

How to Provision Oracle Linux with Oracle Enterprise Manager 13c

ORACLE WHITE PAPER | MAY 2017

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Introduction

Bare Metal Provisioning is a framework within Oracle Enterprise Manager Cloud Control which enables rapid and efficient provisioning of Linux and Oracle VM Server onto multiple x86 hosts. The framework uses standard PXE (Preboot Execution Environment) booting process for provisioning both bare-metal and virtual servers. The framework provides a role-based UI (User Interface), for the creation of the Bare Metal Provisioning framework components. These components will be explained in detail with regard to their configuration and use cases.

Bare Metal Provisioning Concepts

The following are concepts related to the Bare Metal Provisioning framework within Oracle Enterprise Manager:

Software Library

The Bare Metal Provisioning framework stores metadata within the Oracle Enterprise Manager Software Library. The Software Library maintains version, maturity versions and state. Examples of the metadata are Deployment Plans, Operating System (OS), Disk Layout and Oracle VM Server provisioning profiles.

Boot Server

The Boot Server enables the target provisioning host to boot over the network. The Boot Server must be a host target within Oracle Enterprise Manager and therefore requires an Oracle Enterprise Manager agent installed and running. The Boot Server must be able to receive the BOOTP (Bootstrap Protocol) and TFTP (Trivial File Transfer Protocol) requests over the network from the target provisioning host.

Stage Server

During the provisioning process, the required binaries and files are transferred to a Stage Server. This process, referred to as staging, is responsible for preparing images to be installed over the network. The Stage Server must be a host target within Oracle Enterprise Manager and therefore requires an Oracle Enterprise Manager agent installed and running. The Stage Server delivers content via HTTP or NFS, therefore an HTTP or NFS server is required to be installed and running. The Bare Metal Provisioning framework requires at least one Stage Server. The Stage Server can also be used to host an Oracle Enterprise Manager agent RPM which can be used in the Bare Metal Provisioning process. This enables the seamless install and configuration of the Oracle Enterprise Manager agent on the target provisioning host.

RPM Repository

The Bare Metal Provisioning framework receives the RPM's for the target provisioning hosts' OS from the RPM Repository. From a networking perspective, it is a best practice to have the RPM Repository as close to the target provisioning host as possible. This will bring down the installation time by reducing the time taken to transfer RPM's from the RPM Repository to the target provisioning hosts. The RPM Repository must be a

host target within Oracle Enterprise Manager and therefore requires an Oracle Enterprise Manager agent installed and running. The RPM Repository delivers content via HTTP or NFS, therefore an HTTP or NFS server is required to be installed and running. The Bare Metal Provisioning framework requires at least one RPM Repository.

DHCP Server

A DHCP Server is required as part of the PXE provisioning process. See Figure 2 and Appendix A for details on the PXE process. It is a best practice and recommended to have the DHCP Server and Boot Server on the same host. If this is not possible, the DHCP Server must be a host target within Oracle Enterprise Manager and therefore requires an Oracle Enterprise Manager agent installed and running.

Reference Host

A reference host (also called a gold machine), is a host that the Bare Metal Provisioning framework can use to create the Linux OS provisioning profiles which are stored in the Oracle Enterprise Manager Software Library. The Bare Metal Provisioning framework picks up the list of RPM's installed on the reference host. It then fetches those RPM's from an RPM repository, to create a Linux OS provisioning profile that represents the OS installed on the reference host. The reference host must be an Oracle Enterprise Manager host target and therefore have an Oracle Enterprise Manager agent installed and running.

Target Provisioning Hosts

A Target Provisioning Host must contain a physical or virtual NIC (Network Interface Controller) which is PXE capable.

Bare Metal Provisioning portal

The Oracle Enterprise Manager Bare Metal Provisioning framework has a portal which consists of three sections:

- Deployments: all provisioning for Linux and Oracle VM Server is defined and tracked.
- Infrastructure: Bare Metal Provisioning framework components such as the Boot, Stage, RPM and DHCP servers are defined and managed.
- Saved Plans: allows the user to view all the deployment procedures that were saved as templates with all the essential attribute values for future runs.



Figure 1 Bare Metal Provisioning portal tabs

Target Provisioning Host

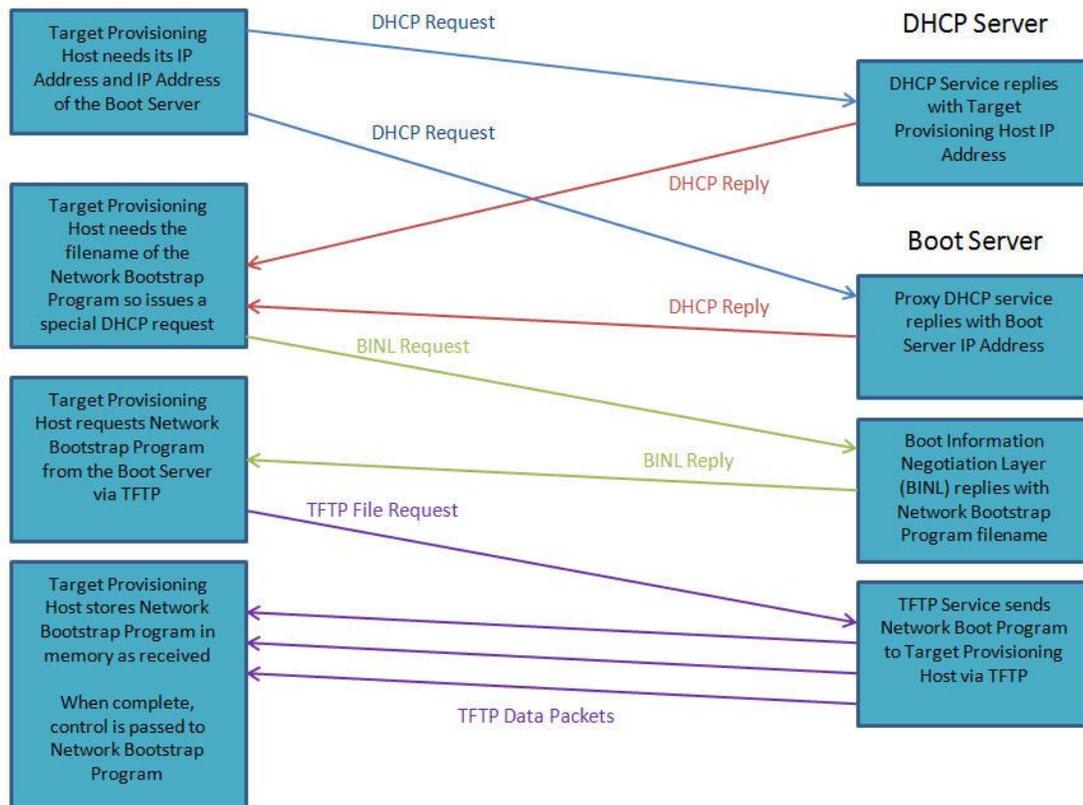


Figure 2 PXE Process

Bare Metal Provisioning Deployment Concepts

It is essential to understand all aspects of Oracle Enterprise Manager security concepts when planning a Bare Metal Provisioning framework.

The following is required:

- Boot, Stage, RPM and DHCP servers require a supported Oracle Linux operating system detailed in the [Installing Oracle Management Agents](#) section of Oracle Enterprise Manager Cloud Control Basic Install Guide
- A valid Customer Support Identifier (CSI) from Oracle is required to access the Unbreakable Linux Network (ULN). Alternatively, public access to the Oracle Linux Yum Server.
- Boot, Stage, RPM and DHCP servers require an Oracle Enterprise Manager agent to be installed and running
- SSH and SCP are required to push the Oracle Enterprise Manager agent on Boot, Stage, RPM and DHCP servers

- 
- The Oracle Enterprise Manager agent user requires `sudo root` access to deploy the Oracle Enterprise Manager agent on the Boot, Stage, RPM and DHCP servers. Configuration of `root` access via `sudo` is explained on page 9
 - Once the Oracle Enterprise Manager agent is deployed, it only requires `sudo root` access to the Oracle Enterprise Manager `nmosudo` binary
 - Firewall settings should allow the Oracle Enterprise Manager agent port as well as protocols for each server component:
 - Boot Servers: TFTP and ProxyDHCP (UDP)
 - DHCP Servers: DHCP
 - Stage Servers: HTTP or NFS
 - RPM Servers: HTTP

Refer to Figure 3 and the [Oracle Enterprise Manager Cloud Control Advanced Installation and Configuration Guide](#) which describes the firewall port requirements for Oracle Enterprise Manager

- Target Provisioning Hosts should be a supported Linux operating system detailed in the [Supported Releases of Linux](#) section, Bare Metal Provisioning chapter of the Oracle Enterprise Manager Lifecycle Management Administrators Guide

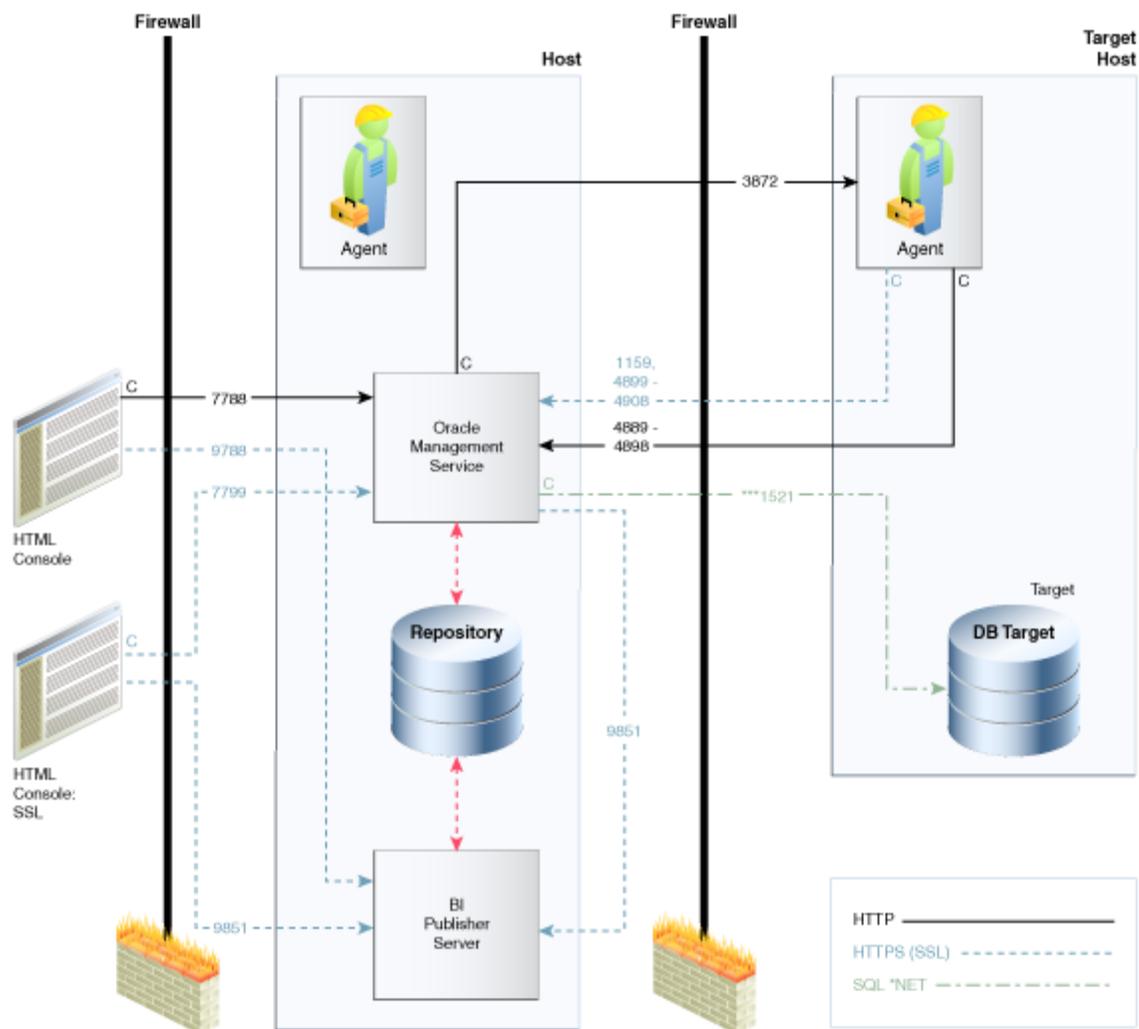


Figure 3 Oracle Enterprise Manager Firewall port requirements

Bare Metal Provisioning Framework Setup

Configure the Oracle Enterprise Manager Software Library

The configuration of the Oracle Enterprise Manager Software Library is a prerequisite for the Bare Metal Provisioning framework as the Software Library stores metadata such as OS, Disk Layout and Oracle VM Server provisioning profiles. A relevant or shared Software Library location must be configured. For further information refer to the [Configuring Software Library](#) section of the Oracle Enterprise Manager Cloud Control Getting Started Guide.

Setup flow as the super administrator:

- Setup > Provisioning and Patching > Software Library

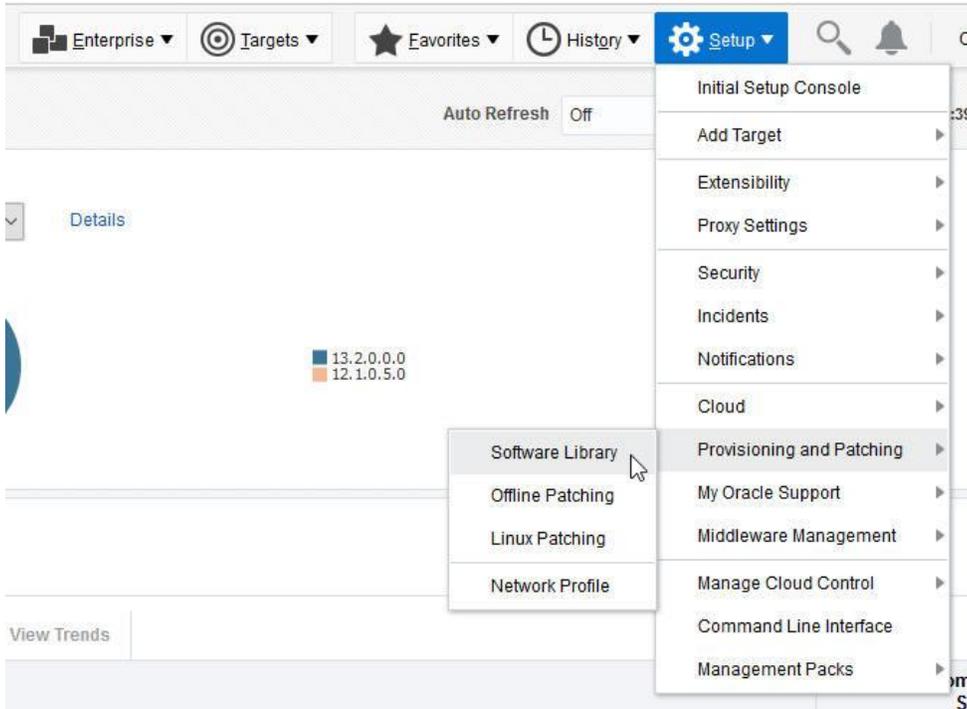


Figure 4 Setup flow for the Software Library



Figure 5 How to add a location for use as a Software Library

Install the Oracle Enterprise Manager agent on the Boot, Stage, RPM and DHCP servers

The Boot, Stage, RPM and DHCP servers, if separate servers, all require the Oracle Enterprise Manager agent installed and running. The following example can be used for each server.

