying configuration of hardware and software.
Chef Server	Manages many of the software packages and allows the easy changing of node roles.
DHCP server	Assigns and manages IPs for the compute and storage nodes. The admin node must be the only DHCP server visible to the compute and storage nodes.
NTP server	Synchronizes all nodes to the same time reference.
TFTP server	PXE boots compute and storage nodes with a Linux kernel. The TFTP server services any PXE boot request it receives with its default options.
DNS server	Manages the name resolution for the nodes and can be configured to provide external name forwarding.

Installing the Admin Node Operating System and Software

The initial admin node installation is performed by PXE booting the admin node from a bootstrap node, typically a laptop. The steps are:

1. Power on the admin node, and ensure that:
 - a. It is set up to boot from the hard disk for subsequent boots.
 - b. This first boot (and only this first boot) is a network boot.
2. Power off the admin node.
3. Make sure you have VMware Player¹ installed on the laptop.
4. Make sure you have the current Crowbar ISO image loaded on the laptop.
5. Turn off or disable wireless networking on the laptop.
6. Open the VMware machine configuration distributed with Crowbar (this will be a .vmx file).

¹ VMware Player may be freely downloaded from VMware's website.
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7. Edit the machine settings within Player and ensure that the network adapter is configured to use Bridged Networking (see Figure 3: VMware Player Configuration for Network Bridging), connected to the physical network adapter.
8. Configure VMware Player to mount the Crowbar ISO image DVD in the VM (see Figure 2: VMware Player Configuration for ISO Boot).
9. Connect the network crossover cable between eth0 of the admin node and the network port of the laptop.
10. Power on the VM—it should boot and present a login prompt in under a minute.
11. Power on the admin node. It should PXE boot, obtaining its image from the VM.
12. The admin node will automatically install its operating system and deployment software.
13. Once the installation is complete, power down the installer VM, and disconnect the laptop.
14. Reconnect eth0 of the admin node to the appropriate switch port.
15. Reboot the admin node.

When this process has completed, the operating system and deployment software has been installed on the admin node. The Crowbar software has been copied to the admin node, but final installation has not been completed.

Figure 2: VMware Player Configuration for ISO Boot

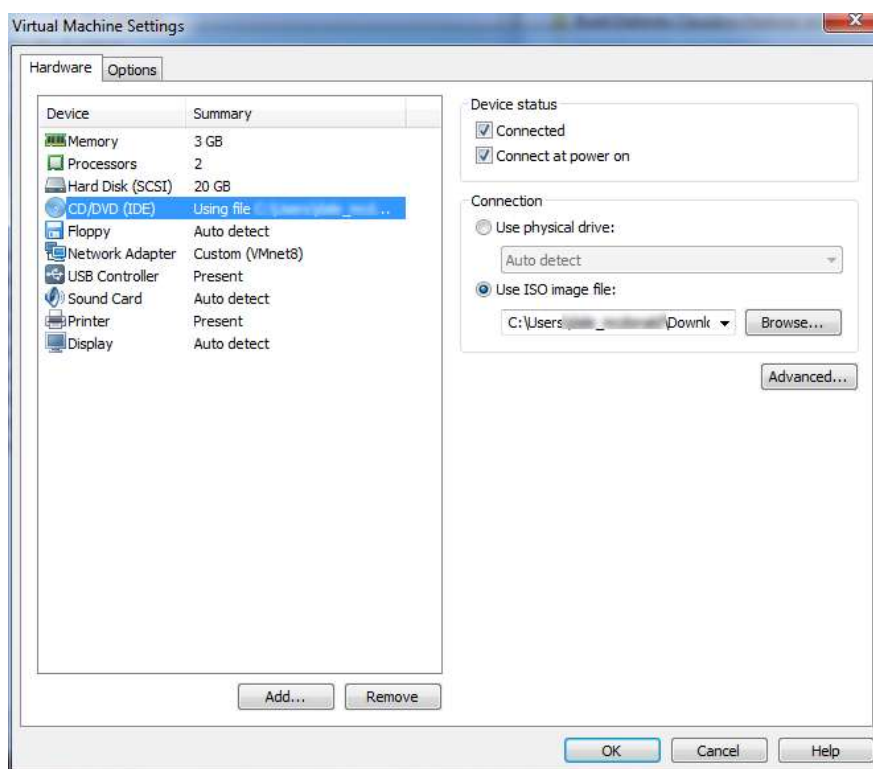
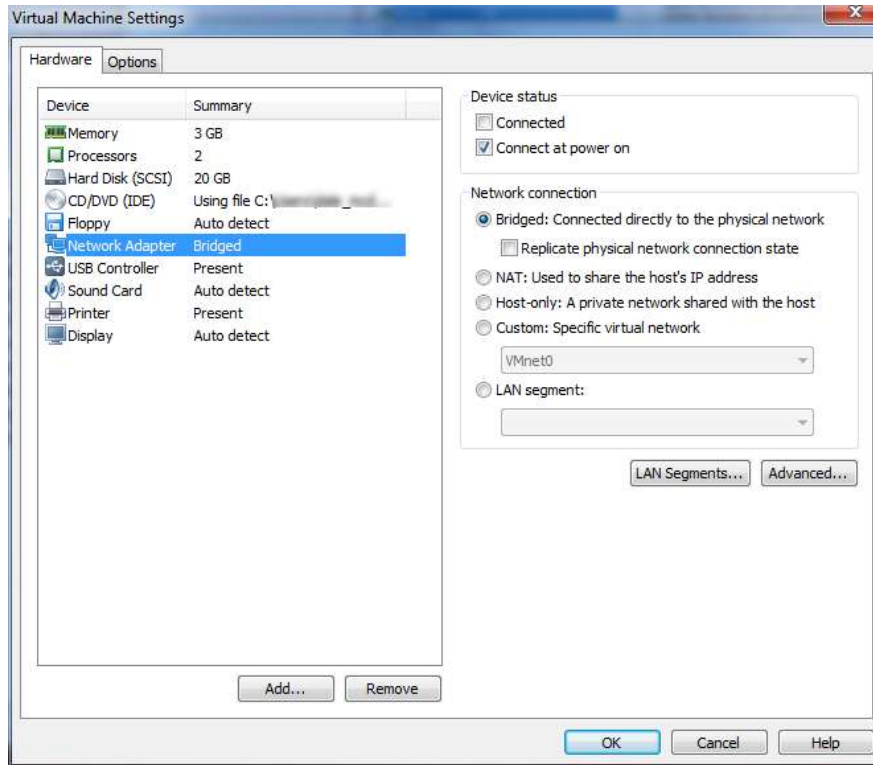


