

Dell OpenStack- Powered Cloud Solution

A Dell Deployment Guide

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The power to do more

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Notes, Cautions, and Warnings



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



CAUTION: A CAUTION indicates potential damage to hardware or loss of data if instructions are not followed.



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

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1 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 Barclamps User Guide*, and the *Dell Crowbar 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.

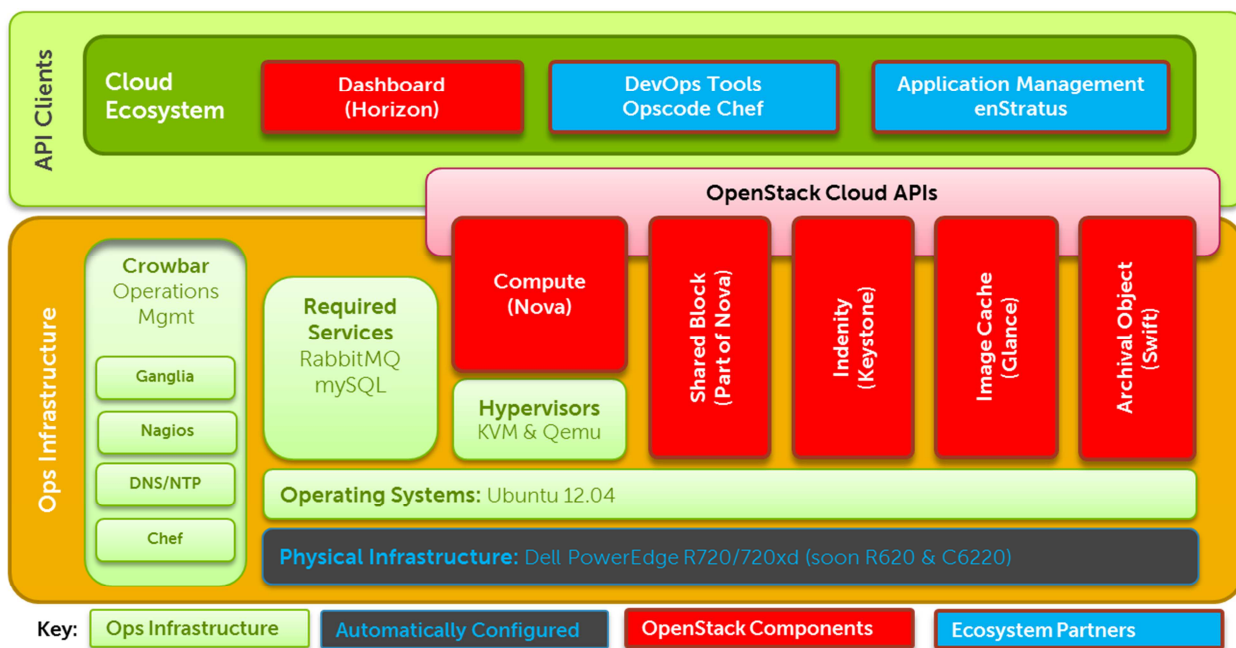


Figure 1: OpenStack Solution Taxonomy

2 Site Preparation and Hardware Installation

2.1 Hardware Setup

All systems should be installed and cabled according to 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 PDU and ensure the cooling is adequate.

2.2 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.

2.3 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, and manual steps are not required.

2.4 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.

2.5 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.

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.

3 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 **Error! Reference source not found.** 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 nodes.
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.

3.1 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 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).
7. Edit the machine settings within Player and ensure that the network adapter is configured to use Bridged Networking (see Figure 3), connected to the physical network adapter.
8. Configure VMware Player to mount the Crowbar ISO image a DVD in the VM (see **Error! Reference source not found.**).
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.

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.

¹ VMware Player may be freely downloaded from VMware's website.