The Boot, Stage, RPM and DHCP servers can be installed on the same server or split into multiples as required. The recommendation is that the Boot and DHCP server are on the same server.

Create the Oracle Enterprise Manager agent install user

As the root user, create a user to install the Oracle Enterprise Manager agent; in this example we will use oma:

```
[root@mybmpserver~]# groupadd oinstall
[root@mybmpserver~]# useradd -g oinstall oma
[root@mybmpserver~]# passwd oma
```

Create the key required directories and set ownership for the Oracle Enterprise Manager agent

```
[root@mybmpserver~]# mkdir -p /u01/app/oracle/product/
[root@mybmpserver~]# chown oma:oinstall /u01/app/oracle/product
```

Check the properties file on the Oracle Enterprise Manager management server (OMS)

As the `oracle` user, check and if required, set the `oracle.sysman.prov.agentpush.enablePty` property to `true` in the `$(OMS_HOME)/sysman/prov/agentpush/agentpush.properties` file. This will enable the agent deployment to complete without any need to edit the `Pty` property in the `/etc/sudoers` file on the target server host. There is no need to restart the Oracle Enterprise Manager management server following this configuration change.

Enable sudo access on the Boot, Stage, RPM and DHCP server(s) for the Oracle Enterprise Manager agent install

The agent deployment is executed from the Oracle Enterprise Manager UI. The last step of the guided process executes a script that must be run as the `root` user. If the Oracle Enterprise Manager agent install user (`oma`) on the target server cannot execute the script as `root`, a manual login as `root` on the target server is required to run the script manually. Oracle Enterprise Manager will indicate the name of the scripts you will need to execute as the `root` user.

However, for a fully automated Oracle Enterprise Manager agent deployment it is possible to configure `sudo` to allow the `oma` user to execute the script as `root` to avoid this manual step at the end of the agent deployment. Execute the following command as `root` on the target server:

```
[root@mybmpserver~]# visudo
```

Add the following entry based upon this example and the agent home location. The following string should be on a single line in the file opened by the `visudo` command:

```
oma ALL=(root) /usr/bin/id, /u01/app/oracle/product*/agentdeployroot.sh, /u01/app/oracle/product/core/agent_13.2.0.0.0/root.sh, /bin/sh
```



Note

Once the Oracle Enterprise Manager agent has been correctly installed the above line can be removed from the `sudoers` file. However in order to support patching and provisioning functionality the following line should exist to provide privileged access to the Oracle Enterprise Manager `nmosudo` binary.

```
oma ALL=(root) <agent home>/sbin/nmosudo
```

Oracle recommends that you check the latest documentation for your version of Oracle Enterprise Manager to verify this process hasn't changed since this document was published.

For further details on `sudo` configuration, consult the Oracle Enterprise Manager 13.2 basic install guide for [Standalone Agent install](#). Note the section on `sudo/pbrun/sesu/su` for executing commands as the `root` user.

Register the Boot, Stage, RPM and DHCP server(s) with the ULN or Oracle Linux Yum Server

It is always a good practice to have the target server at the latest revision for Oracle Linux. By registering with the ULN the latest packages can be installed as well as any required ones for the Bare Metal Provisioning framework setup. If this is a new server install, a review of the [Unbreakable Linux Network FAQ](#), with regard to ULN registration, is recommended. For successful registration with the ULN a valid Customer Support Identifier (CSI) from Oracle is required. To register with the ULN, run the following command as the `root` user:

```
[root@mybmpserver~]# uln_register
```

Run through the prompts entering the relevant information regarding the server.

Once the process has completed, it is possible to run the following command to check what repositories (or channels) were chosen during the registration process:

```
[root@mybmpserver~]# yum repolist
```

Next, it is a good practice to update the Bare Metal Provisioning framework server(s) to the latest version of Oracle Linux by running the following command:

```
[root@mybmpserver~]# yum update
```

It is advisable to log on to the [ULN](#) and view the server configuration. Channels are added and removed using the `Manage Subscriptions` button under the `Subscribed Channels` panel.

Install software needed by the Oracle Enterprise Manager agent

Ensure the following software packages are installed on the server using the following command. If any packages exist they will simply report as installed and not re-install:

```
[root@mybmpserver~]# yum install binutils gcc glibc-common glibc-devel libaio libstdc++ make sysstat
```

For access to the Oracle Linux Yum Server follow the [Downloading the Oracle Yum Server Repository Files](#) section from the Oracle Linux Administrators Guide. The previous link is from the Administrators Guide for Oracle Linux 7.

Add Oracle Enterprise Manager agent firewall rule

It is possible to skip this step if the firewall is not being used on the Boot, Stage, RPM and DHCP server(s).

If a firewall is to be used, a firewall rule for the default port of 3872 is required to allow the Oracle Enterprise Manager agent to be installed, configured and used. The following example command, based upon `iptables`, can be used to allow access to the Oracle Enterprise Manager agent. Adjust the service port if the default port of 3872 is not being used. The default port can be changed during the install agent flow via the UI.

```
[root@mybmpserver~]# iptables -A INPUT -m state --state NEW -m tcp -p tcp --dport 3872 -j ACCEPT
```

Save and restart `iptables` as shown below:

```
[root@mybmpserver~]# service iptables save  
[root@mybmpserver~]# service iptables restart
```

Create a Named Credential for the Oracle Enterprise Manager agent user

A Named Credential is required for the Bare Metal Provisioning framework and must relate to the Oracle Enterprise Manager agent user for the Boot, Stage, RPM and DHCP server(s). This Named Credential is the target user account authentication information stored in Oracle Enterprise Manager and used for running the Bare Metal Provisioning framework jobs. Named Credentials can be created with a user name / password or SSH keys.

Create a Named Credential with the user you intend to install as the Oracle Enterprise Manager agent. Use Figure 6 – 8 below as an example.

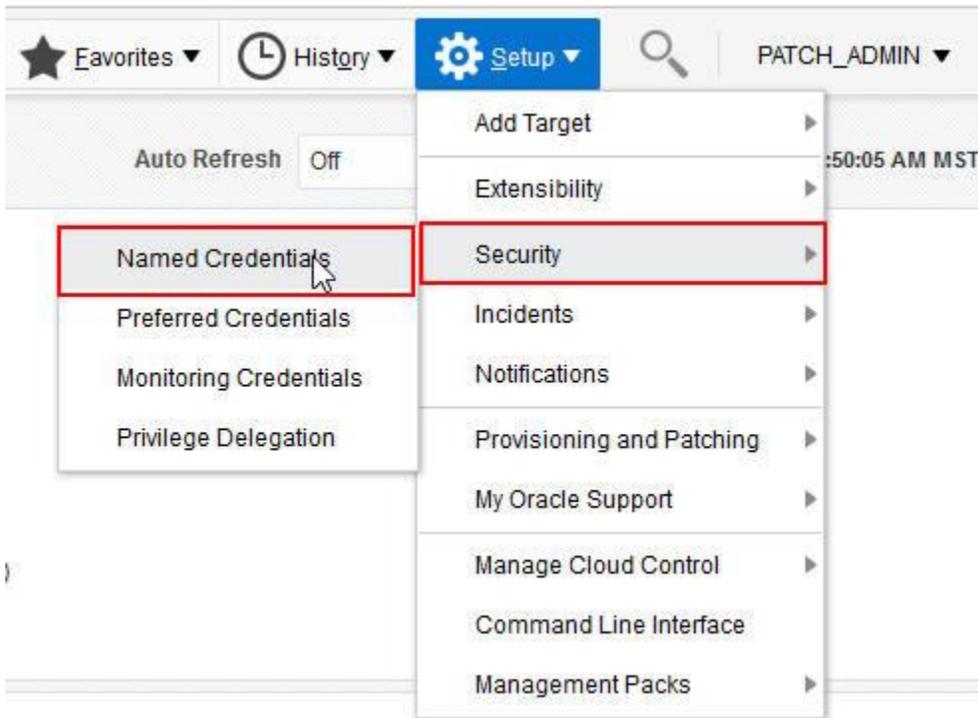


Figure 6 Create Named Credentials

Security
Named Credentials

Following are the list of named credentials you can access. This list include credentials created by you, and credentials for which explicit grant is given to you. Maximum 2000 credentials will be shown. Click on Query by Example icon to search appropriate credential.

View

Credential Name	Credential Owner	Authenticating Target Type	Credential Type	Target Name	Target Username
EMPLUGIN	OVMPM	Oracle Flash St...	Oracle FS Credentials		EMplugin
LINUX_PATCH_NC_HOST_2016-12-09-063419	OVMPM	Host	Host Credentials		root
LINUX_PATCH_NC_HOST_2016-12-09-063420	OVMPM	Host	Host Credentials		root
NEW_FLASH	OVMPM	Oracle Flash St...	Oracle FS Credentials	coaxm140	LabEM

Figure 7 Create Named Credentials, continued

Security
Named Credentials - Create Credential
Create Credential

Test and Save

General Properties

- * Credential name: rpm_oma 1
- Credential description: Credential for RPM Ge 2
- * Authenticating Target Type: Host 3
- * Credential type: Host Credentials 3
- Scope: Target Global 4

Credential Properties

- * Username: oma 5
- * Password: ***** 6
- * Confirm Password: ***** 6
- Run Privilege: Sudo Ran as: root 7

Figure 8 Fill in Create Credential form using Table 1 below

TABLE 1: EXPLANATION OF NUMBERED ITEMS IN FIGURE 8

Item	Description
1	Provide the name for the Named Credential that will be used to install the Oracle Enterprise Manager agent on the Boot, Stage, RPM and DHCP server(s)
2	A short description that will enable administrators to understand the role and purpose of the Named Credential
3	Choose "Host" and "Host Credentials"
4	Select "Global". You can specify a single host, however this credential may be a common standard in the data center and be reused
5	The administrator user account created on the RPM server to install the Oracle Enterprise Manager agent
6	The password for the administrator user account created on the Boot, Stage, RPM and DHCP server(s) to install the Oracle Enterprise Manager agent
7	If sudo has been configured on the Boot, Stage, RPM and DHCP server(s) then choose sudo and run as root

Finally, click on Save to complete the process.



Note

It is not possible to test the credential until the Oracle Enterprise Manager agent has been installed and is running. Therefore, confirm to save the credential without testing.

Deploy Oracle Enterprise Manager agents via the UI

The following steps are required to deploy the Oracle Enterprise Manager agent to the Boot, Stage, RPM and DHCP server(s). This process can be carried out by a superuser or by any user with the `Add Target` privilege. The following screenshot depicts a user, (`patch_admin`) which has been configured with the Oracle Enterprise Manager role `EM_LINUX_PATCHING_ADMIN`. This role is able to be used to push Oracle Enterprise Manager agents as well as configure the Linux Host Patching and Bare Metal Provisioning framework.

Add the targets manually using Figure 9 as an example.

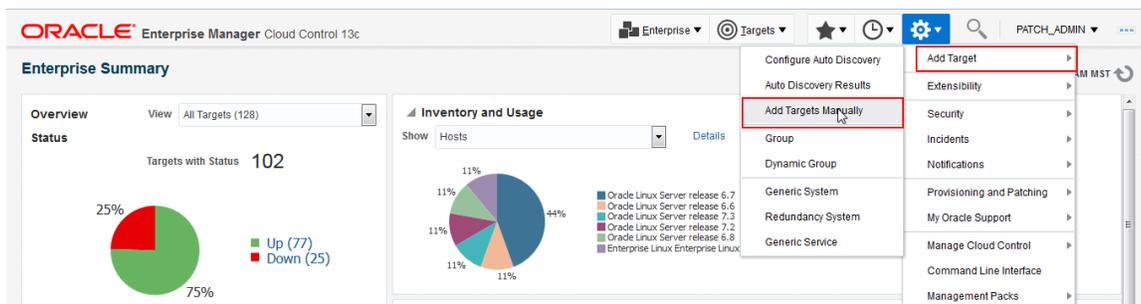


Figure 9 Choose to add targets manually

Choose to install an agent on a host as shown in Figure 10 below.

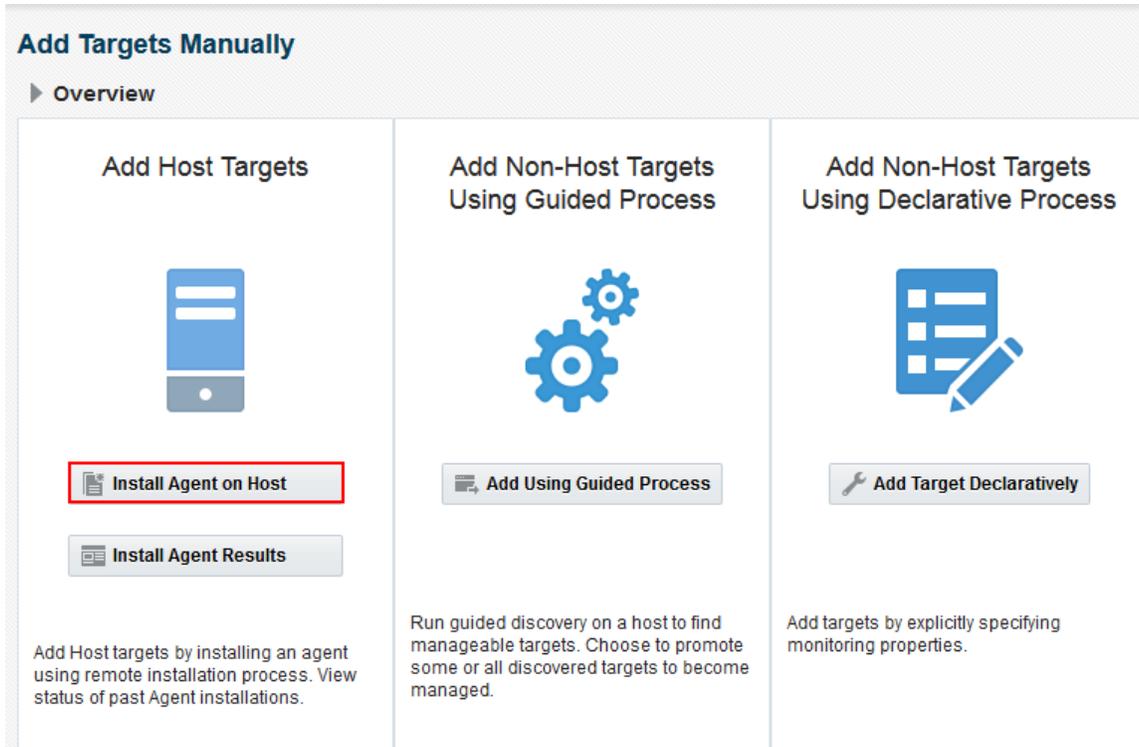


Figure 10 Choose to install agent on host

Choose **Add** as shown in Figure 11 and then provide the hostname for the Boot, Stage, RPM and DHCP server(s).

