Introduction

The Oracle Linux operating system is engineered for open cloud infrastructure. It delivers leading performance, scalability and reliability for enterprise SaaS and PaaS workloads as well as traditional enterprise applications. Oracle Linux Support offers access to award-winning Oracle support resources and Linux support specialists, zero-downtime updates using Ksplice (Oracle Premier Support required), additional management tools such as Oracle Enterprise Manager, and lifetime support, all at a low cost.

Oracle offers a complete Linux-based solution stack—applications, middleware, database, management tools, operating system and hardware—along with a single point of support. Oracle invests significantly in testing Oracle Linux, releasing critical bug fixes that enable enterprises to deploy with confidence.

With Oracle Enterprise Manager 13c, Oracle offers a simple, integrated solution for Linux lifecycle management, from applications to disk.

Oracle Enterprise Manager 13c is system management software that delivers centralized monitoring, administration, and lifecycle management functionality for the complete IT infrastructure, including systems running Oracle and non-Oracle technologies.

An environment may comprise multiple Oracle databases, Oracle Applications and web servers all deployed on operating environments running on physical or virtual servers. Using the individual product consoles to monitor the status of each of these targets can become cumbersome, shuttling between console windows to track the health and security of each of these targets.

Oracle Enterprise Manager 13c offers a solution that allows the monitoring and management of the complete Oracle IT infrastructure from a single console. In addition, it provides support for business-driven IT management and business-centric, top-down application management to manage business services, user experience, and infrastructure.

Oracle Enterprise Manager 13c provides an integrated and cost-effective solution for complete Oracle Linux server lifecycle management. Oracle Enterprise Manager 13c delivers comprehensive provisioning, patching, monitoring, and administration capabilities via a single, web-based user interface, significantly reducing the complexity and cost associated with managing Linux operating system environments on bare metal physical machines or virtualized environments.

For more information about Oracle Enterprise Manager 13c, see Ref 1 at the end of this paper.
Oracle Enterprise Manager 13c Overview

Oracle Enterprise Manager 13c provides the most comprehensive management solution for Oracle environments. Key product capabilities include complete cloud lifecycle management, integrated cloud stack management, and business-driven application management. It also provides comprehensive Oracle Linux management capabilities. Oracle Linux Support customers are eligible to use Oracle Enterprise Manager 13c to manage all their Oracle Linux installed servers.

Oracle Enterprise Manager 13c enables administrators to:
- Discover assets within the data center and organize them in patching groups
- Monitor assets
- Provision Oracle Linux
- Manage Oracle Linux patching
- Manage systems compliance to enterprise rules
- Execute operational procedures on a group of servers or on individual servers

Oracle Enterprise Manager 13c easily integrates into an existing Linux patching and provisioning infrastructure because its Linux management is based on open Linux standards (yum patching, PXE boot provisioning). From Oracle Enterprise Manager 13c version 13.3, Linux patching using Oracle Ksplice is enabled.

This paper will show how Oracle Enterprise Manager 13c enables the administrator to accomplish multiple Linux system management tasks securely from a single console.
Managing Oracle Linux with Oracle Enterprise Manager 13c

Discovery and Inventory
Oracle Enterprise Manager 13c launches periodic jobs that scan for unmanaged hosts via a network scan. The discovered hosts can then be promoted to “managed” status by installing and running the Oracle Enterprise Manager agent.

Oracle Linux Home
From Oracle Enterprise Manager 13c version 13.3, a new Oracle Linux Home target has been introduced. View the Oracle Linux Home from the Cloud Menu via Enterprise > Cloud > Oracle Linux Home:
This new home page, exclusively for Oracle Linux, enables customers to perform management and monitoring of Oracle Linux hosts. Features include:

- Oracle Linux host administration and management
- Bare Metal Provisioning (BMP)
- Oracle Linux OS Patching
- Oracle Ksplice patching (provides the ability to update the Oracle Linux operating system kernel and key user space libraries while the OS is running, without a reboot or interruption. See Ref 4)
- Add a new Oracle Linux host which directs the user to the Setup > Add Target > Add Targets Manually wizard to push an Oracle Enterprise Manager agent to the Oracle Linux host

This new target is also visible from the All Targets view:
Navigate to the Oracle Linux Home from either the Enterprise or All Targets page.