Figure 3: VMware Player Configuration for Network Bridging



Network Configuration

Logical Network Configuration

Crowbar manages the network settings for the deployment using the Network barclamp. The base networking configuration has been architected to maintain a logical segregation of traffic, with minimal configuration. There are several logical networks defined, segmented into separate vLANs, as shown in Table 2: Logical Network Definitions.

The Crowbar network configuration can be customized to support site-specific networking needs and conventions. These changes include adding additional vLANs, changing vLAN mappings, changing IP address range assignments, and teaming NICs.

If changes are required, they must be done at this point, before the final Crowbar installation.

Table 2: Logical Network Definitions

Name	Usage	Notes
os-sdn	Used for GRE tunnels	Only used if GRE is selected as the networking mode in Quantum.
admin	Private management network for node-to-node communication	A router, if wanted, is external to the system. This network must be owned by the Crowbar system to run DHCP on.
bmc	Private network for BMC communication	This can be the same as the admin network by using the ranges to limit what IP goes where. A router, if needed, is external to the system.

Name	Usage	Notes
bmc_vlan	Private network for admin nodes on the BMC network	This must be the same as the BMC network and have the same VLAN. This will be used to generate a VLAN tagged interface on the admin nodes that can access the BMC LAN.
storage	Private network for storage traffic	A router, if wanted, is external to the system.
public	Public network for Crowbar and other components	A router, if wanted, is external to the system.
nova_fixed	Public network for Nova virtual machines	The Nova-network node acts as a router. This must be completely owned by the Nova system.
nova_floating	Used for external access to Nova virtual machines	

Changing the Network Configuration

The network configuration is defined by the Crowbar network barclamp. The details are specified in a text file in JSON² format. This file can be edited to change many parameters in the network configuration. After making the changes, the final Crowbar installation can be completed (see Installing Crowbar.)

The configuration file is on the admin node, with the pathname:

```
/opt/dell/barclamps/network/chef/data_bags/crowbar/bc-template-network.json
```

When editing the file, be careful with the syntax, particularly with commas. A common mistake is to add trailing commas at the end of sections. The file is validated at Crowbar installation time. If there are errors the Crowbar installation will fail, and the log files will contain references to the errors.

Network Configuration Options

The JSON configuration file is divided into several sections. This document contains a summary of the options for convenience. For more details, refer to the network barclamp section in the *Dell Crowbar Software Framework User's Guide*.

Refer to the sample JSON file in Sample Network Configuration JSON or the file on disk to see the actual file syntax.

Attributes

This section contains global settings for the network configuration.

Table 3: Network Configuration

Name	Default	Description
start_up_delay	30	Used to provide a delay in seconds, so the spanning tree in the switch can settle when new interfaces are brought up.
mode	single	This controls whether single or teamed (bonded) NICS are used (it actually defines which conduit map is used).
teaming	6	Determines the Linux teaming mode used.

² JavaScript Object Notation <http://www.json.org/>

Interface Maps

This section specifies the hardware bus order used to define eth0, eth1, etc., on particular hardware systems. This rarely needs to be changed, unless a particular system is not correctly enumerating network controllers in the correct order.

Conduit Maps and Lists

The Crowbar network barclamp uses an abstraction, called a conduit, to map hardware network interfaces into logical interfaces. This section defines the logical conduit names (intf0, intf2, etc.,) and the interfaces in the conduit. The interfaces are defined by the type of network interface card (NIC). 1g refers to a 1Gb network interface, 10g refers to a 10Gb network interface.

Networks

The network section defines the individual networks. Each subsection specifies the network name, its vLAN assignments, and the IP parameters.

- The networks section is the one which is most commonly edited to change vLAN assignments and IP address parameters. Each network has the following parameters:

Table 4: Network Parameters

Name	Default	Description
vlan	Integer	The vLAN ID to use on the switch and interfaces for this network.
use_vlan	true	A value of true enables vLAN tagging. A value of false assumes that the node will receive untagged traffic for this network.
add_bridge	false	Indicates if the network should have a bridge built on top of it. The bridge will be named <i>brnnn</i> . This is used for Nova compute nodes.
subnet	IP Address	The subnet for this network
netmask	Netmask	The netmask for this network.
router	IP Address	The default router for this network.
broadcast	IP Address	The default broadcast address for this network.
ranges	map	This contains a map of strings to start and stop values for network. This allows for sub-ranges with the network for specific uses. e.g. dhcp, admin, bmc, hosts.

The range map has a string key that is the name and a map defining the range.