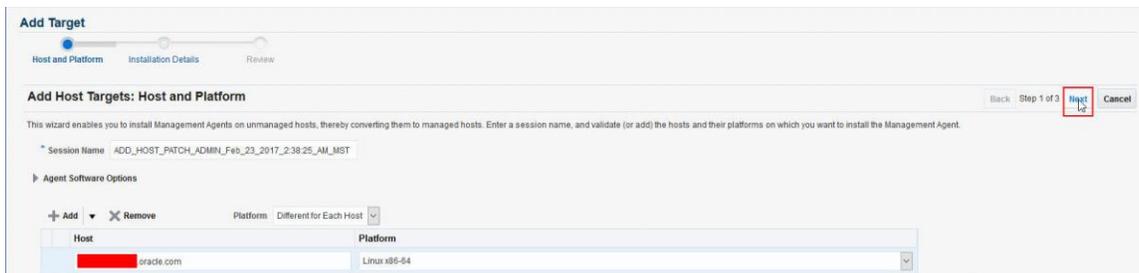


Figure 11 Add the Boot, Stage, RPM and DHCP server(s) using a FQDN and selecting the correct platform.

Populate the page as shown in Figure 12 below. Refer to Table 2 below for detailed explanations about each of the required fields indicated by the callouts in the screen shot.

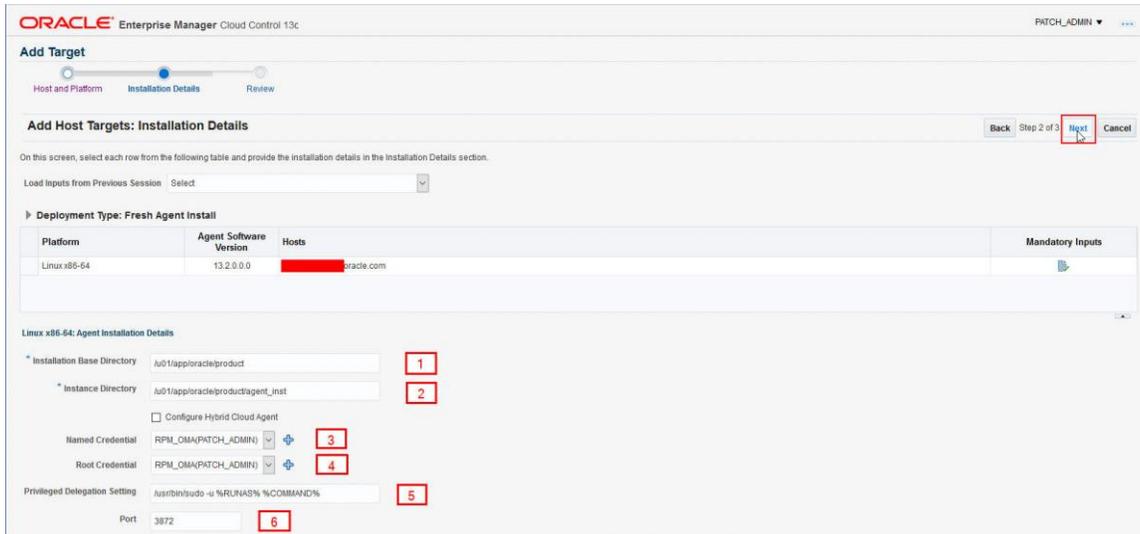


Figure 12 Installation details for the Oracle Enterprise Manager agent

TABLE 2: EXPLANATION OF NUMBERED ITEMS IN FIGURE 12 ABOVE

Item	Description
1	The value should reflect the installation base directory created for the Oracle Enterprise Manager agent, in our example: /u01/app/oracle/product
2	The value is automatically populated with the correct string, based on the installation base directory when this field is selected; the default value should not be modified once it is automatically populated
3	Choose the named credential (oma user)
4	Choose the named credential (oma user)
5	If sudo access for the oma user was enabled, then leave the default setting. If no sudo is configured, then this value can be removed. If no sudo is configured, one of the final steps of the Oracle Enterprise Manager agent install will fail and the process will advise that a script must be run manually as the root user. Follow the prompts to continue to complete the install process and then run the scripts as the root user as directed
6	This shows the default service port (3872). This value should be changed if a different port is to be used.

This step will deploy the Oracle Enterprise Manager agent to the Boot, Stage, RPM and DHCP server(s).

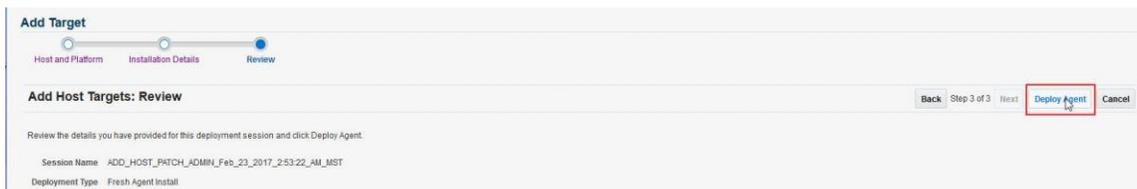


Figure 13 Deploy the Oracle Enterprise Manager agent

The progress can be viewed closely, to help ensure all steps are completed.

Add Host Page Refreshed Feb 23, 2017 3:11:06 AM MST

Refresh Frequency 30 seconds Refresh Cancel

Agent Deployment Summary: ADD_HOST_PATCH_ADMIN_Feb_23_2017_2:53:22_AM_MST

Platform	Host	Initialization	Remote Prerequisite Check	Agent Deployment
Linux x86-64	[redacted] oracle.com	●	●	●

Agent Deployment Details

OMS Log Location [redacted] oracle.com/u01/app/oracle/gc_inst1/em/EMGC_OMS1/sysman/agentpush/2017-02-23_02-53-22-AM/applogs/[redacted] oracle.com_deploy.log

Show only warnings and failures

Deployment Phase Name	Status	Error	Cause	Recommendation
Installation and Configuration	⚠			
Secure Agent	●			
Root.sh	●			
Collect Log	●			
Clean up	●			

Figure 14 Monitor the progress of the Oracle Enterprise Manager agent installation

Following the successful install of the agent, the `/etc/sudoers` file should be edited (as the `root` user using `visudo`) to:

- Remove the Oracle Enterprise Manager agent install requirements
- Add the `nmosudo` binary for the Oracle Enterprise Manager agent user

Using the document example, remove the following line:

```
oma ALL=(root) /usr/bin/id, /u01/app/oracle/product/*/agentdeployroot.sh, /u01/app/oracle/product/core/agent_13.2.0.0.0/root.sh, /bin/sh
```

Add the following line:

```
oma ALL=(root) /u01/app/oracle/product/agent_13.2.0.0.0/sbin/nmosudo
```

Add Host Page Refreshed Feb 23, 2017 3:11:06 AM MST

Agent Deployment Succeeded Done

Agent Deployment Summary: ADD_HOST_PATCH_ADMIN_Feb_23_2017_2:53:22_AM_MST

Platform	Host	Initialization	Remote Prerequisite Check	Agent Deployment
Linux x86-64	[redacted] oracle.com	✓	✓	✓

Agent Deployment Details: myguest200.us.oracle.com

Initialization Details

Remote Prerequisite Check Details

Agent Deployment Details

OMS Log Location [redacted] oracle.com/u01/app/oracle/gc_inst1/em/EMGC_OMS1/sysman/agentpush/2017-02-23_02-53-22-AM/applogs/[redacted] oracle.com_deploy.log

Show only warnings and failures

Deployment Phase Name	Status	Error	Cause	Recommendation
Installation and Configuration	✓			
Secure Agent	✓			
Root.sh	✓			
Collect Log	✓			
Clean up	✓			

Figure 15 Successful completion of the Oracle Enterprise Manager agent installation

Configure Privilege Delegation

All Oracle Enterprise Manager deployment procedures (DP's) require privileged user access; the Bare Metal Provisioning framework requires running of DP's. Therefore Oracle Enterprise Manager needs to be informed of which hosts have privileged user access; this is achieved using Privilege Delegation.

To configure Privilege Delegation, follow the examples in Figure 16 – 19:

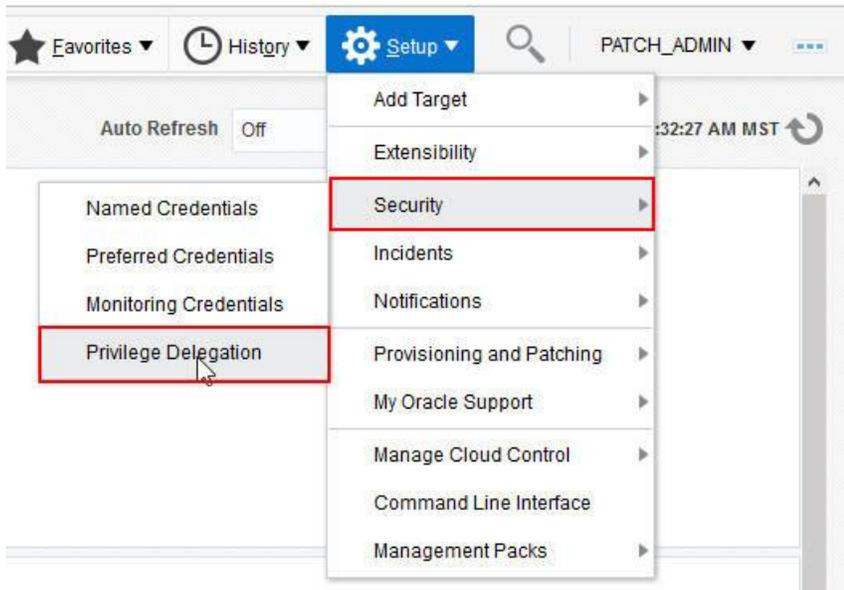


Figure 16 Configure Privilege Delegation



Figure 17 Edit to set Privilege Delegation

To edit the settings, choose sudo and then input the command. For Oracle Linux, this is usually `/usr/bin/sudo`, then copy the example command string from `-u ie /usr/bin/sudo -u %RUNAS% %COMMAND%`

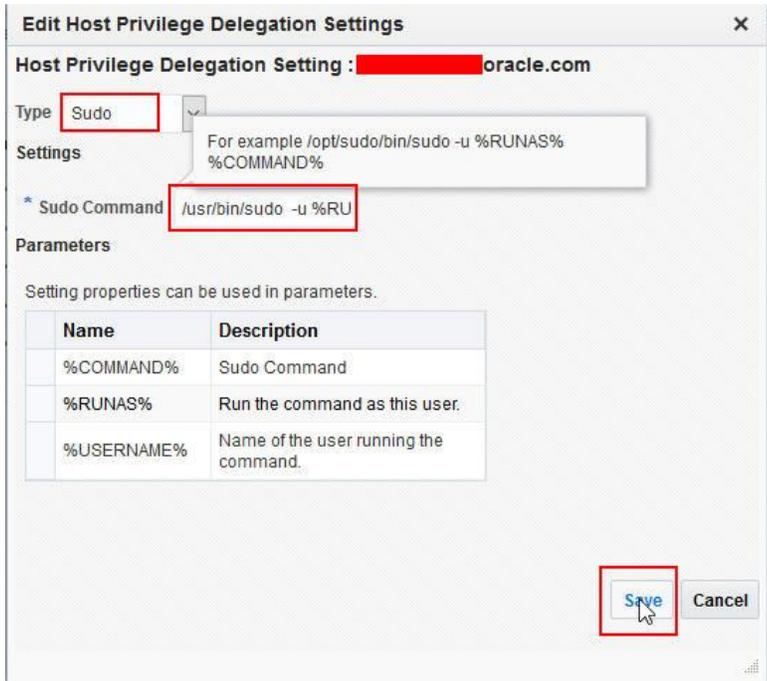


Figure 18 Set sudo Privilege Delegation

Once set, the following screenshot reflects the Type and Command information just set. It is possible to test the setting using the Test button.



Figure 19 Test Privilege Delegation

A template can be created which can be quickly and easily replicated to multiple hosts. Privilege Delegation should be set for the Boot, Stage, RPM and DHCP server(s).

Configure Preferred Credentials

Preferred Credentials are stored within Oracle Enterprise Manager. Once stored, Preferred Credentials enable simpler deployment or patching flows as they are set system wide and the user does not have to set individual credentials for each host. A best practice is to create a “normal” user credential with no root

privilege, then another for the “privilege” user which has `root` privilege set. For this example, the same user with `root` privilege is used for simplicity.

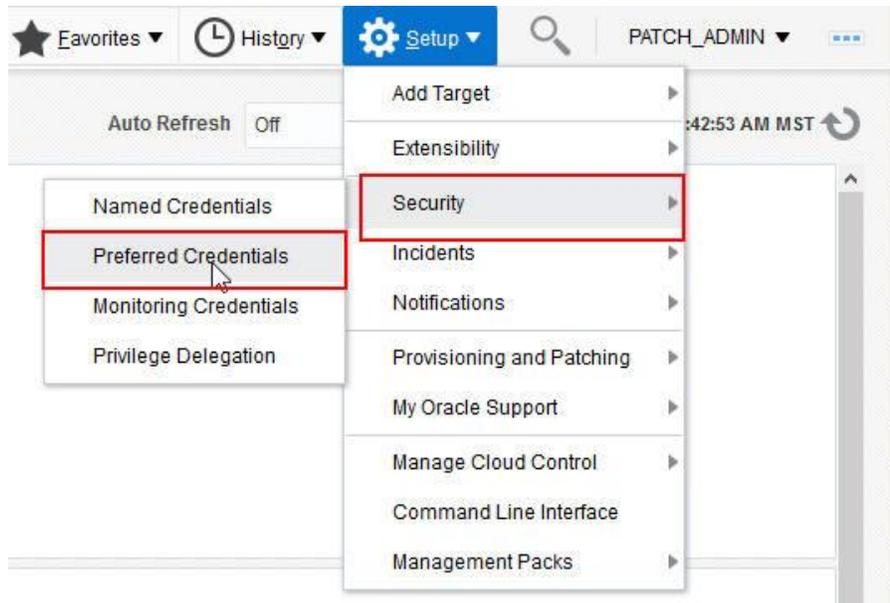


Figure 20 Configure Preferred Credentials

Highlight the `Host` target and select `Manage Preferred Credentials`.

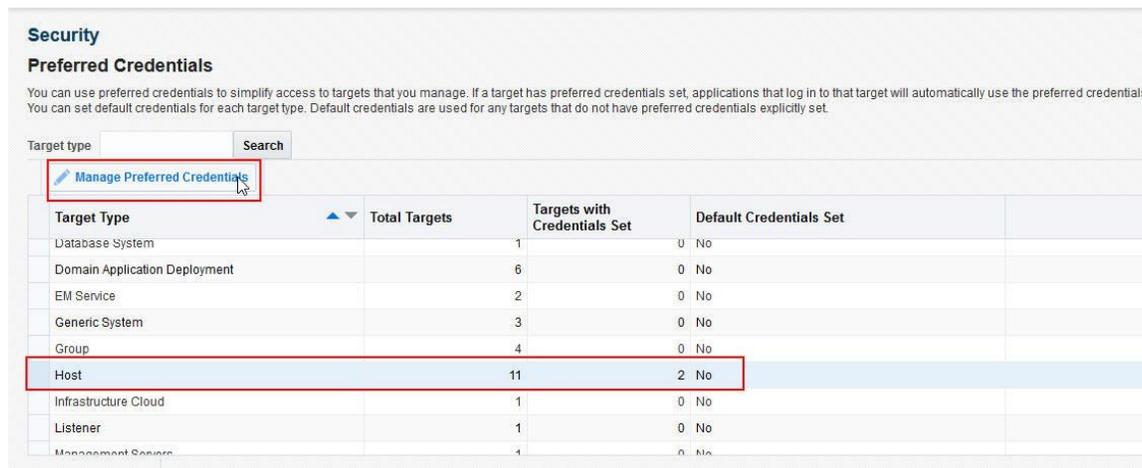


Figure 21 Manage Preferred Credentials

If you have separate users, for `Normal` and `Privilege` then highlight each and use `Set` to configure the `Preferred Credential`. For our example, there is a single user set for both, therefore both are highlighted.