Oracle Linux Home has the following regions:

- General
- Overview of Incidents and Problems
- Host flux
- CPU
- Memory
- Linux patching compliance / summary
- Ksplice patching compliance / summary

General

The general region shows a summary of the Oracle Linux hosts, showing total numbers of each Oracle Linux version, as well as their status.

![General](image)

Figure 6. Oracle Linux Home General Region

From here, click on the OS Version, which will show a tabular view of all Oracle Linux hosts matching that version. A similar view can be seen by clicking on any of the total or green arrow links. This view displays useful information such as CPU and memory utilization as well as the total IO/second. These metrics have links which when clicked will take you to the metric monitoring area for that host. Other useful information such as logical memory, CPU load, network interface rate, and swap utilization are available.

![Figure 7. Oracle Linux Hosts](image)
Overview of Incidents and Problems

From here, any incidents or problems affecting the Oracle Linux hosts with respect to availability, performance, and security can be viewed.
Host flux
When Oracle Linux hosts are retired or added, these events are tracked based on when they occurred over a period of the last 30 days.

[Image: Host Flux (Last 30 Days)]

Figure 10. Host flux

CPU
Here CPU utilization is displayed over a range of Oracle Linux hosts. In this example, there are 12 Oracle Linux hosts where 100% of them have a CPU utilization between 0 – 25%.

[Image: CPU]

Figure 11. CPU

By clicking on the CPU 0-25 bar, a table, view of each host with individual CPU utilization can be viewed.
Figure 12. CPU breakdown

Memory

For memory, a similar approach to CPU is taken. This example shows 12 Oracle Linux hosts split with regard to their memory utilization.

Figure 13. Memory view

Clicking on the memory 25-50 bar will show a table view of each host with individual memory utilization.
Oracle Linux Patching Status / Compliance

Here, two regions are shown: Oracle Linux Status and Compliance.

**Figure 14. Memory breakdown**

**Figure 15. Oracle Linux patching compliant view**

### Oracle Linux Patching Status / Compliance

Here, two regions are shown: Oracle Linux Status and Compliance.

- **Linux Patching**
  - **Status**
    - Patchable Linux Groups: 1
    - Patchable Linux Hosts: 3

### Compliance Report

<table>
<thead>
<tr>
<th>Host</th>
<th>Group</th>
<th>Compliant</th>
<th>Needs Reboot</th>
<th>Out Of Date Packages</th>
<th>Rogue Packages</th>
</tr>
</thead>
<tbody>
<tr>
<td>com</td>
<td>o6_patch</td>
<td>✓</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>com</td>
<td>o6_patch</td>
<td>✓</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>com</td>
<td>o6_patch</td>
<td>✓</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
The status region shows how many Oracle Linux hosts are compliant with respect to Oracle Linux packages present on the Oracle Linux host, compared to packages within Unbreakable Linux Network (ULN)-based or custom patching groups.

The Compliance region view can be changed between Hosts or Patching groups. Both views show any hosts or patching groups that have out of date or rogue packages. A rogue package is one that exists on the Oracle Linux host but not in ULN-based or custom patching groups.

Figure 16 shows a non-compliant view.

![Figure 16. Oracle Linux patching non-compliant view](image)

**Ksplice for Oracle Linux**

Ksplice updates the Oracle Linux operating system kernel and key user space libraries, whilst the operating system is running, without a reboot or interruption. To enable Oracle Enterprise Manager’s Ksplice management capability, all Oracle Linux Hosts must have an Oracle Enterprise Manager agent installed and configured with Ksplice software. For further details, refer to Ref 4 and Ref 5.