Table 5: Network Range Map

Name	Type	Description
start	IP Address	First address in the range, inclusive.
end	IP Address	Last address in the range, inclusive.

Example network definition

This is a sample network definition stanza, for an admin network.

```
1  "admin": {
2    "vlan": 100,
3    "use_vlan": false,
4    "add_bridge": false,
5    "subnet": "192.168.124.0",
6    "netmask": "255.255.255.0",
7    "broadcast": "192.168.124.255",
8    "ranges": {
9      "admin"
10       { "start": "192.168.124.10", "end": "192.168.124.11" },
11      "dhcp"
12       { "start": "192.168.124.21", "end": "192.168.124.80" },
13      "host"
14       { "start": "192.168.124.81", "end": "192.168.124.160" },
15      "switch"
16       { "start": "192.168.124.241", "end": "192.168.124.250" }
17    }
18  }
```

Adding External Access to the Admin Node

A common requirement is to add incoming access to the admin node through a bastion host or network. This requires an additional definition for the external network, a change to the conduit maps to specify the interface, and a one-time IP address allocation. These changes need to be made before Crowbar is installed, and the IP needs to be allocated after Crowbar installation.

Defining the External Network

Add a new network stanza that defines the external network. For this example, we will assume you have one address you want to assign to the admin node and you are going to run this as a native (non-tagged) interface.

The logical name of the network will be "bastion". Set use_vlan and add_bridge to false, and specify any vlan number (since it's unused in this case). Also ensure the rest of the parameters are correct for your network. The admin range will be used to assign the address to the admin node from this pool. Place the assigned address in the start and end fields. The conduit field will be "bastion1".

The results should look like this example:

```
1  "bastion": {
2    "conduit": "bastion1",
3    "vlan": 50,
4    "use_vlan": false,
5    "add_bridge": false,
6    "subnet": "192.168.235.0",
7    "netmask": "255.255.255.0",
8    "broadcast": "192.168.235.255",
9    "ranges": {
10      "admin": { "start": "192.168.235.10", "end": "192.168.235.10" }
11    }
12  }
```

Defining the Interface in the Conduit Map

Update the conduit map to include the conduit defined in the new network. For this example, we will assume you are in single mode and have a second 1Gb interface to use.

Add an entry for conduit "bastion1" to the conduit list in the "single" section of the conduit maps, and specify the interface is 1g2. Here is an example, where lines 4-6 were added:

```
1      {
2      "pattern": "single/./.*",
3      "conduit_list": {
4        "bastion1": {
5          "if_list": [ "1g2" ]
6        },
7        "intf0": {
8          "if_list": [ "1g1" ]
9        },
10       "intf1": {
11         "if_list": [ "1g1" ]
12       },
13       "intf2": {
14         "if_list": [ "1g1" ]
15       }
16     }
17   },
```

Allocating the IP Address

After the Crowbar installation is complete, the last steps are to actually allocate the IP address and assign it to the interface:

```
# crowbar network allocate_ip default <admin name> bastion admin
# chef-client
```

Once the Chef-client has finished, you should have access to the admin node through the new interface.

Configuring the Network for Outbound Connectivity

The default configuration assumes the admin node is isolated, and does not depend on external connectivity. In some cases, it may be desirable to allow outbound access from the admin node, possibly to access external NTP or DNS servers. This requires updates to the public network definition. These changes need to be made before Crowbar is installed, and the IP needs to be allocated after Crowbar installation.

Updating the public network definition

Change the definition of the public network to match the external LAN before installing Crowbar. For example, in the following definition of the public network, lines 6-9, 12, and 13 would need to be updated to match the existing LAN. The entries that must be updated are the subnet, netmask, broadcast address, router, and ranges. You might also need to change the conduit entry, depending on which network interface is connected to the external network.

```

1      "public": {
2          "conduit": "intf1",
3          "vlan": 300,
4          "use_vlan": true,
5          "add_bridge": false,
6          "subnet": "192.168.126.0",
7          "netmask": "255.255.255.0",
8          "broadcast": "192.168.126.255",
9          "router": "192.168.126.1",
10         "router_pref": 5,
11         "ranges": {
12             "host": { "start": "192.168.126.2", "end": "192.168.126.49" },
13             "dhcp": { "start": "192.168.126.50", "end": "192.168.126.127" }
14         }
15     },

```

After saving the changes, finish the Crowbar installation.

Allocating the IP Address

After the Crowbar installation is complete, the last steps are to actually allocate the IP address and assign it to the interface. On the admin node, execute the commands:

```

# crowbar network allocate_ip default <admin name> public host
# chef-client
# /etc/init.d/chef-server-webui restart

```

Once the chef-client has finished, you should have access to the admin node through the new interface, and can outbound access to DNS or NTP servers.

If external access was being configured to support external DNS and/or NTP servers, then edit any new or existing barclamp proposals to include the external server entries, and apply the proposals.

To verify NTP access, you can use the ntpq utility. The '*' before the node IP indicates the local NTP client has synchronized to the external server. You should wait for the admin node to initially sync to the external time server before deploying the remaining nodes.

```

[root@admin config]# ntpq -p
remote refid st t when poll reach delay offset jitter
=====
*172.26.1.50 132.163.4.103 2 u 40 64 377 0.287 -0.433 0.169

```

Installing Crowbar

The initial admin node installation does not complete the Crowbar installation, to allow the network configuration to be customized. After any customizations have been made, the final Crowbar installation can be completed.

 The networks cannot be reconfigured after Crowbar is installed.