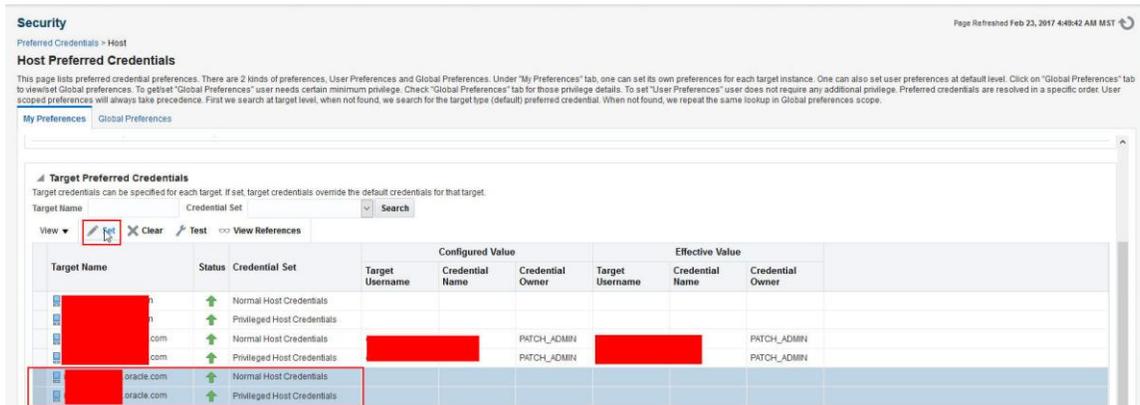


Figure 22 Set Preferred Credentials

The Named Credential is selected and displays the username and privilege type. Click **Save** to set.

The Preferred Credentials are now set as in the screenshot below:

Target Name	Status	Credential Set	Target Username	Credential Name	Credential Owner	Target Username	Credential Name	Credential Owner
[redacted]	↑	Normal Host Credentials						
[redacted]	↑	Privileged Host Credentials						
[redacted].com	↑	Normal Host Credentials	[redacted]		PATCH_ADMIN	[redacted]	PATCH_ADMIN	PATCH_ADMIN
[redacted].com	↑	Privileged Host Credentials	[redacted]		PATCH_ADMIN	[redacted]	PATCH_ADMIN	PATCH_ADMIN
oracle.com	↑	Normal Host Credentials						
oracle.com	↑	Privileged Host Credentials						

Figure 23 Set Preferred Credentials, continued

It is required to set Preferred Credentials for the Stage Server and Reference host, however, it is a good practice to set Preferred Credentials for the Boot, RPM and DHCP server(s).

Configure Stage Server

NFS or HTTP can be used for the Stage server; for this example, NFS is used. The Stage Server requires a minimum of 100MB for the staging directory. For both implementations, the top level or stage directory should be created as the Oracle Enterprise Manager agent user, which must have sudo access to `root`. This setting of sudo access is described on page 9.

If the Stage Server is running a firewall, then NFS must be enabled for the firewall.

Check that NFS is installed and running on the Stage server. For this example the Stage Server is Oracle Linux 7:

```
[root@mybmpserver~]# yum install nfs-utils
```

We then need to create the stage directory and add to the `/etc/exports` file:

```
[root@mybmpserver~]# mkdir -p /scratch/stage
[root@mybmpserver~]# chown oma:oinstall /scratch/stage
[root@mybmpserver~]# STAGE_TOP_LEVEL_DIRECTORY=/scratch/stage
[root@mybmpserver~]# echo "${STAGE_TOP_LEVEL_DIRECTORY} *(ro,sync)" >>/etc/exports
[root@mybmpserver~]# cat /etc/exports
/scratch/stage *(ro,sync)
```

Next, start and enable the NFS server:

```
[root@mybmpserver~]# systemctl start nfs
[root@mybmpserver~]# systemctl enable nfs-server
Check the exports:
[root@mybmpserver~]# showmount -e
Export list for mybmpserver:
/scratch/stage*(ro,sync) *
```

Now, we need to create and copy the Oracle Enterprise manager agent RPM to the Stage Server NFS share. This process needs to be run on the Oracle Enterprise Manager management server (OMS).

Firstly, as the root user (or oracle with sudo configured) check for the existence of two RPMs:

```
[root@myomsserver~]$ yum info rpm-build gcc
```

Next, as the oracle user run the following commands:

```
[oracle@myomsserver~]$ $OMS_HOME/bin/emcli login -username=patch_admin
[oracle@myomsserver~]$ $OMS_HOME/bin/emcli get_agentimage_rpm -
destination="/home/oracle" -platform="Linux x86-64"
```

This process may take a few minutes to complete. Once complete, copy the agent RPM (oracle-agt-13.2.0.0.0-1.0.x86_64.rpm) from the OMS server to the Stage Server and place in /scratch/stage. The agent RPM should be owned by the Named Credential user (in our example oma) and also have permissions of 755.

Finally, we need to add the Stage Server to the Oracle Enterprise Manager Bare Metal Provisioning framework portal. Using the UI and as the patch_admin user, the flow is as follows:

- Enterprise > Provisioning and Patching > Bare Metal Provisioning

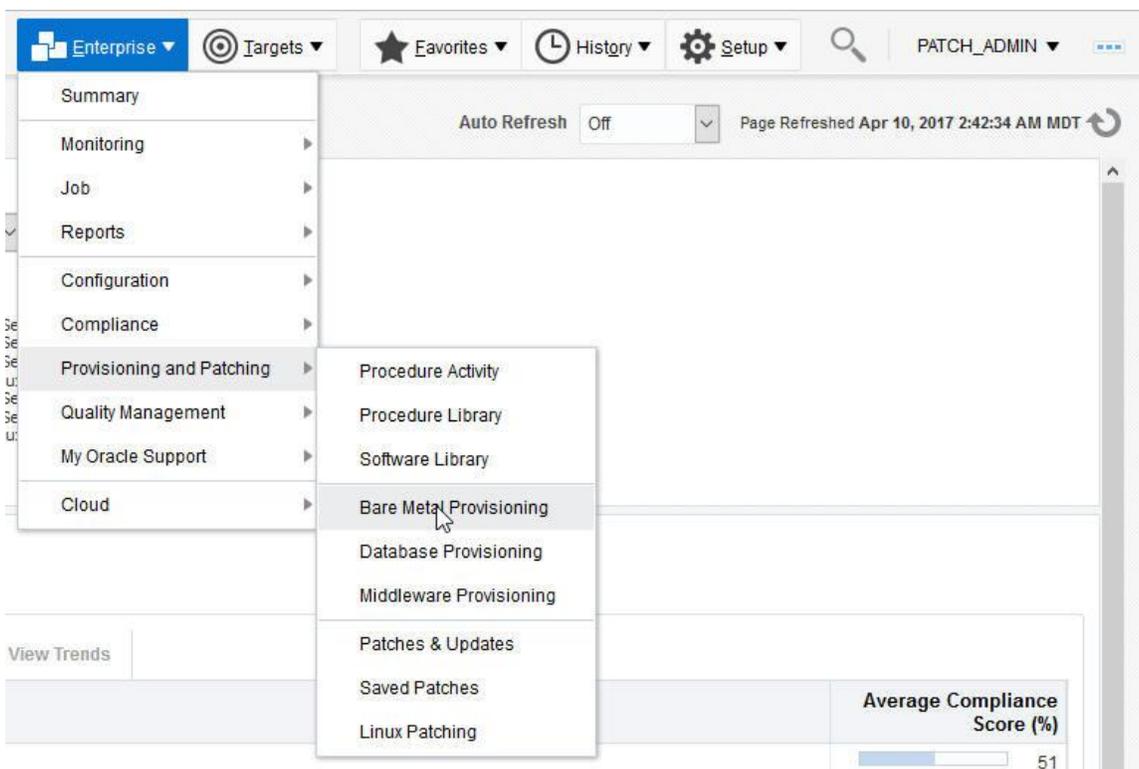


Figure 24 Access the Bare Metal Provisioning portal

Next, click on the Infrastructure tab, then within the Stage Server section click Add Server:

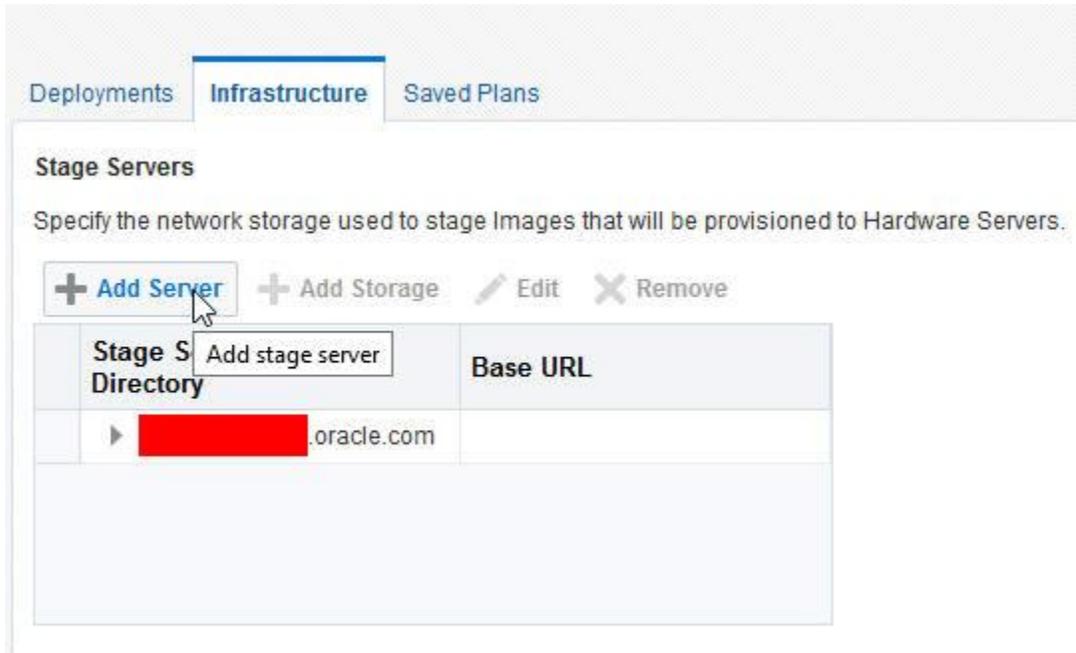


Figure 25 Add Stage Server

The Add Stage Server section should be completed as follows:

- Stage Server: use the radio or search button to select the Stage Server host
- Stage Directory: enter in the NFS or HTTP directory path. In our NFS example /scratch/stage
- Base URL: for NFS the format is file://FQDN or IP Address/stage directory path. In our NFS example file://mybmphost/scratch/stage



Figure 26 Add Stage Server NFS example

Once the Stage Server has been added, to view the configuration click on the collapse / expose arrow next to the newly added Stage Server:

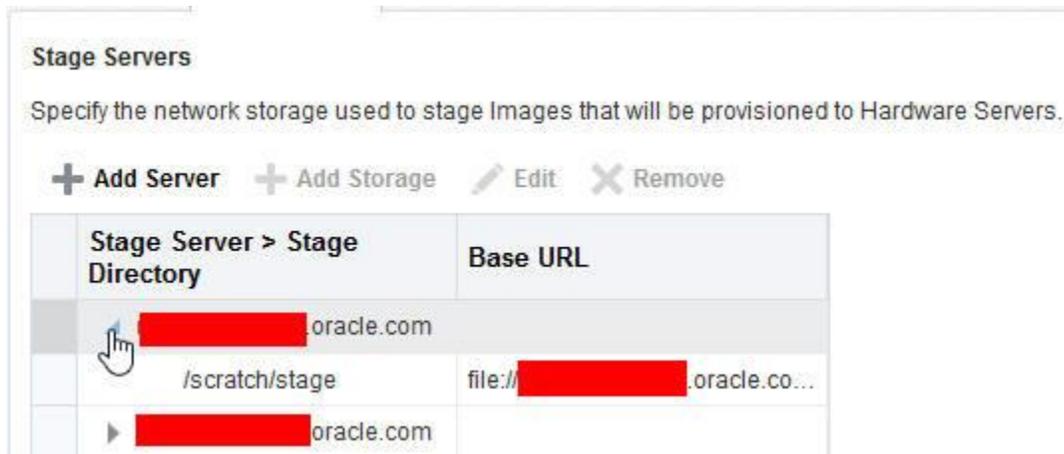


Figure 27 Stage Server details

Configure Boot Server

The Boot Server should have a minimum of 2GB RAM. As previously detailed the recommendation, this is for the Boot and DHCP Server to exist on the same server. If the Boot Server is running a firewall, then TFTP and ProxyDHCP must be enabled for the firewall.

Check that the required packages are installed and running on the Boot server. For this example the Boot Server is Oracle Linux 7:

```
[root@mybmpserver~]# yum install tftp tftp-server syslinux
```

Once installed we need to copy the pxelinux.0 file over to the TFTP directory:

```
[root@mybmpserver~]# rpm -ql syslinux | grep pxe
/usr/share/doc/syslinux-4.05/pxelinux.txt
/usr/share/syslinux/gpxecmd.c32
/usr/share/syslinux/gpxelinux.0
/usr/share/syslinux/gpxelinuxk.0
/usr/share/syslinux/pxechain.com
/usr/share/syslinux/pxelinux.0
[root@mybmpserver~]# mkdir -p /var/lib/tftpboot/pxelinux.cfg
[root@mybmpserver~]# cp /usr/share/syslinux/pxelinux.0 /var/lib/tftpboot
```

Next, we need to start and enable the TFTP service:

```
[root@mybmpserver~]# systemctl start tftp
[root@mybmpserver~]# systemctl enable tftp
```

Finally, we need to add the Boot Server to the Oracle Enterprise Manager Bare Metal Provisioning framework portal. Using the UI and as the patch_admin user, the flow is as follows:

- Enterprise > Provisioning and Patching > Bare Metal Provisioning > infrastructure

Within the Boot Server section click Add:



Figure 28 Add Boot Server

The Add Boot Server section should be completed as follows:

- Boot Server: use the radio or search button to select the Boot Server host
- TFTP Boot Directory: enter in the directory path. In our example /var/lib/tftpboot/

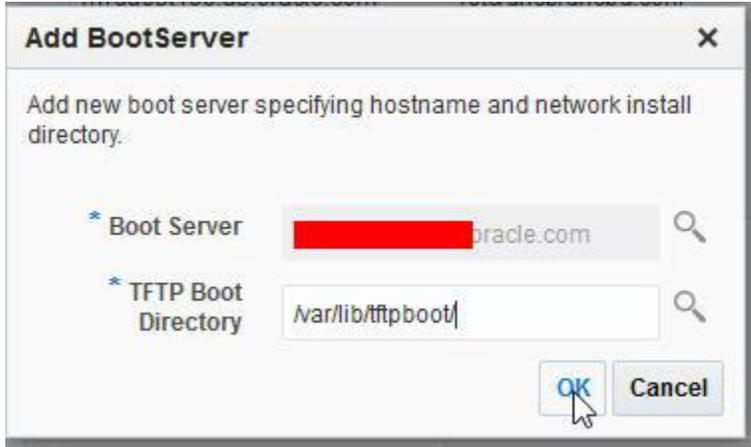


Figure 29 Add Boot Server example

Configure DHCP Server

The DHCP Server should have a minimum of 2GB RAM. As previously detailed, the recommendation is for the Boot and DHCP Server to exist on the same server. If the DHCP Server is running a firewall, then DHCP must be enabled for the firewall.