Ksplice configuration metrics are collected on every monitored Oracle Linux Host configured with Ksplice software (Uptrack v1.2.45 or Enhanced Ksplice v1.0.29 or higher). To access these metrics: From the Host menu on a host's home page, select Configuration > Latest:
Figure 17. Oracle Linux Host > Configuration > Latest

This view is for an offline Ksplice host, which is up to date for the kernel but out of date for user space:

Figure 18. Oracle Linux Host Ksplice offline

This view is for an online Ksplice host, which is up to date for the kernel but out of date for user space:
The following metrics are collected:

- **Ksplice Version**
  This reports the version of the Ksplice software installed on the Target Host.

- **Ksplice Status**
  This reports if the host is configured to receive updates from the Ksplice Server or if it is Ksplice offline.

- **Base Kernel Version**
  This queries the stock (base) kernel running in the system; this version does not represent the patched version, only the one that booted the system.

- **Effective Kernel Version**
  This reports the Effective Kernel, which means the kernel version after the live Ksplice patching, including security fixes. This also reports the last applied patch date.

- **Kernel Status**
This reports if the kernel of the host is up to or out of date. A system is up to date if it has all available Ksplice patches installed.

- **Kernel Patches Installed**
  This reports the count of Ksplice packages installed on the system.

- **User Space Status**
  This reports if the host's user space Ksplice-aware packages are up to or out of date. If this in an offline Ksplice host then the status is based upon the local repositories configured on the system.

- **User Space Packages Installed**
  This reports the count of Ksplice user space packages installed on the system.

- **Kernel Installed Patches**
  This reports the installed Ksplice patches in the system.

- **Kernel Available Patches**
  This lists the available Ksplice patches for the kernel, in essence it list the patches that have not yet been installed. This information is gathered based on the Ksplice configuration. In the case of an online Ksplice host configured with Ksplice server, it gets that information from ULN.

  In the case of an offline Ksplice host, it reflects the data based on the `uptrack-updates-`uname -r` package installed on the system.

- **User Space Installed Packages**
  This reports the Ksplice user space packages installed on the system.

The Ksplice Patching region on the Oracle Linux Home Page uses the metrics collected, detailed earlier, to collate the Ksplice status over all the Ksplice-enabled Oracle Linux hosts monitored; it contains two sub-regions:

- **Ksplice Status Region**
  This region shows the total number of Ksplice-enabled hosts; clicking on that number will open a list of hosts.

  The Ksplice Status Region contains two pie charts:
  - **Kernel Status**
  - **User Space Status**

  Each pie chart shows the status of all hosts, including how many are compliant, non-compliant, or compliance unknown. Clicking on a particular compliance status will open another page with associated hosts.

- **Ksplice Summary Region**
  This region shows Ksplice enabled hosts:
Ksplice Status (Online/Offline)
Kernel Status (Compliant/Non-Compliant/Compliance unknown)
User Space Status (Compliant/Non-Compliant/Compliance unknown)
Effective Kernel Version

By clicking on the number next to Ksplice Enabled Hosts (in Figure 20 above “10”), this leads to the Ksplice Linux Hosts page, which contains a table displaying the following:

- Ksplice Enabled Hosts with Ksplice software
- Ksplice software Version
- Ksplice Status (Online – Green / Offline – Grey)
- Kernel Status (Compliant/Non-Compliant/Compliance unknown – in case of unconfigured/offline systems)
- Number of Kernel Installed Patches
- User Space Status (Compliant/Non-Compliant/Compliance unknown – in case of unconfigured/offline systems)
- Number of User Space Installed Patches
- Base Kernel Version
- Effective Kernel Version
In Figure 21, the last two hosts have a version of 1.2.47. This denotes that the Ksplice enhanced client is not installed (uptrack client) and therefore no user space patches are listed.

By clicking on a host name in the Ksplice detail table, a new page will be opened. This page will list the installed Ksplice patches on that host. If this host is a Ksplice online host, it will also list what updates are available; these updates can be added or removed from this page.