To complete the Crowbar installation:

1. Log onto the admin node. The default username is `crowbar`, password: `crowbar`.
2. Switch to the superuser:

```
sudo -i
```

3. Verify or edit the network configuration file:
`/opt/dell/barclamps/network/chef/data_bags/crowbar/bc-template-network.json.`
4. Configure the date and timezone. See the Ubuntu man pages for valid settings. For example, replace {timezone} with America/New_York:

```
dpkg-reconfigure tzdata
echo "{timezone}" | sudo tee /etc/timezone
```
5. Initiate the installation script:

```
cd /tftpboot/ubuntu_dvd/extra
./install systemname.yourdomain.com
```
6. Reboot the admin node.

The Crowbar installation will be started in a screen session. You can attach to this session to follow the install process. The install logs are written to `/var/log`, and can be checked if there are any errors during the install process. The process will take several minutes to complete.

The main cause of errors at this point is usually syntax errors caused while modifying the network configuration. If an error occurs, check the log files, fix any syntax errors, and then restart the Crowbar install process.

Verifying Admin Node Status

When the Crowbar installation completes, the admin node will remain at a shell prompt. At this point, all Crowbar and operations services have started. Consult the table below to access these services from a web browser on the administration network.

Table 6: Crowbar and Operations Service Access

Service	URL	Credentials
SSH	crowbar@192.168.124.10	crowbar / crowbar
Crowbar UI	http://192.168.124.10:3000/	crowbar / crowbar
Nagios	http://192.168.124.10/nagios3	nagiosadmin / password
Ganglia	http://192.168.124.10/ganglia	nagiosadmin / password
Chef UI	http://192.168.124.10:4040/	admin / password

Logging into the Crowbar interface requires acceptance of the license agreement. It can be found:

- On the dashboard under *EULA*
- In the End User License Agreement section of this document
- At this web page:
<http://www.dell.com/content/topics/global.aspx/policy/en/policy?c=us&l=en&s=gen&~section=015#dsla>

Discovering and Allocating Additional Nodes

After Crowbar has been installed, all additional deployment is performed through Crowbar.

When additional nodes are powered on, they will PXE boot from the admin server. The initial boot will use a special “discovery” image, which will probe the node and report its configuration and status to Crowbar. When this process completes for each node, it will appear in Crowbar as discovered.

At this point, no changes have been made to the node. The node must explicitly be allocated in Crowbar to continue the process. (This step allows verification of the node identity before continuing.) After the node has been allocated, it will reboot, and go through a process of installing a base operating system plus operational infrastructure such as NTP, DNS, Nagios, Ganglia, and Chef.


At the end of the allocation phase, the nodes are ready to have specific OpenStack components deployed to them.

Installing OpenStack™ Components

The general workflow to use Crowbar to deploy OpenStack components is:

1. Create a default proposal that includes the parameters for the OpenStack deployment.
2. Edit or verify the proposal to assign the correct nodes for each component, or to customize the configuration.
3. Save the proposal to Crowbar.
4. Commit the proposal.

This may be done through the use of the Crowbar command line tool, or the web interface. The sections that follow use the command line tool: `/opt/dell/bin/crowbar` (for details on using the UI, see the *Dell Crowbar User's Guide*).

 When using the crowbar tool on the admin node, you may first have to set the following environment variable:

```
export CROWBAR_KEY=`cat /etc/crowbar.install.key`
```


If on a non-admin node, one may also use:

```
export CROWBAR_KEY=crowbar:crowbar
```

(the default username/password)

The OpenStack components should be installed in the same order as they appear in the Crowbar interface. Generally, the OpenStack Compute components are installed on one set of nodes, and the OpenStack Swift components are installed on a different set of nodes.

Example: Implementing a Proposal via the Command. Line

 You must be root in order to run the crowbar command.

Create a Proposal

Crowbar will inspect the current known nodes and provide a proposal that it believes will best utilize available systems for the component being installed. To create and inspect this proposed configuration:

```
/opt/dell/bin/crowbar <component> proposal create <name>
```

```
/opt/dell/bin/crowbar <component> proposal show <name> > <local_file_name>
```

Where:

- `<component>` - is the component for which the proposal is made; e.g. Swift, Nova, Glance
- `<name>` - is the name assigned to this proposal. This name should be unique for the component; i.e. if two Swift clusters are being installed, the proposals for each should have unique names. They need not be unique between components of different types
- `<local_file_name>` - is a file into which the proposal will be written

Update a Proposal

The local file created above can be inspected and modified. Common changes include:

- Changing default passwords and other barclamp parameters (e.g. Swift replica count)
- Changing the assignment of machines to roles

Once edits are completed, Crowbar must be updated. To update Crowbar with a modified proposal:


```
/opt/dell/bin/crowbar <component> proposal --file=<local_file_name> edit <name>
```

where the parameters in this command are the same as mentioned above. Crowbar will validate the proposal for syntax and perform basic sanity checks as part of this process.

Committing a Proposal

Once the proposal content is satisfactory, the barclamp instance can be activated:

```
/opt/dell/bin/crowbar <component> proposal commit <name>
```

This might take a few moments, as Crowbar is deploying the required software to the machines mentioned in the proposal.