Check that the required packages are installed and running on the DHCP server. For this example the DHCP Server is Oracle Linux 7:

```
[root@mybmpserver-]# yum install dhcp
```

Once DHCP is installed we need to create the `/etc/dhcp/dhcpd.conf` file.

An example file is below:

```
option domain-name "mydom.org";
option domain-name-servers 192.168.2.1, 10.0.1.4;

default-lease-time 600;
max-lease-time 7200;

subnet 10.80.120.0 netmask 255.255.254.0 {
    option broadcast-address    10.80.121.255;
    option routers              10.80.120.1;
    next-server                 10.80.120.226;
    filename                    "pxelinux.0";
}
host svr01 {
    hardware ethernet 80:56:3e:00:10:00;
    fixed-address 10.180.121.100;
    option host-name "svr01";
}
```

The key fields are as follows:

`next-server` - This option specifies the hostname or IP address of the Boot Server, which is the server hosting the TFTP service.

`filename` - This option specifies the boot loader location on the Boot Server. The location of the file is relative to the main TFTP directory.

Next, we need to start and enable the DHCP service:

```
[root@mybmpserver-]# systemctl start dhcpd
[root@mybmpserver-]# systemctl enable dhcpd
```

Finally, we need to add the DHCP Server to the Oracle Enterprise Manager Bare Metal Provisioning framework portal. Using the UI and as the `patch_admin` user, the flow is as follows:

- Enterprise > Provisioning and Patching > Bare Metal Provisioning > infrastructure

Within the DHCP Server section click Add:

DHCP Servers

Specify the full host name and DHCP configuration file path for DHCP servers.

+ Add **Edit** **Remove**

DHCP Server	DHCP Configuration File
<input type="text" value="Add a new DHCP server"/>	
<input type="text" value="oracle.com"/>	<input type="text" value="/etc/dhcp/dhcpd.conf"/>

Figure 30 Add DHCP Server

The Add DHCP Server section should be completed as follows:

- DHCP Server: use the radio or search button to select the DHCP Server host
- DHCP Configuration File: enter in the path; in our example `/etc/dhcp/dhcpd.conf/`

Add DHCP Server [X]

Add new DHCP server specifying hostname and configuration file path.

* DHCP Server 🔍

* DHCP Configuration File 🔍

OK **Cancel**

Figure 31 Add DHCP Server example

Configure RPM Repository

The RPM Repository should have a minimum of 2GB RAM. If the RPM Server is running a firewall, then HTTP must be enabled for the firewall.

Check that the required packages are installed and running on the RPM server. For this example the RPM Repository is Oracle Linux 7:

```
[root@mybmpserver~]# yum install httpd
```

Next, we need to start and enable the HTTP service:

```
[root@mybmpserver~]# systemctl start httpd
[root@mybmpserver~]# systemctl enable httpd
```

To test the HTTP configuration use a browser to view the FQDN of the RPM Repository. This should return the test page, if configured correctly.

There are options to setup the RPM repository:

Using an ISO image, copy the required packages into an install tree structure using the [Setting up RPM Repository](#) section, Bare Metal Provisioning chapter of the Oracle Enterprise Manager Lifecycle Management Administrators Guide.

Within the RPM server loopback, mount an Oracle Linux 7 DVD; for example:

```
[root@mybmpserver~]# cd /var/www/html
[root@mybmpserver~]# mkdir isos
[root@mybmpserver~]# cd isos
[root@mybmpserver~]# mkdir ol7
[root@mybmpserver~]# mount /dev/cdrom /var/www/html/isos/ol7
```

To test the RPM repository configuration, use a browser to view the FQDN of the RPM server with “/isos/ol7” at the end of the FQDN. This should return the Oracle Linux 7 repository structure, if configured correctly.

NFS mount existing RPM repositories; for example from the /etc/fstab file:

```
iso-nfs:/osimages/OL6.7-64 /var/www/html/isos/ol6-7-64bit nfs ro,nosuid 0 0
iso-nfs:/osimages/OL5.8-64 /var/www/html/isos/ol5-8-64bit nfs ro,nosuid 0 0
iso-nfs:/osimages/OL7.3-64 /var/www/html/isos/ol7-3-64bit nfs ro,nosuid 0 0
```

Finally, we need to add the RPM Repository to the Oracle Enterprise Manager Bare Metal Provisioning framework portal. Using the UI and as the patch_admin user, the flow is as follows:

- Enterprise > Provisioning and Patching > Bare Metal Provisioning > infrastructure

Within the RPM Repositories section click Add:

RPM Repositories

Specify the name and full directory path for RPM repositories.

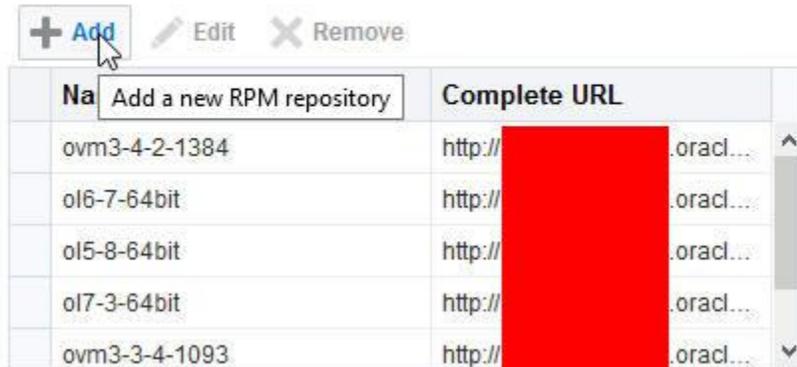


Figure 32 Add Repositories

The Add RPM Repository section should be completed as follows:

- Repository Name: use a descriptive name for the Repository
- Complete URL: enter in the Repository http URL



Figure 33 Add Repository example

Checklist for Boot Server, Stage Server, RPM Repository and Reference host

Ensure the following criteria are met before proceeding to Configuring Bare Metal Provisioning framework Software Library components:

TABLE 3: CHECKLIST FOR BOOT SERVER, STAGE SERVER, RPM REPOSITORY AND REFERENCE HOST

Resource Name	Checklist
Boot Server	<ul style="list-style-type: none">• TFTP is up and running• Boot Server is present in the same subnet where the target provisioning hosts are present, or will be added• Boot Server has an Oracle Enterprise Manager agent installed and running• Boot Server has been added to the Bare Metal Provisioning framework portal
DHCP Server	<ul style="list-style-type: none">• DHCP is up and running• The <code>next_server</code> entry in <code>/etc/dhcp/dhcpd.conf</code> (Oracle Linux 7 example) file points to the Boot Server IP address or hostname• DHCP Server has an Oracle Enterprise Manager agent installed and running• DHCP Server has been added to the Bare Metal Provisioning framework portal
Stage Server	<ul style="list-style-type: none">• The required Oracle Enterprise Manager agent RPM is staged for installing agents on target provisioning hosts• Stage Server has an Oracle Enterprise Manager agent installed and running• Stage Server is reachable from the target provisioning host (or the same subnet)• Stage Server has been added to the Bare Metal Provisioning framework portal• Preferred Credentials are set
RPM Repository	<ul style="list-style-type: none">• RPM Repository is as close as possible to the target provisioning servers• RPM Repository is available via HTTP• RPM Repository server has an Oracle Enterprise Manager agent installed and running• RPM Repository Server has been added to the Bare Metal Provisioning framework portal
Software Library	<ul style="list-style-type: none">• Software Library is configured
Reference Host	<ul style="list-style-type: none">• Reference Host has an Oracle Enterprise Manager agent installed and running• Preferred Credentials are set

Configuring Bare Metal Provisioning framework Software Library components

The Software Library stores the components or metadata for the Bare Metal Provisioning framework. These components are Deployment Plans, OS , Disk Layout and Oracle VM Server provisioning profiles. These

profiles are used in the provisioning process to create the required configuration to support the provisioning process.

Using the UI and as the `patch_admin` user, the flow is as follows:

- Enterprise > Provisioning and Patching > Software Library

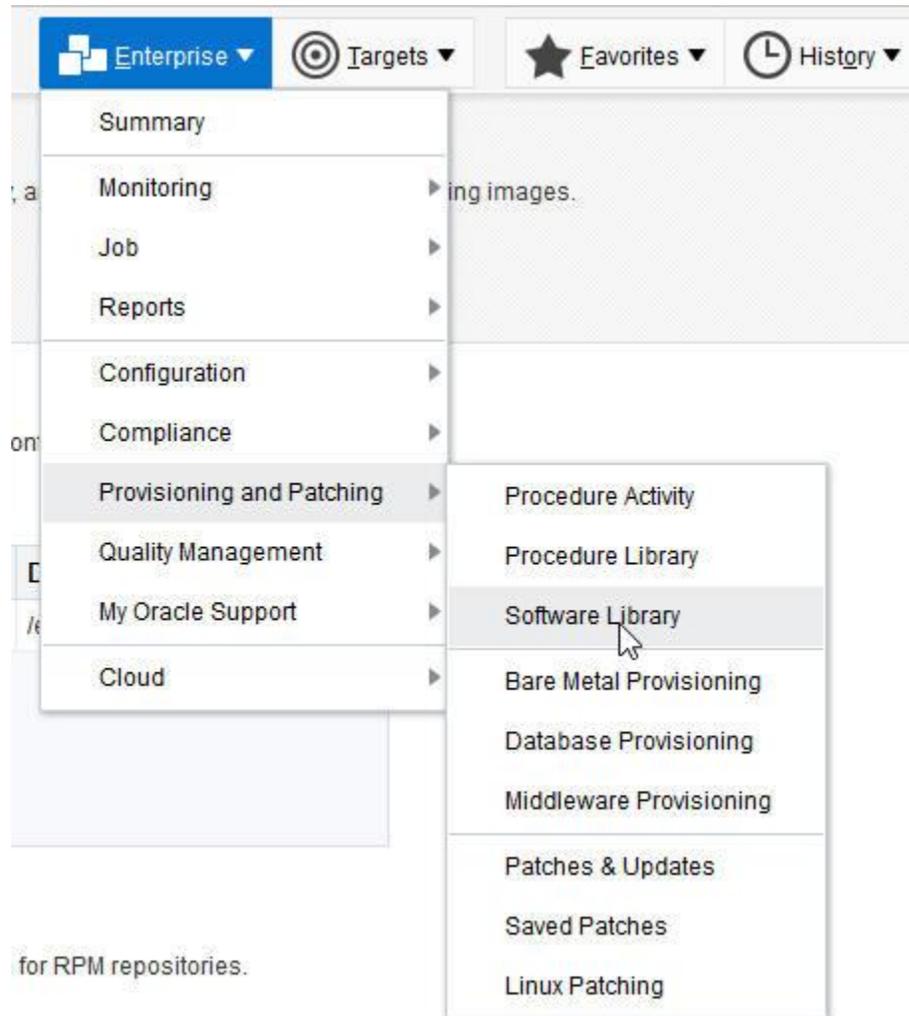


Figure 34 Navigate to the Software Library

It is a best practice to configure an area within the Library to provide organization and store the provisioning profiles. To do this as the `patch_admin` user from the `Actions` menu select `Create Folder`:



Figure 35 Create Folder

Provide a meaningful name and location for the directory within the Software Library.

The new folder is now highlighted. From the Actions menu, it is possible to create the provisioning profiles:

- `Actions > Create Entity > Bare Metal Provisioning`

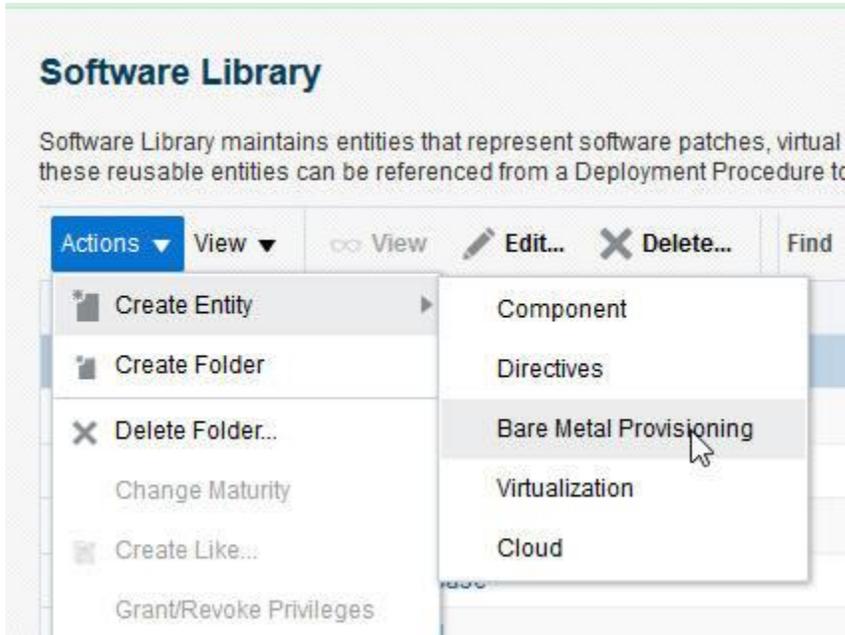


Figure 36 Create Bare Metal Provisioning Entity

From here, we can choose which profile we wish to create:

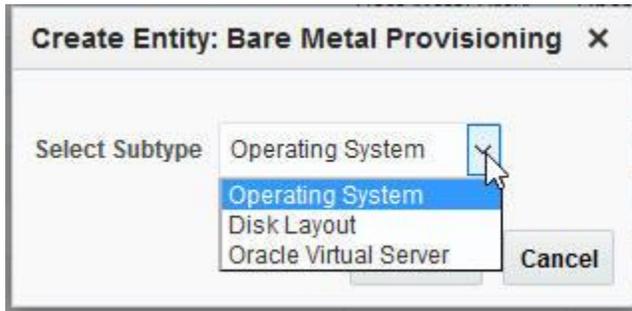


Figure 37 Bare Metal Provisioning profile choice

Operating System provisioning profile

A wizard is launched for the Create Operating System process.