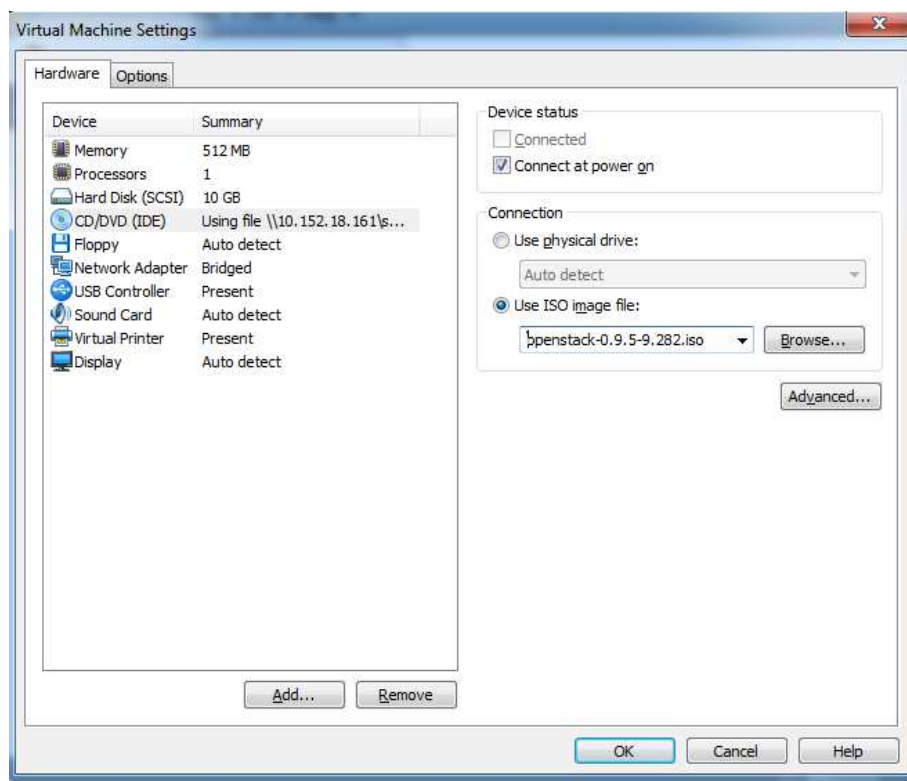


Figure 2: VMware Player Configuration for ISO Boot

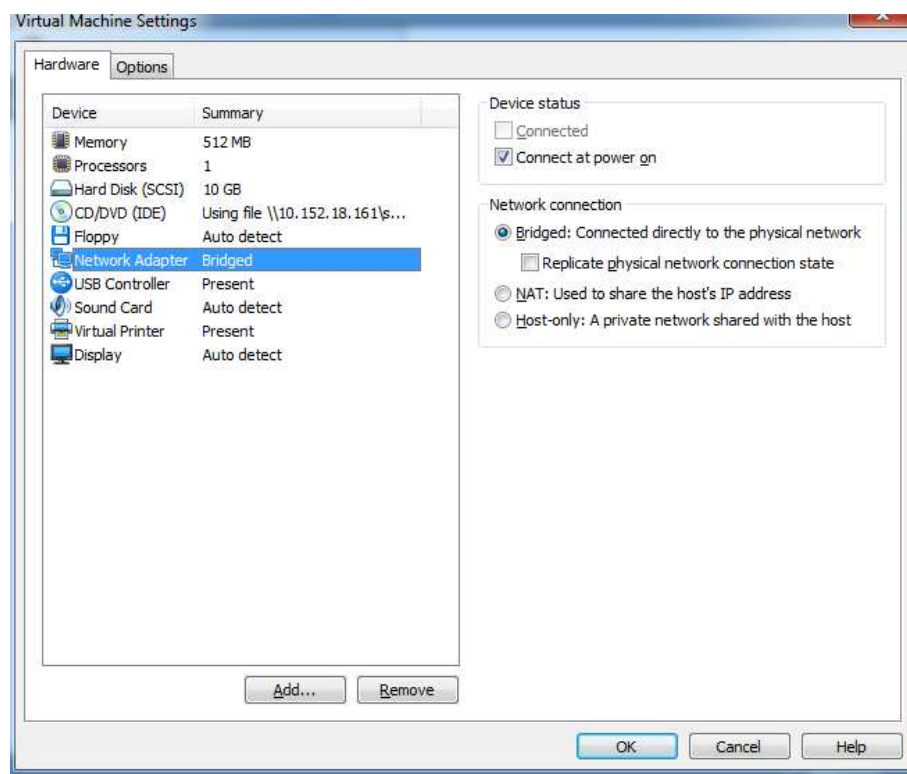


Figure 3: VMware Player Configuration for Network Bridging

3.2 Network Configuration

3.2.1 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 **Error! Reference source not found.**

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
admin	Private 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.
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	

3.2.2 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 Section 3.2.4: 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 a reference to the error.