Appendix A. Default Switch Configurations

When deploying the switches the following configurations should be used to appropriately setup the VLANs:

- [Dell™ PowerConnect™ 6248 Switch Configuration](#)
- [Dell™ Force10™ Switch Configuration](#)

Dell™ PowerConnect™ 6248 Switch Configuration

The following commands are to be used with a Dell™ PowerConnect™ 6248 switch. Modifications will be required depending on the network configuration of the environment (lines 62-68 are optional).

```
1  #
2  #
3  vlan database
4  vlan 2,100,200,300,400,500
5  interface vlan 2
6  name mgmt
7  exit
8  switch 1 priority 10
9  switch 2 priority 9
10 interface vlan 100
11 name Admin_Net
12 ip address 192.168.124.1 255.255.255.0
13 routing
14 exit
15 interface vlan 200
16 name Storage_Net
17 exit
18 interface vlan 300
19 name External_Net
20 exit
21 interface vlan 400
22 name Nova_Floating
23 exit
24 interface vlan 500
25 name Nova_Fixed
26 exit
27 #
28 #
29 interface range ethernet 1/g1-1/g48,2/g1-2/g48
30 shutdown
31 spanning-tree portfast
32 switchport mode general
33 switchport general pvid 100
34 switchport general allowed vlan add 100
35 switchport general allowed vlan add 200,300,400,500 tagged
36 switchport general allowed vlan remove 1
37 no switchport general acceptable-frame-type tagged-only
38 lldp transmit-tlv port-desc sys-name sys-desc sys-cap
39 lldp transmit-mgmt
40 lldp notification
41 no shutdown
42 exit
43 #
44 #
45 ip address 192.168.254.250 255.255.255.0
46 ip address vlan 2
47 ip ssh server
48 #
49 #
50 UPLINK Port
51 interface ethernet 1/gxxx
52 shutdown
```

```

53 switchport general pvid 300
54 no switchport general acceptable-frame-type tagged-only
55 switchport general allowed vlan add 300
56 switchport general allowed vlan remove 1,2
57 lldp transmit-tlv port-desc sys-name sys-desc sys-cap
58 lldp transmit-mgmt
59 lldp notification
60 no shutdown
61 exit
62 switchport general allowed vlan add xxxx
63 switchport general allowed vlan add 300 tagged
64 switchport general allowed vlan remove 1
65 lldp transmit-tlv port-desc sys-name sys-desc sys-cap
66 lldp transmit-mgmt
67 lldp notification
68 exit

```

Dell™ Force10™ Switch Configuration

The following commands are to be used with a Dell™ Force10™ switch. Modifications will be required depending on the network configuration of the environment.

```

1  ! Version 8.3.12.0
2  ! Last configuration change at Sun May 19 06:01:08 2013 by randy ! Startup-config last updated at
  Sat Apr 27 13:35:29 2013 by twalker !
3  boot system stack-unit 0 primary system: A:
4  boot system stack-unit 0 secondary system: B:
5  boot system stack-unit 0 default system: A:
6  !
7  redundancy auto-synchronize full
8  !
9  hardware watchdog
10 !
11 hostname mhtllabclsolr5sw5
12 !
13 username Joe password 7 apassword privilege 15 !
14 protocol spanning-tree rstp
15   no disable
16   bridge-priority 4096
17
18 !
19 stack-unit 0 provision S4810
20 !
21 interface TenGigabitEthernet 0/0
22   no ip address
23   portmode hybrid
24   switchport
25 !
26   spanning-tree rstp edge-port
27   no shutdown
28 !
29 interface TenGigabitEthernet 0/1
30   no ip address
31   portmode hybrid
32   switchport
33 !
34   spanning-tree rstp edge-port
35   no shutdown
36 !
37 interface TenGigabitEthernet 0/2
38   no ip address
39   portmode hybrid
40   switchport
41 !
42   spanning-tree rstp edge-port
43   no shutdown
44 !
45 interface TenGigabitEthernet 0/3
46   no ip address

```

```

47  portmode hybrid
48  switchport
49  !
50  spanning-tree rstp edge-port
51  no shutdown
52  !
53  interface TenGigabitEthernet 0/4
54  no ip address
55  portmode hybrid
56  switchport
57  !
58  spanning-tree rstp edge-port
59  no shutdown
60  !
61  interface TenGigabitEthernet 0/5
62  no ip address
63  portmode hybrid
64  switchport
65  !
66  spanning-tree rstp edge-port
67  no shutdown
68  !
69  interface TenGigabitEthernet 0/6
70  no ip address
71  portmode hybrid
72  switchport
73  !
74  spanning-tree rstp edge-port
75  no shutdown
76  !
77  interface TenGigabitEthernet 0/7
78  no ip address
79  portmode hybrid
80  switchport
81  !
82  spanning-tree rstp edge-port
83  no shutdown
84  !
85  interface TenGigabitEthernet 0/8
86  no ip address
87  portmode hybrid
88  switchport
89  !
90  spanning-tree rstp edge-port
91  no shutdown
92  !
93  interface TenGigabitEthernet 0/9
94  no ip address
95  portmode hybrid
96  switchport
97  !
98  spanning-tree rstp edge-port
99  no shutdown
100 !
101 interface TenGigabitEthernet 0/10
102 no ip address
103 portmode hybrid
104 switchport
105 !
106 spanning-tree rstp edge-port
107 no shutdown
108 !
109 interface TenGigabitEthernet 0/11
110 no ip address
111 portmode hybrid
112 switchport
113 !
114 spanning-tree rstp edge-port
115 no shutdown
116 !
117 interface TenGigabitEthernet 0/12
118 no ip address
119 portmode hybrid