The Describe page enables you to enter the following:

- A meaningful name and description
- Using the Add button, attach any useful files (2MB size limit) such as readme, collateral or licensing
- Using the Notes field, include useful information such as modification history

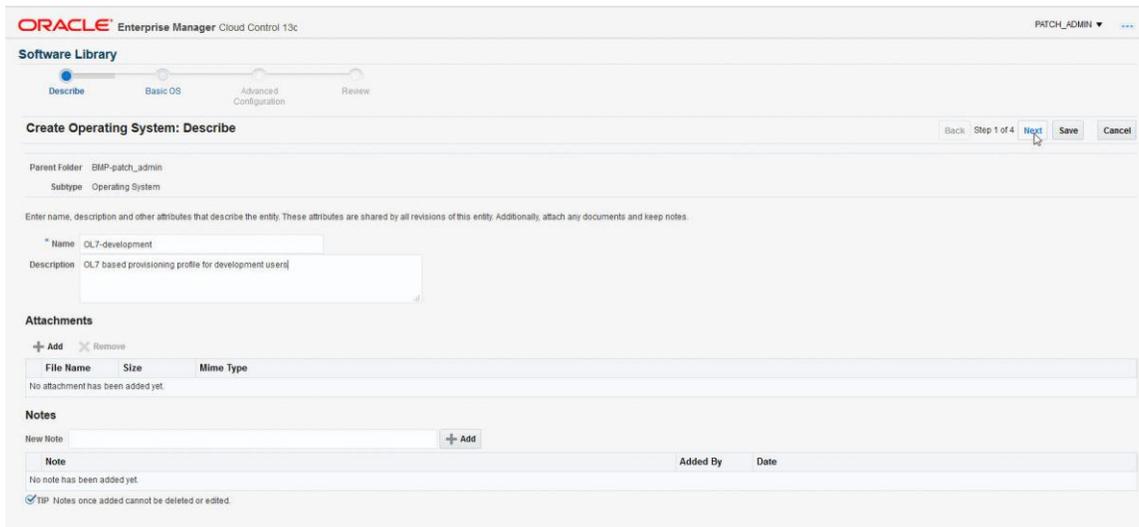


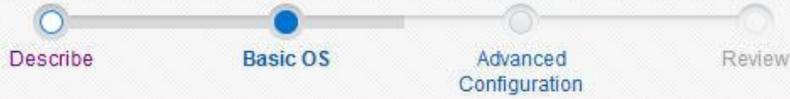
Figure 38 Operating System Describe page

Click Next to proceed to the Basic OS page.

The Basic OS page enables you to enter the following:

- Timezone
- Root password
- Add users, setting groups and if required, enabling sudo access

Software Library



Create Operating System: Basic OS

Parent Folder BMP-patch_admin

Subtype Operating System

Time Zone ▼

* Root Password

* Confirm Root Password

Operating System Users List

User Name	Primary Group	Additional Groups	Enable Sudo Access
oma	oinstall		<input checked="" type="checkbox"/>

Figure 39 Basic OS page

At the bottom of the Basic OS page is the Fetch Configuration properties from Reference Enterprise Manager Host Target section. There is a Fetch properties box which, if ticked, will prompt you to choose the Reference Host and configurations. This section will also confirm the Preferred Credentials:

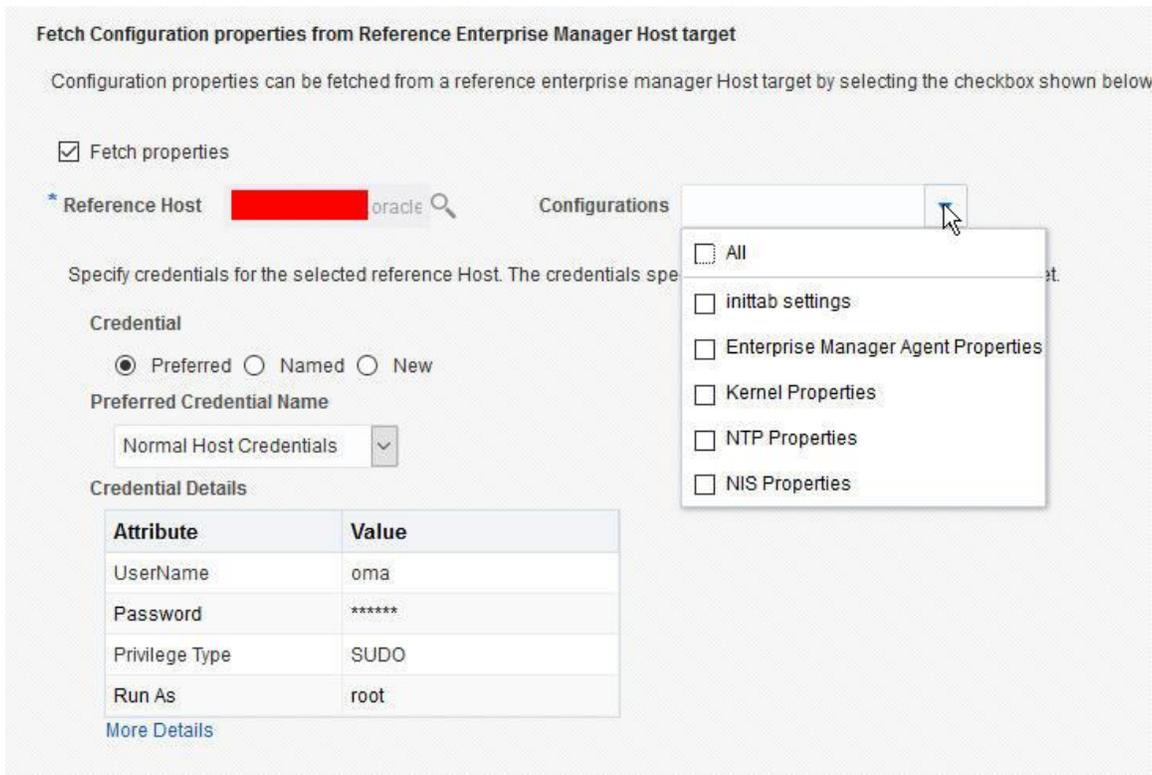


Figure 40 Reference Host

The Reference Host feature is useful for governance, compliance and configuration.

Click Next to proceed to the Advanced Configuration page.

The Advanced Configurations page has four sections:

1. Enterprise Manager Agent Properties: the install user and install group are set with the chosen user from the Basic OS page. Here you can enter the Agent Registration password and, if the Stage Server was configured with HTTP, enter the URL for the Agent RPM. If NFS was used, as in our

example, then leave this blank.

Enterprise Manager Agent Properties

Specify enterprise manager agent properties to configure the agent on the upcoming targets. Once configured, agent will be used to monitor the host target.

Install User: oma

Install Group: oinstall

Agent Registration Password: ●●●●●●●●

Agent RPM URL: |

Figure 41 Oracle Enterprise Manager Agent Properties

2. Boot Configurations: properties such as advanced power or Paravirtualized kernel can be set here as well as the configuration of a Post Install or First Boot script.

Boot Configurations

Specify boot properties and configure post install & first boot scripts for the upcoming targets

Advanced Configuration & Power Interface On Off

Use Paravirtualized kernel

Configuration Scripts

Name	Configure
Post Install	

Figure 42 Boot Configurations

3. Configure Package Selection: in our example, this list is populated from our choice of Reference Host in the Basic OS page. If no Reference Host was selected then this list would have to be populated manually. Please note the target provisioning host will need the required packages to access the Oracle Enterprise Manager agent RPM present on the Stage Server. For example, if the Stage Server is presenting by NFS, then NFS utilities must be in the Package Section. If the Stage Server is presenting by HTTP then `wget` should be in the Package Section.

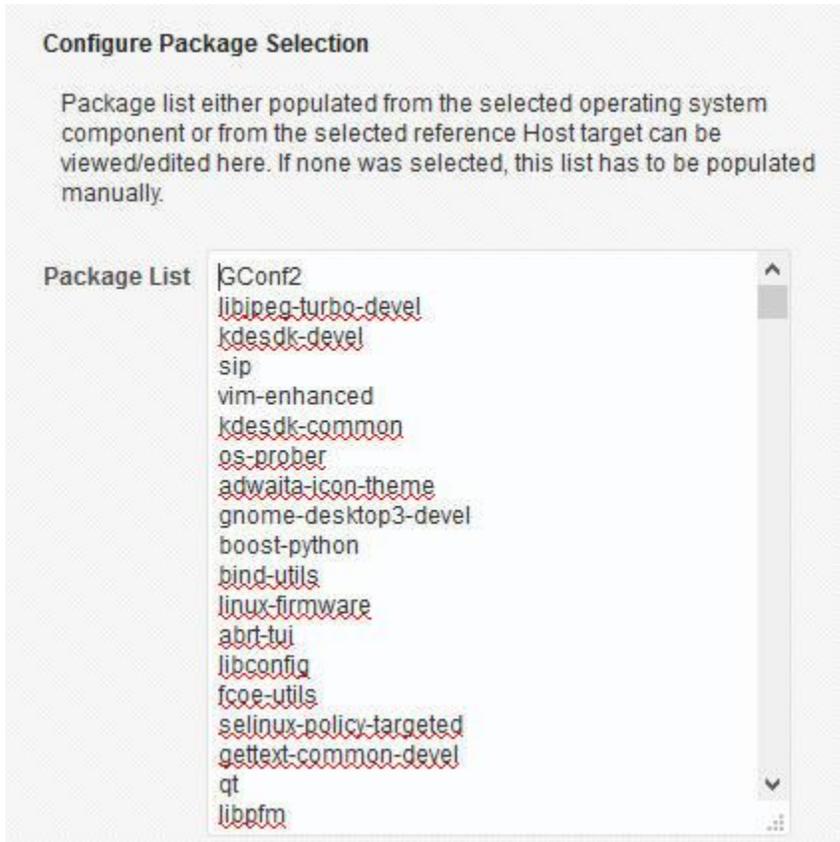


Figure 43 Configure Package Selection

- 4. Additional OS Details: options such as SELinux, mount points, NIS, NTP, Kernel and Firewall settings can be configured.

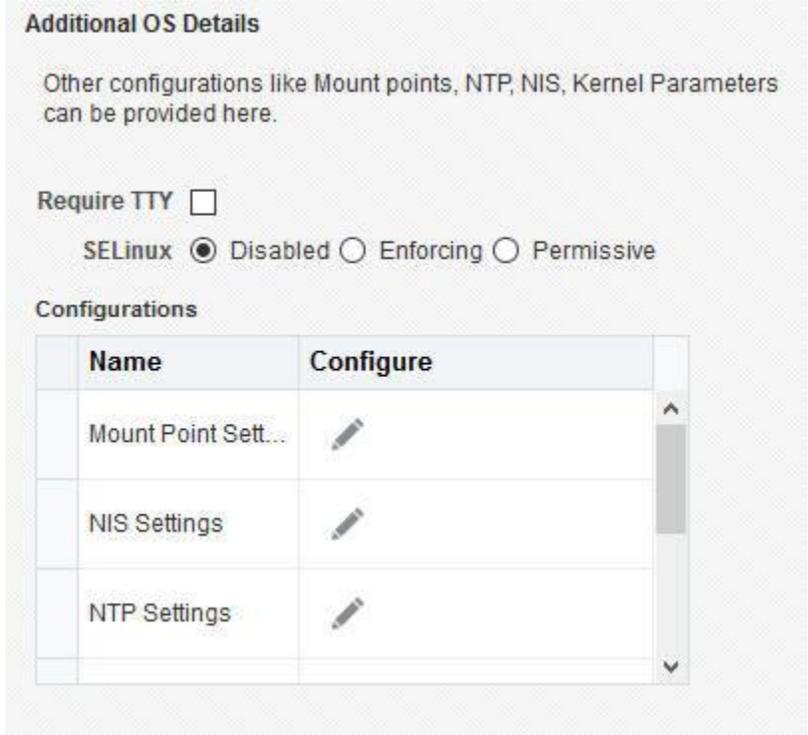


Figure 44 Additional OS Details

Click Next to proceed to the Review page which provides a view of all configuration options selected. Click Save and Upload to create the Operating System provisioning profile and upload it to the Software Library folder.

Disk Layout provisioning profile

A wizard is launched for the Create Disk Layout process.

The Describe page enables you to enter the following:

- A meaningful name and description
- Using the Add button, attach any useful files (2MB size limit) such as readme, collateral or licensing
- Using the Notes field, include useful information such as modification history

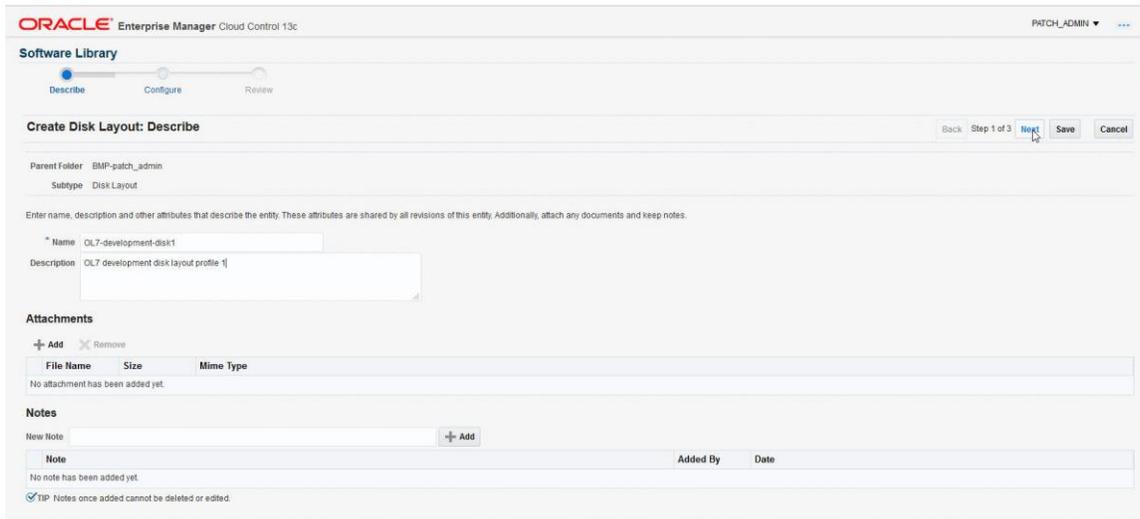


Figure 45 Disk Layout Describe page

Click Next to proceed to the Configure page.

The Configure page, using the relevant section Add button, enables you to enter the following:

- Hard Disk Profile: allows the entry of a physical disk name for example sda and a capacity in MB.
- Partition Configuration: allows the entry of a partition such as custom, swap or LVM, with attributes such as Mount Point, Grow and size in MB.
- RAID Configuration: allows the entry of Device Name and capacity.
- Logical Volume Groups: allows the entry of a Group Name based upon a partition or RAID.
- Logical Volumes: allows the entry of Logical Volumes with attributes such as Mount Point, type and size in MB.

The following example is a basic standard partition configuration:



Figure 46 Example Disk Layout

This configuration has no RAID or Logical Groups / Volumes configured.

The following example has Logical Group and Volumes configured:



Figure 47 Logical Group and Volume Disk Layout examples

Click Next to proceed to the Review page which provides a view of all configuration options selected. Click Save and Upload to create the Disk Layout provisioning profile and upload it to the Software Library folder.

Oracle Virtual Server provisioning profile

This provisioning profile is for the provisioning of the [Oracle VM Server for x86](#) product.

A wizard is launched for the Create Oracle Virtual Server process.

The Describe page is the same flow and content as the Operating System provisioning profile described previously in the Operating System provisioning profile section. Click Next to proceed to the Basic OS page.