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

3.2.3 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 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.

3.2.3.1 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.

3.2.3.2 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.

3.2.3.3 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.

3.2.3.4 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 brnnn. 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 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.

3.2.3.5 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  }
```

3.2.4 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.

3.2.4.1 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 }
```

3.2.4.2 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 lg2. Here is an example, where lines 4-6 were added:

```
1  {
2    "pattern": "single/././.*",
3    "conduit_list": {
4      "bastion1": {
5        "if_list": [ "lg2" ]
6      },
7      "intf0": {
8        "if_list": [ "lg1" ]
9      },
10     "intf1": {
11       "if_list": [ "lg1" ]
12     },
13     "intf2": {
14       "if_list": [ "lg1" ]
15     }
16   },
17 }
```

3.2.4.3 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.

3.2.5 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.

3.2.5.1 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": "192.168.122.0",
7          "netmask": "255.255.255.0",
8          "broadcast": "192.168.122.255",
9          "router": "192.168.122.1",
10         "router_pref": 5,
11         "ranges": {
12             "host": { "start": "192.168.122.2", "end": "192.168.122.49" },
13             "dhcp": { "start": "192.168.122.50", "end": "192.168.122.127" }
14         }
15     },

```

After saving the changes, finish the Crowbar installation.

3.2.5.2 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

```

3.3 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, the steps are:

1. Log onto the admin node. The default username is **crowbar**, password: **crowbar**.
2. Verify or edit the network configuration file: `/opt/dell/barclamps/network/chef/data_bags/crowbar/bc-template-network.json`
3. `sudo -i`

4. `cd /tftpboot/ubuntu_dvd/extra`
5. `./install systemname.yourdomain.com`

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.

3.3.1 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 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

[End User License Agreement](#)

[End User License Agreement](#) of this document, or at this web page:

<http://www.dell.com/content/topics/global.aspx/policy/en/policy?c=us&l=en&s=gen&~section=015#dsla>

3.4 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.

4 Installing OpenStack Components

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

- Obtain a default proposal that includes the parameters for the OpenStack deployment.
- Edit or verify the proposal to assign the correct nodes for component, or to customize the configuration.
- Save the proposal to Crowbar
- 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, the user 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.

4.1 Example: Implementing a Proposal via Cmd. Line



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

4.1.1 Obtain 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 obtain 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

4.1.2 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.

4.1.3 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.

4.1.4 Modifying an Active Configuration

When committing a proposal which was previously committed, Crowbar compares the new configuration to the currently active state and applies the deltas.

To force Crowbar to reapply a proposal, the active state needs to be deleted via:

```
/opt/dell/bin/crowbar <component> delete <name>
```

Then commit the proposal again as described above.