```

```

120 switchport
121 !
122 spanning-tree rstp edge-port
123 no shutdown
124 !
125 interface TenGigabitEthernet 0/13
126 no ip address
127 portmode hybrid
128 switchport
129 !
130 spanning-tree rstp edge-port
131 no shutdown
132 !
133 interface TenGigabitEthernet 0/14
134 no ip address
135 portmode hybrid
136 switchport
137 !
138 spanning-tree rstp edge-port
139 no shutdown
140 !
141 interface TenGigabitEthernet 0/15
142 no ip address
143 portmode hybrid
144 switchport
145 !
146 spanning-tree rstp edge-port
147 no shutdown
148 !
149 interface TenGigabitEthernet 0/16
150 no ip address
151 portmode hybrid
152 switchport
153 !
154 spanning-tree rstp edge-port
155 no shutdown
156 !
157 interface TenGigabitEthernet 0/17
158 no ip address
159 portmode hybrid
160 switchport
161 !
162 spanning-tree rstp edge-port
163 no shutdown
164 !
165 interface TenGigabitEthernet 0/18
166 no ip address
167 portmode hybrid
168 switchport
169 !
170 spanning-tree rstp edge-port
171 no shutdown
172 !
173 interface TenGigabitEthernet 0/19
174 no ip address
175 portmode hybrid
176 switchport
177 !
178 spanning-tree rstp edge-port
179 no shutdown
180 !
181 interface TenGigabitEthernet 0/20
182 no ip address
183 portmode hybrid
184 switchport
185 !
186 spanning-tree rstp edge-port
187 no shutdown
188 !
189 interface TenGigabitEthernet 0/21
190 no ip address
191 portmode hybrid
192 switchport

```

```

193 !
194 spanning-tree rstp edge-port
195 no shutdown
196 !
197 interface TenGigabitEthernet 0/22
198 no ip address
199 portmode hybrid
200 switchport
201 !
202 spanning-tree rstp edge-port
203 no shutdown
204 !
205 interface TenGigabitEthernet 0/23
206 no ip address
207 portmode hybrid
208 switchport
209 !
210 spanning-tree rstp edge-port
211 no shutdown
212 !
213 interface TenGigabitEthernet 0/24
214 no ip address
215 portmode hybrid
216 switchport
217 !
218 spanning-tree rstp edge-port
219 no shutdown
220 !
221 interface TenGigabitEthernet 0/25
222 no ip address
223 portmode hybrid
224 switchport
225 !
226 spanning-tree rstp edge-port
227 no shutdown
228 !
229 interface TenGigabitEthernet 0/26
230 no ip address
231 portmode hybrid
232 switchport
233 !
234 spanning-tree rstp edge-port
235 no shutdown
236 !
237 interface TenGigabitEthernet 0/27
238 no ip address
239 portmode hybrid
240 switchport
241 !
242 spanning-tree rstp edge-port
243 no shutdown
244 !
245 interface TenGigabitEthernet 0/28
246 no ip address
247 portmode hybrid
248 switchport
249 !
250 spanning-tree rstp edge-port
251 no shutdown
252 !
253 interface TenGigabitEthernet 0/29
254 no ip address
255 portmode hybrid
256 switchport
257 !
258 spanning-tree rstp edge-port
259 no shutdown
260 !
261 interface TenGigabitEthernet 0/30
262 no ip address
263 portmode hybrid
264 switchport
265 !

```

```

266 spanning-tree rstp edge-port
267 no shutdown
268 !
269 interface TenGigabitEthernet 0/31
270 no ip address
271 portmode hybrid
272 switchport
273 !
274 spanning-tree rstp edge-port
275 no shutdown
276 !
277 interface TenGigabitEthernet 0/32
278 no ip address
279 portmode hybrid
280 switchport
281 !
282 spanning-tree rstp edge-port
283 no shutdown
284 !
285 interface TenGigabitEthernet 0/33
286 no ip address
287 portmode hybrid
288 switchport
289 !
290 spanning-tree rstp edge-port
291 no shutdown
292 !
293 interface TenGigabitEthernet 0/34
294 no ip address
295 portmode hybrid
296 switchport
297 !
298 spanning-tree rstp edge-port
299 no shutdown
300 !
301 interface TenGigabitEthernet 0/35
302 no ip address
303 portmode hybrid
304 switchport
305 !
306 spanning-tree rstp edge-port
307 no shutdown
308 !
309 interface TenGigabitEthernet 0/36
310 no ip address
311 portmode hybrid
312 switchport
313 !
314 spanning-tree rstp edge-port
315 no shutdown
316 !
317 interface TenGigabitEthernet 0/37
318 no ip address
319 portmode hybrid
320 switchport
321 !
322 spanning-tree rstp edge-port
323 no shutdown
324 !
325 interface TenGigabitEthernet 0/38
326 no ip address
327 portmode hybrid
328 switchport
329 !
330 spanning-tree rstp edge-port
331 no shutdown
332 !
333 interface TenGigabitEthernet 0/39
334 no ip address
335 portmode hybrid
336 switchport
337 !
338 spanning-tree rstp edge-port

```

```

339 no shutdown
340 !
341 interface TenGigabitEthernet 0/40
342 no ip address
343 portmode hybrid
344 switchport
345 !
346 spanning-tree rstp edge-port
347 no shutdown
348 !
349 interface TenGigabitEthernet 0/41
350 no ip address
351 portmode hybrid
352 switchport
353 !
354 spanning-tree rstp edge-port
355 no shutdown
356 !
357 interface TenGigabitEthernet 0/42
358 no ip address
359 portmode hybrid
360 switchport
361 !
362 spanning-tree rstp edge-port
363 no shutdown
364 !
365 interface TenGigabitEthernet 0/43
366 no ip address
367 portmode hybrid
368 switchport
369 !
370 spanning-tree rstp edge-port
371 no shutdown
372 !
373 interface TenGigabitEthernet 0/44
374 no ip address
375 portmode hybrid
376 switchport
377 !
378 spanning-tree rstp edge-port
379 no shutdown
380 !
381 interface TenGigabitEthernet 0/45
382 no ip address
383 portmode hybrid
384 switchport
385 spanning-tree rstp edge-port
386 no shutdown
387 !
388 interface TenGigabitEthernet 0/46
389 description Uplink_to_BMC_switch
390 no ip address
391 portmode hybrid
392 switchport
393 !
394 no shutdown
395 !
396 interface TenGigabitEthernet 0/47
397 no ip address
398 !
399 no shutdown
400 !
401 interface fortyGigE 0/48
402 no ip address
403 !
404 no shutdown
405 !
406 interface fortyGigE 0/52
407 no ip address
408 !
409 no shutdown
410 !
411 interface fortyGigE 0/56