The Basic OS page enables you to enter the following:

- Timezone
- Root password
- Oracle VM agent password
- Add users, setting groups and, if required, enabling sudo access

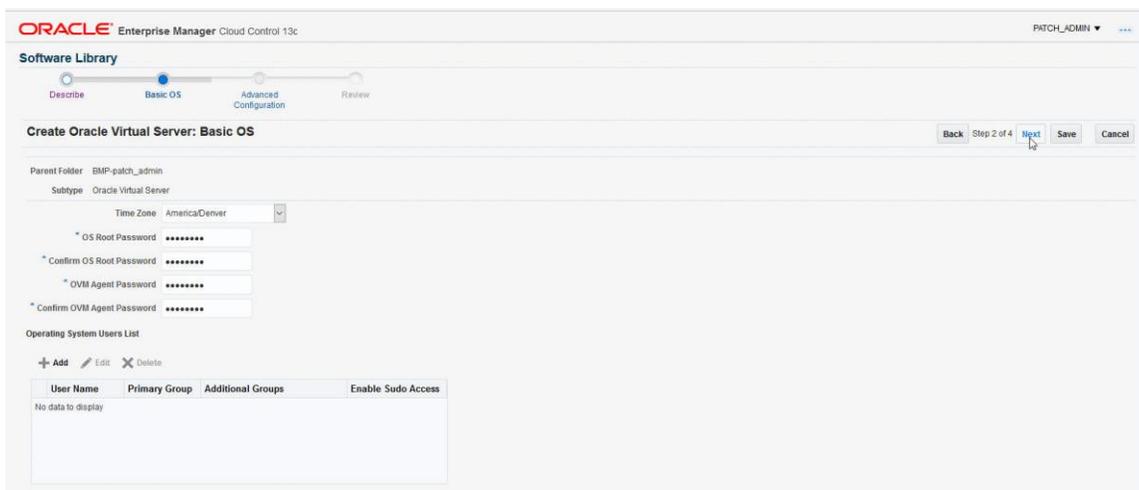


Figure 48 Oracle Virtual Server Basic OS

Click Next to proceed to the Advanced Configuration page.

The Advanced Configurations page has three sections:

1. Dom0 Configuration: the dom0 memory in MB can be set here as well as settings for boot time parameters for kernel (acpi).
2. Boot Configurations: advanced properties such as the configuration of a Post Install or First Boot script.
3. Additional OS Details: options such as mount points, NIS, NTP, Kernel and Firewall settings can be configured.

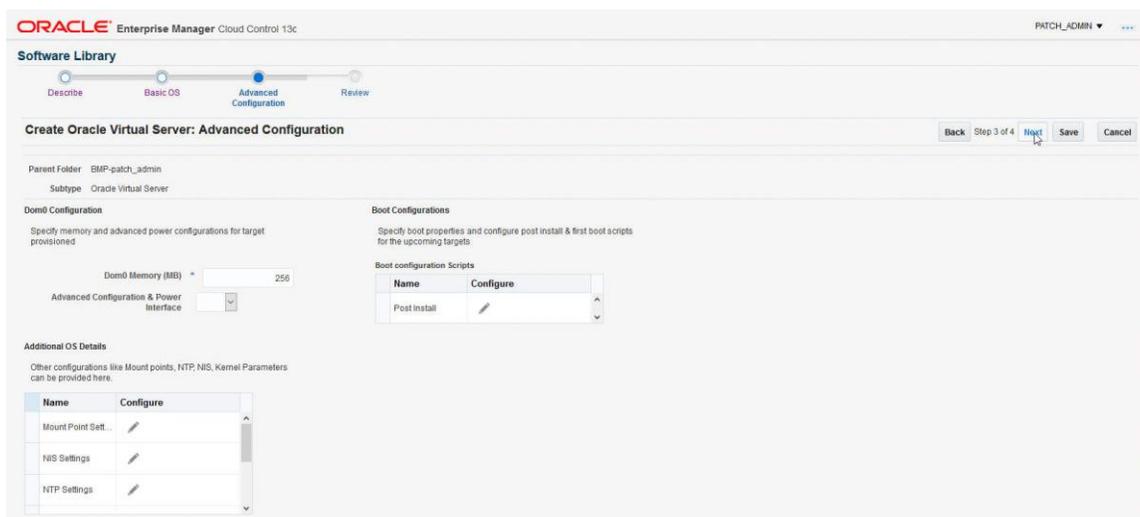


Figure 49 Advanced Configuration

Click Next to proceed to the Review page which provides a view of all configuration options selected. Click Save and Upload to create the Disk Layout provisioning profile and upload it to the Software Library folder.

Provisioning with the Bare Metal Provisioning framework

Using the UI and as the patch_admin user, the flow is as follows:

- Enterprise > Provisioning and Patching > Bare Metal Provisioning > Deployments

Provisioning is driven and managed from this section of the portal. Here, all Server images and their configuration are able to be viewed and removed.

Using the Provisioning drop down menu select one of the following:

- Operating System
- Oracle VM Server
- Using Saved Plan

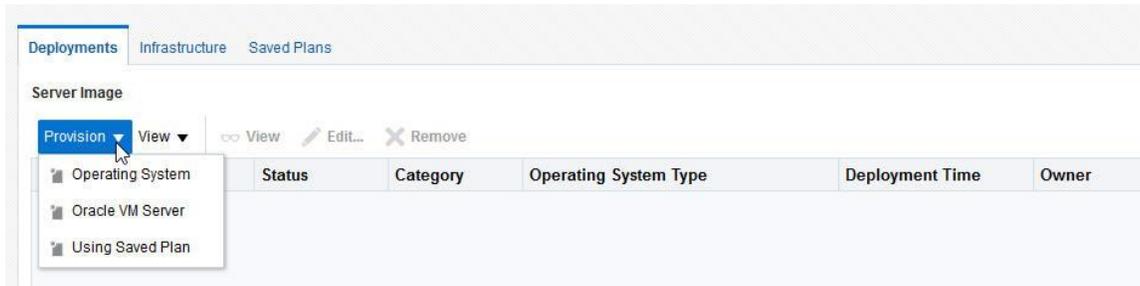


Figure 50 Deployments

Provisioning Operating System

A wizard is launched for the Provision Operating System process and the General/Target Selection page is shown.

Populate the page as shown in Figure 51 above. Refer to Table 4 above for detailed explanations about each of the required fields indicated by the callouts in the screen shot.

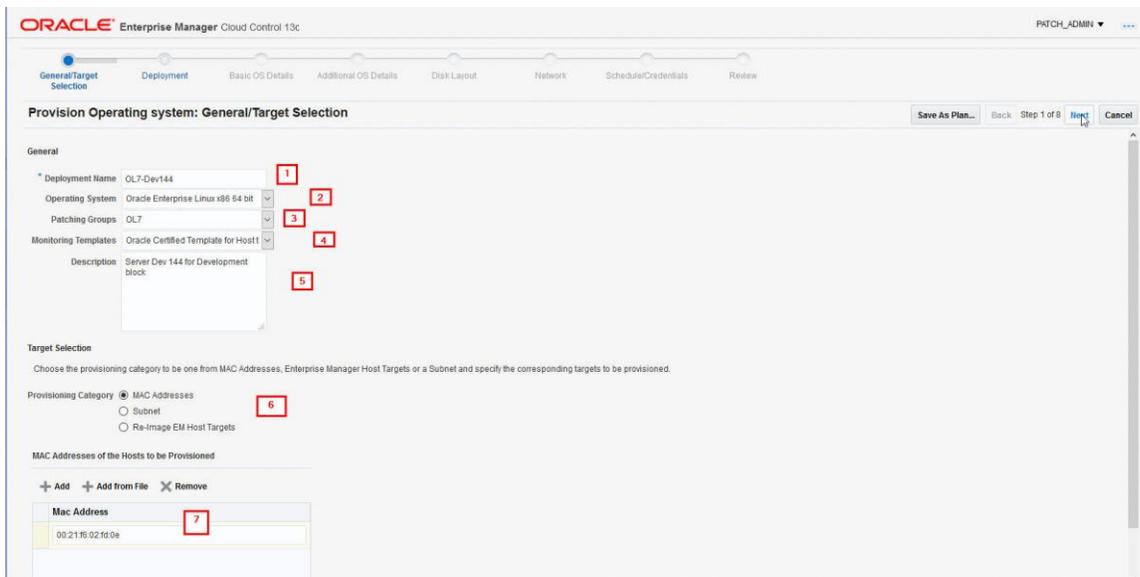


Figure 51 General/Target Selection

TABLE 4: EXPLANATION OF NUMBERED ITEMS IN FIGURE 51 ABOVE

Item	Description
1	A meaningful name for the deployment
2	Operating System definition with respect to 32 or 64-bit
3	If the Oracle Enterprise Manager Linux Host Patching framework is configured with Patching Groups, these can be selected here. The target provisioning host will be added to the selected Patching Group after provisioning is complete. This feature is dependent upon the Oracle Enterprise Manager agent being provisioned and configured as part of the provisioning process
4	Select the Oracle Enterprise Manager monitoring template. For host management, the Certified Template for Host is recommended

Item	Description
5	A meaningful description for the deployment
6	The Provisioning category can be a MAC address, an existing Oracle Enterprise Manager host target or a Subnet
7	MAC address can be added here directly or from a file

Click Next to proceed to the Deployment page.

Populate the page as shown in Figure 52 above. Refer to Table 5 above for detailed explanations about each of the required fields indicated by the callouts in the screen shot.

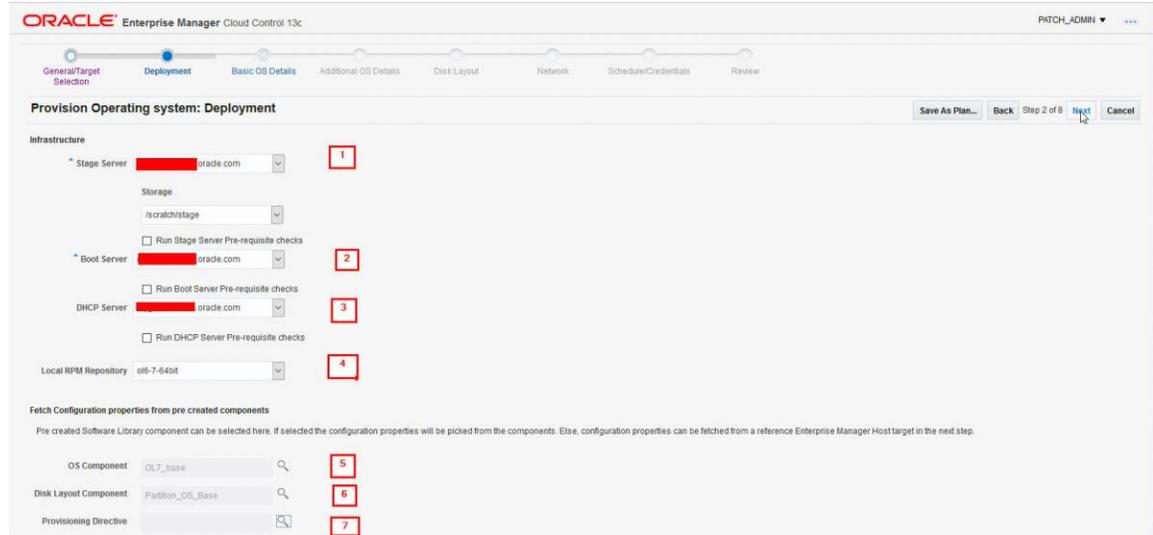


Figure 52 Deployment

TABLE 5: EXPLANATION OF NUMBERED ITEMS IN FIGURE 52 ABOVE

Item	Description
1	Drop down list for Stage Server Selection, which will display the storage path
2	Drop down list for Boot Server Selection -it is possible to have the framework run pre-requisite checks on the Boot Server as part of the provisioning process
3	Drop down list for DHCP Server Selection -it is possible to have the framework run pre-requisite checks on the DHCP Server as part of the provisioning process
4	Drop down list for the RPM Repository
5	Search / radio button to select the Operating System provisioning profile
6	Search / radio button to select the Disk layout provisioning profile
7	Provisioning Directives are out of scope for this whitepaper. They exist in Oracle Enterprise Manager to provide directives for other Oracle product provisioning such as ASM or Oracle Database

Click Next to proceed to the Basic OS Details page. This page confirms the Basic OS Details. Here, choices and changes can be made in the Operating System provisioning profile.

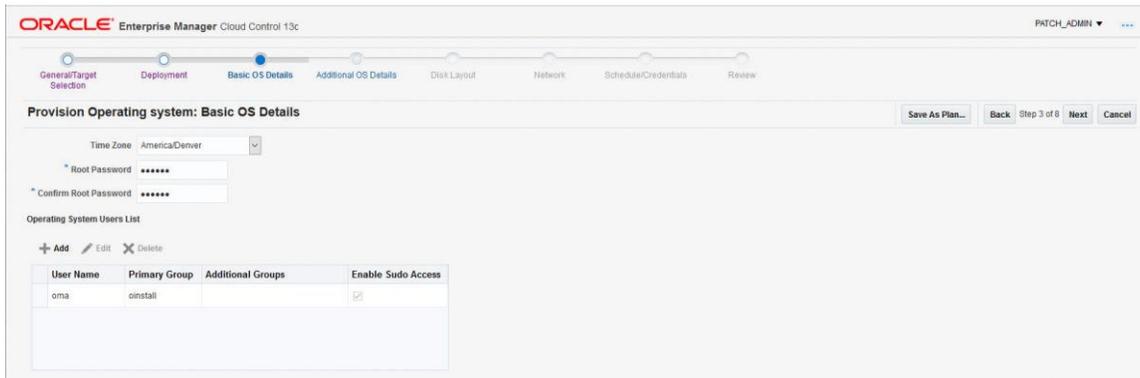


Figure 53 Basic OS Details

Click Next to proceed to the Additional OS Details page. This page confirms the Additional OS Details. Here, choices and changes can be made in the Operating System provisioning profile.

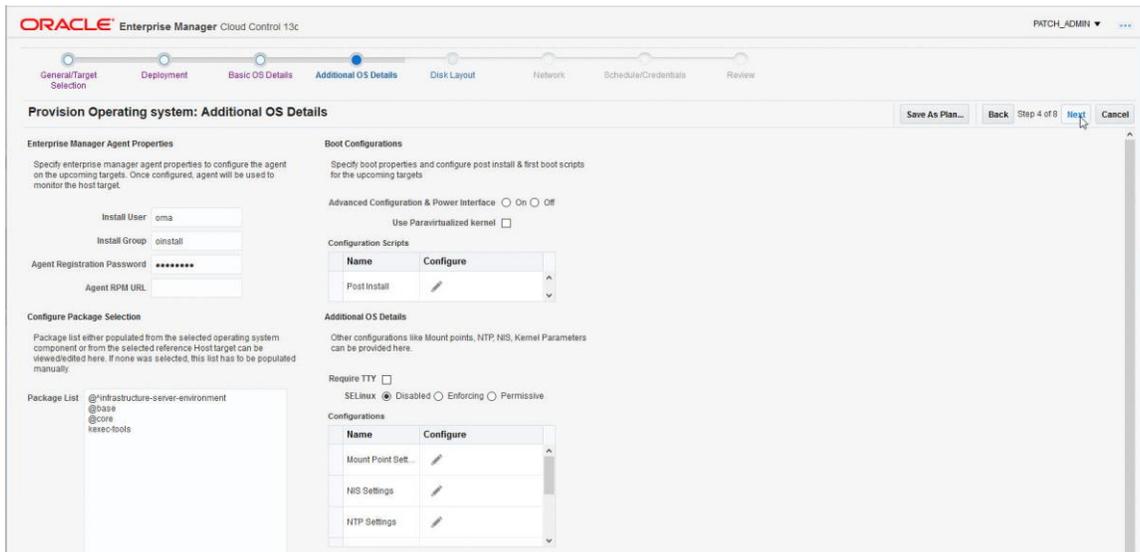


Figure 54 Additional OS Details

Click Next to proceed to the Disk Layout page. This page confirms the Disk Layout choices made in the Disk Layout provisioning profile and, if required, can be changed.