Appendix A. Default Switch Configuration

When deploying the switches the following configuration should be used to appropriately setup the VLANs. 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
```

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
the address pool",
4    "attributes": {
5      "network": {
6        "start_up_delay": 30,
7        "mode": "single",
8        "teaming": {
9          "mode": 6
10       },
11       "interface_map": [
12         {
13           "pattern": "PowerEdge R610",
14           "bus_order": [
15             "0000:00/0000:00:01",
16             "0000:00/0000:00:03"
17           ]
18         },
19         {
20           "pattern": "PowerEdge R710",
21           "bus_order": [
22             "0000:00/0000:00:01",
23             "0000:00/0000:00:03"
24           ]
25         },
26         {
27           "pattern": "PowerEdge C6145",
28           "bus_order": [
29             "0000:00/0000:00:04",
30             "0000:00/0000:00:02"
31           ]
32         },
33         {
34           "pattern": "PowerEdge C2100",
35           "bus_order": [
36             "0000:00/0000:00:1c",
37             "0000:00/0000:00:07",
38             "0000:00/0000:00:09",
39             "0000:00/0000:00:01"
40           ]
41         },
42         {
43           "pattern": "C6100",
44           "bus_order": [
45             "0000:00/0000:00:01",
46             "0000:00/0000:00:03",
47             "0000:00/0000:00:07"
48           ]
49         },
50         {
51           "pattern": "product",
52           "bus_order": [
53             "0000:00/0000:00:01",
54             "0000:00/0000:00:02"
55           ]
56         }
57       ],
58       "conduit_map": [
59         {
60           "pattern": "team/*/*.*",
61           "conduit_list": {
62             "intf0": {
63               "if_list": [ "lg1", "lg2" ],

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64         "team_mode": 6
65     },
66     "intf1": {
67         "if_list": [ "lg1", "lg2" ],
68         "team_mode": 6
69     },
70     "intf2": {
71         "if_list": [ "lg1", "lg2" ],
72         "team_mode": 6
73     }
74 },
75 },
76 {
77     "pattern": "dual/./.*",
78     "conduit_list": {
79         "intf0": {
80             "if_list": [ "?lg1" ]
81         },
82         "intf1": {
83             "if_list": [ "?lg2" ]
84         },
85         "intf2": {
86             "if_list": [ "?lg1" ]
87         }
88     }
89 },
90 {
91     "pattern": "single/./.*",
92     "conduit_list": {
93         "intf0": {
94             "if_list": [ "?lg1" ]
95         },
96         "intf1": {
97             "if_list": [ "?lg1" ]
98         },
99         "intf2": {
100             "if_list": [ "?lg1" ]
101         }
102     }
103 },
104 {
105     "pattern": ".*./.*",
106     "conduit_list": {
107         "intf0": {
108             "if_list": [ "?lg1" ]
109         },
110         "intf1": {
111             "if_list": [ "lg1" ]
112         },
113         "intf2": {
114             "if_list": [ "lg1" ]
115         }
116     }
117 },
118 {
119     "pattern": "mode/lg_adpt_count/role",
120     "conduit_list": {
121         "intf0": {
122             "if_list": [ "lg1" ]
123         },
124         "intf1": {
125             "if_list": [ "?lg1" ]
126         },
127         "intf2": {
128             "if_list": [ "?lg1" ]
129         }
130     }
131 }
132 ],
133 "networks": {
134     "storage": {
135         "conduit": "intf1",
136         "vlan": 200,
137         "use_vlan": true,

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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": "192.168.122.0",
152     "netmask": "255.255.255.0",
153     "broadcast": "192.168.122.255",
154     "router": "192.168.122.1",
155     "router_pref": 5,
156     "ranges": {
157         "host": { "start": "192.168.122.2", "end": "192.168.122.49" },
158         "dhcp": { "start": "192.168.122.50", "end": "192.168.122.127" }
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": "192.168.122.128",
182     "netmask": "255.255.255.192",
183     "broadcast": "192.168.122.191",
184     "ranges": {
185         "host": { "start": "192.168.122.129", "end": "192.168.122.191" }
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 },

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

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18. **Choice of Law and Language.** This EULA shall be governed by the laws of the State of Texas, USA, to the exclusion of the UN Convention on Contracts for the International Sale of Goods. You acknowledge that the headquarters of the Dell family of companies is located in Texas, and that the software licensed under this EULA and the related products marketed in connection with such software were in substantial part conceived, developed, and marketed by Dell personnel in Texas. Further, you acknowledge, agree, and stipulate that the laws of the State of Texas bear a substantial relationship to this EULA and that the selection of Texas law to govern this EULA and the license of the Software hereunder is reasonable and appropriate, and you consent to the selection of such law to govern this EULA and the relationship of the parties hereto. This EULA has been agreed only in the English language, which version of this EULA shall be controlling regardless of whether any translations of this EULA have been prepared or exchanged. As an exception to the preceding sentence, if Dell provides this EULA to you only in a non-English language version, then such non-English language version shall control. You acknowledge and represent that you have carefully reviewed this EULA with the involvement and assistance of your employees, advisors, and/or legal counsel fluent in the English language, that you have consulted with local legal counsel and counsel competent to render advice with respect to transactions governed by the law applicable to this EULA, that you have no questions regarding the meaning or effect of any of this EULA's terms, and that you have obtained high-quality translations of this EULA for use by you or any of your team who are not fluent in the English language, with the understanding that you alone shall bear the risk of any misunderstandings that may arise as a result of such translation. All communications in connection with this EULA shall be in the English language.