```



```
412 no ip address
413 !
414 no shutdown
415 !
416 interface fortyGigE 0/60
417 no ip address
418 !
419 no shutdown
420 !
421 interface ManagementEthernet 0/0
422 ip address 192.168.1.2/24
423 no shutdown
424 !
425 interface ManagementEthernet 1/0
426 no shutdown
427 !
428 interface ManagementEthernet 2/0
429 no shutdown
430 !
431 interface ManagementEthernet 3/0
432 no shutdown
433 !
434 interface ManagementEthernet 4/0
435 no shutdown
436 !
437 interface ManagementEthernet 5/0
438 no shutdown
439 !
440 interface ManagementEthernet 6/0
441 no shutdown
442 !
443 interface ManagementEthernet 7/0
444 no shutdown
445 !
446 interface ManagementEthernet 8/0
447 no shutdown
448 !
449 interface ManagementEthernet 9/0
450 no shutdown
451 !
452 interface ManagementEthernet 10/0
453 no shutdown
454 !
455 interface ManagementEthernet 11/0
456 no shutdown
457 !
458 interface Vlan 1
459 !untagged TenGigabitEthernet 0/46
460 !untagged Port-channel 100
461 !
462 interface Vlan 100
463 description prod
464 ip address 192.168.124.1/24
465 tagged TenGigabitEthernet 0/46
466 untagged TenGigabitEthernet 0/0-45
467 no shutdown
468 !
469 interface Vlan 200
470 description Storage
471 no ip address
472 tagged TenGigabitEthernet 0/0-46
473 no shutdown
474 !
475 interface Vlan 300
476 description bmc
477 no ip address
478 tagged TenGigabitEthernet 0/0-46
479 no shutdown
480 !
481 interface Vlan 400
482 description nova-fixed
483 no ip address
484 tagged TenGigabitEthernet 0/0-46
```

```
485 no shutdown
486 !
487 interface Vlan 500
488 description public
489 no ip address
490 tagged TenGigabitEthernet 0/0-46
491 no shutdown
492 !
493 interface Vlan 700
494 description os_sdn
495 no ip address
496 tagged TenGigabitEthernet 0/0-46
497 no shutdown
498 !
499
500 protocol lldp
501 advertise dot1-tlv port-protocol-vlan-id
502 advertise dot3-tlv max-frame-size
503 advertise management-tlv system-description system-name
504 advertise med
505 !
506 line console 0
507 line vty 0
508 line vty 1
509 line vty 2
510 line vty 3
511 line vty 4
512 line vty 5
513 line vty 6
514 line vty 7
515 line vty 8
516 line vty 9
517 !
518 end
```

Appendix B. Sample Network Configuration JSON

This is a sample of the default network configuration included in the Dell™ OpenStack™-Powered Cloud Solution. This is provided for reference — the actual file included on the installation media is the latest version, and may differ slightly from this example.

```
1  {
2    "id": "bc-template-network",
3    "description": "Instantiates network interfaces on the crowbar managed systems. Also manages
4    the address pool",
5    "attributes": {
6      "network": {
7        "start_up_delay": 30,
8        "mode": "single",
9        "teaming": {
10         "mode": 6
11       },
12       "interface_map": [
13         {
14           "pattern": "PowerEdge R610",
15           "bus_order": [
16             "0000:00/0000:00:01",
17             "0000:00/0000:00:03"
18           ]
19         },
20         {
21           "pattern": "PowerEdge R710",
22           "bus_order": [
23             "0000:00/0000:00:01",
24             "0000:00/0000:00:03"
25           ]
26         },
27         {
28           "pattern": "PowerEdge C6145",
29           "bus_order": [
30             "0000:00/0000:00:04",
31             "0000:00/0000:00:02"
32           ]
33         },
34         {
35           "pattern": "PowerEdge C2100",
36           "bus_order": [
37             "0000:00/0000:00:1c",
38             "0000:00/0000:00:07",
39             "0000:00/0000:00:09",
40             "0000:00/0000:00:01"
41           ]
42         },
43         {
44           "pattern": "C6100",
45           "bus_order": [
46             "0000:00/0000:00:01",
47             "0000:00/0000:00:03",
48             "0000:00/0000:00:07"
49           ]
50         },
51         {
52           "pattern": "product",
53           "bus_order": [
54             "0000:00/0000:00:01",
55             "0000:00/0000:00:02"
56           ]
57         }
58       ],
59       "conduit_map": [
60         {
61           "pattern": "team/*/*.*",
62           "conduit_list": {
63             "intf0": {
64               "if_list": [ "1g1", "1g2" ],
```

```

64         "team_mode": 6
65     },
66     "intf1": {
67         "if_list": [ "1g1", "1g2" ],
68         "team_mode": 6
69     },
70     "intf2": {
71         "if_list": [ "1g1", "1g2" ],
72         "team_mode": 6
73     }
74 },
75 },
76 {
77     "pattern": "dual/./.*",
78     "conduit_list": {
79         "intf0": {
80             "if_list": [ "?1g1" ]
81         },
82         "intf1": {
83             "if_list": [ "?1g2" ]
84         },
85         "intf2": {
86             "if_list": [ "?1g1" ]
87         }
88     }
89 },
90 {
91     "pattern": "single/./.*",
92     "conduit_list": {
93         "intf0": {
94             "if_list": [ "?1g1" ]
95         },
96         "intf1": {
97             "if_list": [ "?1g1" ]
98         },
99         "intf2": {
100             "if_list": [ "?1g1" ]
101         }
102     }
103 },
104 {
105     "pattern": ".*/./.*",
106     "conduit_list": {
107         "intf0": {
108             "if_list": [ "?1g1" ]
109         },
110         "intf1": {
111             "if_list": [ "1g1" ]
112         },
113         "intf2": {
114             "if_list": [ "1g1" ]
115         }
116     }
117 },
118 {
119     "pattern": "mode/1g_adpt_count/role",
120     "conduit_list": {
121         "intf0": {
122             "if_list": [ "1g1" ]
123         },
124         "intf1": {
125             "if_list": [ "?1g1" ]
126         },
127         "intf2": {
128             "if_list": [ "?1g1" ]
129         }
130     }
131 }
132 ],
133 "networks": {
134     "storage": {
135         "conduit": "intf1",
136         "vlan": 200,