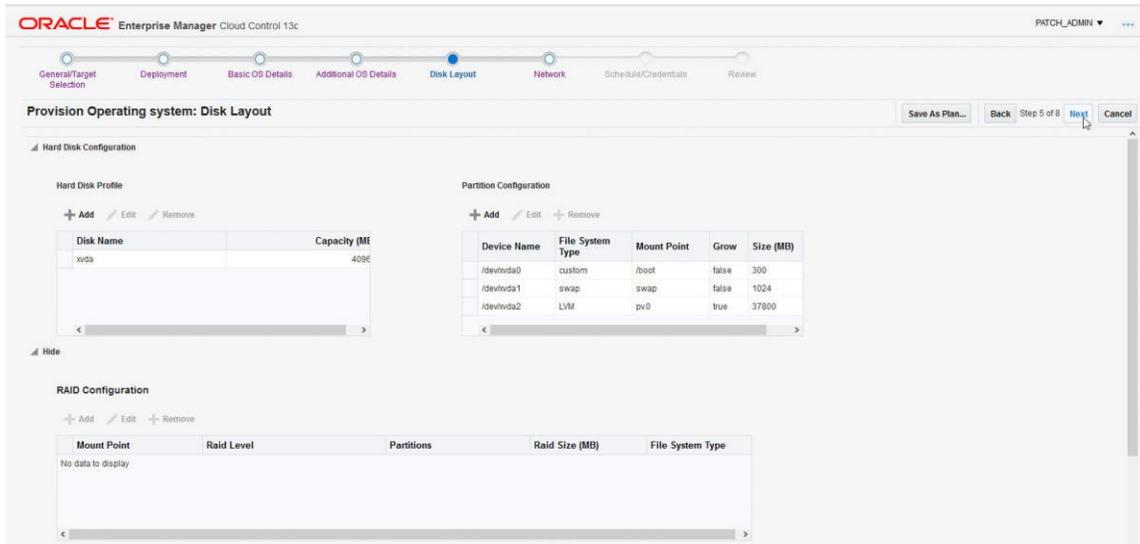


Figure 55 Disk Layout

Click Next to proceed to the Network page. This page confirms the network choices made in the Operating System provisioning profile and, if required, can be changed.

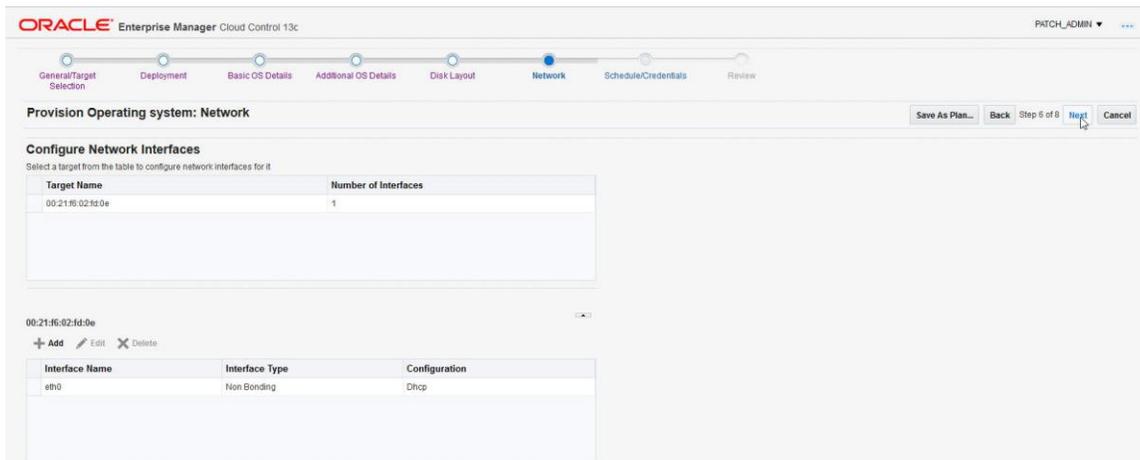


Figure 56 Network

Click Next to proceed to the Schedule / Credentials page. This page enables you to run the provisioning job now or at a later date. It also specifies the credentials for the Stage, Boot, DHCP servers and defaults to Preferred Credentials.

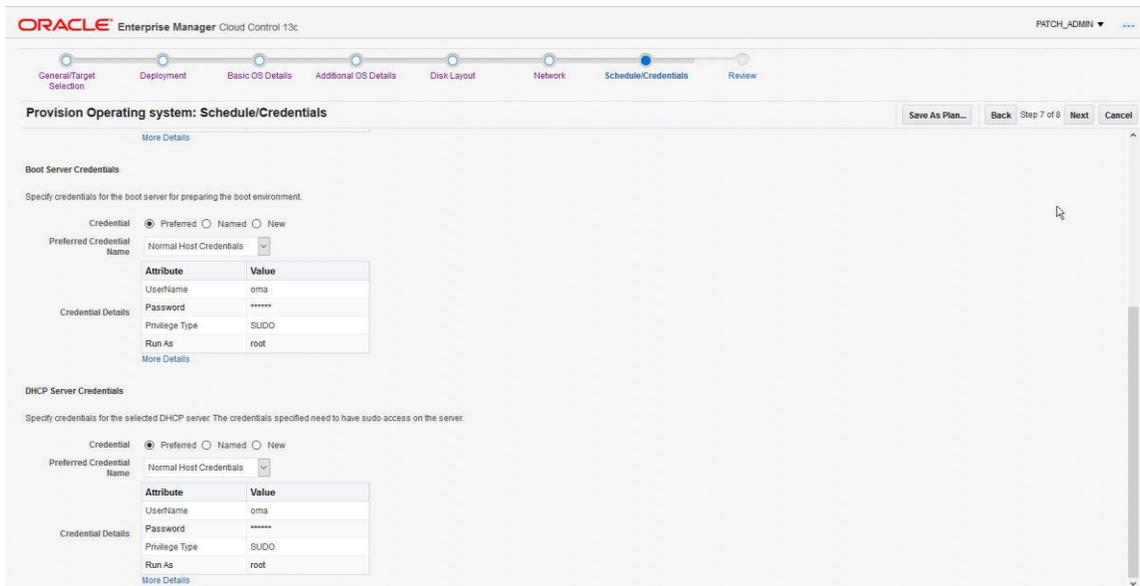


Figure 57 Schedule / Credentials

At this stage in the flow, an option is to click on the `Save as Plan` button. This enables all the configuration choices made during this flow to be available as a pre-defined plan.

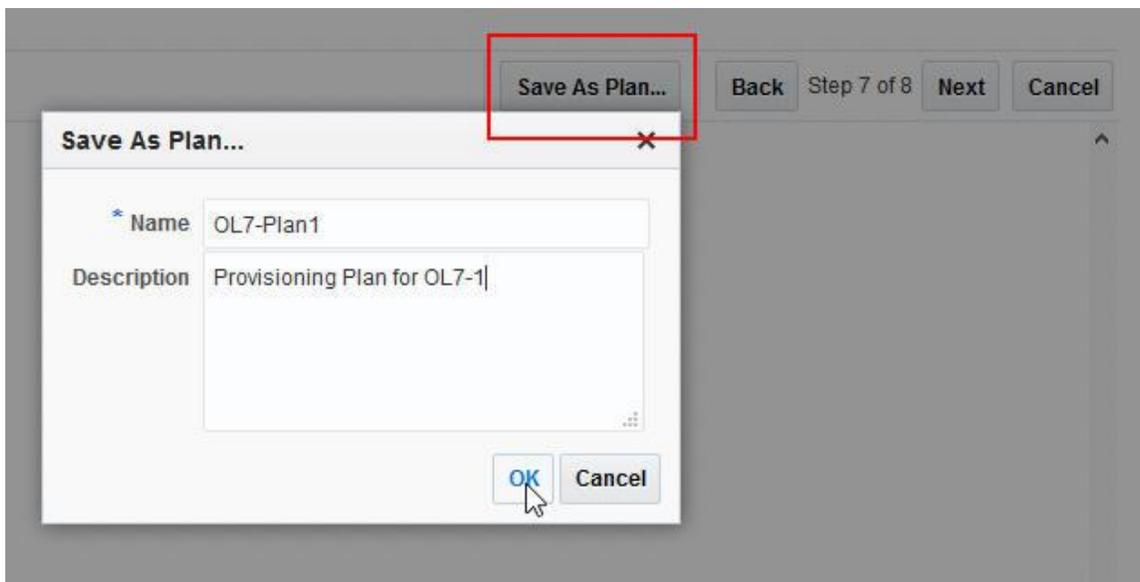


Figure 58 Save as Plan

Click `Next` to proceed to the `Review` page which provides a view of all configuration options selected. Click `Submit` to run the provisioning job.

The provisioning job then runs and displays a status of `Running`. The `BMP Deployment` job can be viewed to monitor progress. Upon successful completion of the provision job, the status changes to `Staged` where all the required components are in place. The next step is to power on the target provisioning host and initiate the PXE boot process.

Provision Oracle VM Server

The provisioning flow for Oracle VM Server is the same for the Operating System. The only differences are the OS details which are explained in the Oracle Virtual Server provisioning profile section.

Provision using Saved Plans

Saved plans is a useful method of creating service catalogues or gold builds which can be used repeatedly and edited during the provisioning flow. They also pre-populate key fields throughout the provisioning flow, which saves time for the user. If the user selects this provisioning method, then a choice of Saved Plans is displayed where the user can select the appropriate plan. The provisioning flow will start, with many screens having key areas already configured, as part of the Saved Plan. The provisioning flow is the same flow as seen previously for the Operating System. Currently it is not possible to use Saved Plans for Oracle VM Server provisioning.

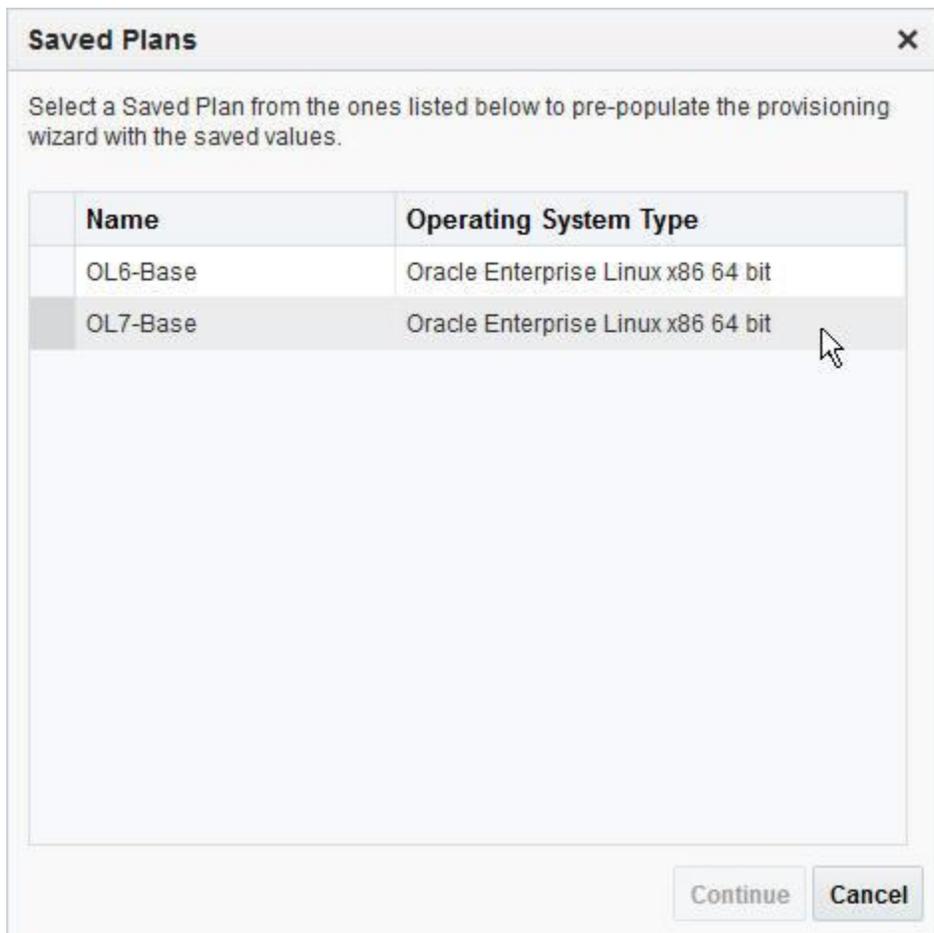


Figure 59 Select Saved Plan for a Provisioning Flow

Summary

In summary, this document has described:

- Oracle Enterprise Manager Bare Metal Provisioning concepts
- Oracle Enterprise Manager Bare Metal Provisioning framework deployment concepts
- Oracle Enterprise Manager Bare Metal Provisioning framework configuration
- Oracle Enterprise Manager Bare Metal Provisioning framework usage

RESOURCES

Download Oracle Linux from the Oracle Software Delivery Cloud.

Oracle Basic and Premium Support comes with Oracle Enterprise Manager 13c, for more information visit [Oracle Linux Support website](#).

Appendix A

PXE works with the Network Interface Card (NIC) of the system by making it function like a boot device. The PXE-enabled NIC of the client sends out a broadcast request to a DHCP server, which returns with the IP address of the client along with the address of the TFTP server, and the location of boot files on the TFTP server.

The following steps describe how it works:

1. Target Machine (either bare metal or with boot sector removed) is booted.
2. The Network Interface Card (NIC) of the machine triggers a DHCP request.
3. DHCP server intercepts the request and responds with standard information (IP, subnet mask, gateway, DNS, etc.). In addition, it provides information about the location of a TFTP server and boot image (pxelinux.0).
4. When the client receives this information, it contacts the TFTP server to obtain the boot image.
5. TFTP server sends the boot image (pxelinux.0), and the client executes it.
6. By default, the boot image searches the pxelinux.cfg directory on the TFTP server for boot configuration files using the following approach:

First, it searches for the boot configuration file that is named according to the MAC address represented in lower case hexadecimal digits with dash separators. For example, for the MAC Address "88:99:AA:BB:CC:DD", it searches for the file 01-88-99-aa-bb-cc-dd.

Then, it searches for the configuration file using the IP address (of the machine that is being booted) in upper case hexadecimal digits. For example, for the IP Address "192.0.2.91", it searches for the file "C000025B".

If that file is not found, it removes one hexadecimal digit from the end and tries again. However, if the search is still not successful, it finally looks for a file named "default" (in lower case).



For example, if the boot file name is `/tftpboot/pxelinux.0`, the Ethernet MAC address is `88:99:AA:BB:CC:DD`, and the IP address `192.0.2.91`, the boot image looks for file names in the following order:

`/tftpboot/pxelinux.cfg/01-88-99-aa-bb-cc-dd`

`/tftpboot/pxelinux.cfg/C000025B`

`/tftpboot/pxelinux.cfg/C000025`

`/tftpboot/pxelinux.cfg/C00002`

`/tftpboot/pxelinux.cfg/C0000`

`/tftpboot/pxelinux.cfg/C000`

`/tftpboot/pxelinux.cfg/C00`

`/tftpboot/pxelinux.cfg/C0`

`/tftpboot/pxelinux.cfg/C`

7. The client downloads all the files it needs (kernel and root file system), and then loads them.

8. Target Provisioning Host reboots. The Bare Metal Provisioning framework uses the Kickstart method to automate the installation of Linux on target machines. Using Kickstart, the system administrator can create a single file containing answers to all the questions that are usually asked during a typical Linux installation. The host specific boot configuration file contains the location of the kickstart file. This kickstart file would have been created earlier, by the stage directive of the OS image, based on the input from the user.



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