- Les parties ont demandé que cette convention ainsi que tous les documents qui s'y rattachent soient rédigés en anglais.
19. **Dispute Resolution and Binding Arbitration.** ANY CLAIM, DISPUTE, OR CONTROVERSY (WHETHER IN CONTRACT, TORT, OR OTHERWISE, WHETHER PREEXISTING, PRESENT OR FUTURE, AND INCLUDING STATUTORY, COMMON LAW, INTENTIONAL TORT AND EQUITABLE CLAIMS) BETWEEN YOU AND DELL arising out of or in connection with this EULA, or the breach, termination or validity thereof shall be finally settled under the Rules of Arbitration of the International Chamber of Commerce ("ICC") by one or more arbitrators with expertise in software licensing appointed in accordance with such rules. The arbitration shall be conducted in the English language. The place of the arbitration shall be a commercial center reasonably chosen by the arbitration panel in a third country so as to ensure that the award resulting from the arbitration shall be of an international character and enforceable under the New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards. The arbitration panel shall be empowered to grant whatever relief would be available in court, including without limitation preliminary relief, injunctive relief, and specific performance. Any award of the arbitration panel shall be final and binding immediately when rendered, and judgment on the award may be entered in any court of competent jurisdiction. Neither you nor Dell shall be entitled to join, consolidate, or include any claims belonging to or alleged or arising from, by, or on behalf of any third party to an arbitration brought hereunder. The individual (non-class) nature of this dispute resolution provision goes to the essence of the parties' dispute resolution agreement, and if found unenforceable, the entire arbitration and dispute resolution provision shall be void. Notwithstanding the foregoing, Dell may apply to any relevant government agency or any court of competent jurisdiction to preserve its rights under this EULA and to obtain any injunctive or preliminary relief, or any award of specific performance, to which it may be entitled, either against you or against a non-party; provided, however, that no such administrative or judicial authority shall have the right or power to render a judgment or award (or to enjoin the rendering of an arbitral award) for damages that may be due to or from either party under this EULA, which right and power shall be reserved exclusively to an arbitration panel proceeding in accordance herewith.
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20. **No Waiver.** No waiver of breach or failure to exercise any option, right, or privilege under the terms of this EULA on any occasion shall be construed to be a waiver of a subsequent breach or right to exercise any option, right, or privilege.
21. **Force Majeure.** Dell shall not be responsible for any delay or failure in performance of any part of this EULA to the extent that such delay or failure is caused by fire, flood, explosion, war, embargo, government requirement, civil, or military authority, act of God, act or omission of carriers, failure of the Internet or other similar causes beyond its control.
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22. **No Assignment.** Except as set forth herein, you may not assign or transfer your interests, rights or obligations under this EULA by written agreement, merger, consolidation, operation of law or otherwise, without the prior written consent of an authorized executive officer of Dell. Any attempt to assign this EULA by you without such prior written consent from Dell shall be null and void.
23. **Entire Agreement.** Unless you have entered into another written agreement with respect to the Software which has been signed by you and an authorized representative of Dell and which conflicts with the terms of this EULA, you agree that this EULA supersedes all prior written or oral agreements, warranties or representations, including any and all other click-wrap, shrink-wrap or similar licenses or agreements, with respect to the Software. No amendment to or modification of this EULA, in whole or in part, will be valid or binding unless it is in writing and executed by authorized representatives of both parties. If any term of this EULA is found to be invalid or unenforceable, the remaining provisions

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will remain effective. You agree that any principle of construction or rule of law that provides that an agreement shall be construed against the drafter shall not apply to the terms and conditions of this EULA.

- 24. Notices.** Notice to Dell under this EULA must be in writing and sent to the address below or to such other address (including facsimile or e-mail) as specified in writing, and will be effective upon receipt.

Dell Inc., Attn: Dell Legal
One Dell Way, Round Rock, Texas 78682

To Learn More

For more information on the Dell OpenStack-Powered Cloud Solution, visit:
www.dell.com/openstack

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