```

```

137         "use_vlan": true,
138         "add_bridge": false,
139         "subnet": "192.168.125.0",
140         "netmask": "255.255.255.0",
141         "broadcast": "192.168.125.255",
142         "ranges": {
143             "host": { "start": "192.168.125.10", "end": "192.168.125.239" }
144         }
145     },
146     "public": {
147         "conduit": "intf1",
148         "vlan": 300,
149         "use_vlan": true,
150         "add_bridge": false,
151         "subnet": "192.168.126.0",
152         "netmask": "255.255.255.0",
153         "broadcast": "192.168.126.255",
154         "router": "192.168.126.1",
155         "router_pref": 5,
156         "ranges": {
157             "host": { "start": "192.168.126.2", "end": "192.168.126.49" },
158             "dhcp": { "start": "192.168.126.50", "end": "192.168.126.127" }
159         }
160     },
161     "nova_fixed": {
162         "conduit": "intf1",
163         "vlan": 500,
164         "use_vlan": true,
165         "add_bridge": true,
166         "subnet": "192.168.123.0",
167         "netmask": "255.255.255.0",
168         "broadcast": "192.168.123.255",
169         "router": "192.168.123.1",
170         "router_pref": 20,
171         "ranges": {
172             "router": { "start": "192.168.123.1", "end": "192.168.123.49" },
173             "dhcp": { "start": "192.168.123.50", "end": "192.168.123.254" }
174         }
175     },
176     "nova_floating": {
177         "conduit": "intf1",
178         "vlan": 300,
179         "use_vlan": true,
180         "add_bridge": false,
181         "subnet": "192.168.126.128",
182         "netmask": "255.255.255.192",
183         "broadcast": "192.168.126.191",
184         "ranges": {
185             "host": { "start": "192.168.126.129", "end": "192.168.126.191" }
186         }
187     },
188     "bmc": {
189         "conduit": "bmc",
190         "vlan": 100,
191         "use_vlan": false,
192         "add_bridge": false,
193         "subnet": "192.168.124.0",
194         "netmask": "255.255.255.0",
195         "broadcast": "192.168.124.255",
196         "ranges": {
197             "host": { "start": "192.168.124.162", "end": "192.168.124.240" }
198         }
199     },
200     "bmc_vlan": {
201         "conduit": "intf2",
202         "vlan": 100,
203         "use_vlan": true,
204         "add_bridge": false,
205         "subnet": "192.168.124.0",
206         "netmask": "255.255.255.0",
207         "broadcast": "192.168.124.255",
208         "ranges": {
209             "host": { "start": "192.168.124.161", "end": "192.168.124.161" }

```

```

210     }
211 },
212     "os_sdn": {
213         "conduit": "intf1",
214         "vlan": 700,
215         "use_vlan": true,
216         "add_bridge": false,
217         "subnet": "192.168.130.0",
218         "netmask": "255.255.255.0",
219         "broadcast": "192.168.130.255",
220         "ranges": {
221             "host": { "start": "192.168.130.10", "end": "192.168.130.254" }
222         }
223     },
224     "admin": {
225         "conduit": "intf0",
226         "vlan": 100,
227         "use_vlan": false,
228         "add_bridge": false,
229         "subnet": "192.168.124.0",
230         "netmask": "255.255.255.0",
231         "broadcast": "192.168.124.255",
232         "router": "192.168.124.1",
233         "router_pref": 10,
234         "ranges": {
235             "admin": { "start": "192.168.124.10", "end": "192.168.124.11" },
236             "dhcp": { "start": "192.168.124.21", "end": "192.168.124.80" },
237             "host": { "start": "192.168.124.81", "end": "192.168.124.160" },
238             "switch": { "start": "192.168.124.241", "end": "192.168.124.250" }
239         }
240     }
241 },
242 },
243 },
244 "deployment": {
245     "network": {
246         "crowbar-revision": 0,
247         "element_states": {
248             "network": [ "readying", "ready", "applying" ]
249         },
250         "elements": {},
251         "element_order": [
252             [ "network" ]
253         ],
254         "config": {
255             "environment": "network-base-config",
256             "mode": "full",
257             "transitions": true,
258             "transition_list": [ "discovered", "reset", "delete" ]
259         }
260     }
261 }
262 }

```

Appendix C. End User License Agreement

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