If the host is a Ksplice offline host, this page will show all the Ksplice kernel or user space patches available in the local repository. If the Ksplice enhanced client software is installed on the host, then it will display a list of installed or available user space patches. Otherwise, it will show "Install/Upgrade/Configure Ksplice Enhanced Client Software". With a Ksplice offline host, the Ksplice status will be a grey rather than a green dot, which denotes an online host. In addition, with an offline host, two dotted clocks are present for the kernel and user space status as the latest updates can only be determined from the offline repository, which may not be the latest from ULN.

Notice the refresh button; this refreshes the latest data to the dashboard. When clicked, there will be a dialogue box, which will take confirmation from the user.

For any install or remove update you have to select and enter root privilege or credentials. The use of the uptrack or the enhanced client features is available. Best practice is to install all updates. Therefore, this model is followed even for the uptrack client, to keep the deployment model consistent. The removal of updates for the kernel is possible by ID / individually, however, for user space it is only possible to remove all updates.
Oracle Linux Patching

Oracle Enterprise Manager 13c provides the following Linux patching features:

- Set up Linux RPM repositories based on ULN channels
- Download advisories (errata) from ULN
- Set up a Linux patching group to update a group of Linux hosts and collect compliance information
- Allow non-compliant packages to be patched
- Roll back last update/uninstall packages from host
- Manage RPM repositories and channels (clone channels, copy packages from one channel into another, delete channels)
- Add RPMs to custom channels
- Manage configuration file channels (create/delete channels, upload files, copy files from one channel into another)
- Run pre- and post-patching scripts
- Linux Patching Admin and Operator role-based access

The patching framework is accessed from either the Enterprise or Oracle Linux Home menu:

![Linux Patching via Oracle Linux Home](image)

From here, it is possible to setup and use the Linux patching framework.

Oracle Enterprise Manager allows the system administrator to create RPM repositories (repo) and use existing repositories. This enables the administrator to easily mirror repositories from ULN and use them to patch the Linux servers.
Existing RPM repositories can be defined in Oracle Enterprise Manager as part of the patching setup. Administrators can create their own channels (custom channels) made of specific packages, at a specific patch level using the `createrepo/yum-arch` commands, and then register these custom repositories in Oracle Enterprise Manager.

For more information on how to manually create mirrors of ULN channels, see Ref 3.

From the Manage RPM Repository section, existing channels can be cloned using the Create-Like feature. The Copy Packages feature allows you to copy packages from one channel to another.

The target servers can be organized in groups that are associated to channels, and periodic scans for updates will be made on the servers of these groups. Managing groups of servers associated with custom channels is an effective way to enforce system image standards. Depending on the purpose of the servers, a set of packages has to be installed and kept up to date on the servers. The administrator creates channels for each group of servers with only the packages that the servers from a particular group need. For example, the database servers with Oracle Database 12c running on Oracle Linux 6 could belong to the group “OL6Host_DB12” with an associated custom channel containing the packages for the installation and execution of Oracle Database. This method helps the administrator maintain a standard in the data center and improves security. In the event the server requires an additional package to be installed, the system administrator would add the package to the custom channel.
Once the patching setup is complete, the administrator can select **Linux Patching** via the Oracle Linux Home target page. Following initialization, it is possible to determine the level of compliance of the systems.

The **Compliance** Home section provides the administrator with status reports showing which systems need updates. From here, patching can be scheduled and rolled back per patching group. During this process, it is possible to run pre-scripts and post-scripts.
Figure 27. Linux patching compliance home section

Advisories indicate how critical the various available updates are.

Figure 28. ULN advisories

Reporting

Use the reporting features of Oracle Enterprise Manager to run the following Linux patching reports:

- Non-compliant packages for all hosts
- Non-compliant packages for a single host
- Compliance information for all patchable Linux groups
- Compliance information for all patchable Linux hosts

![Linux patching reports](image)

Figure 29. Linux patching reports

Configuration files

Configuration file channels can be created by the system administrator to enforce the compliance of the general configuration of different systems. For example, general or explicit network configuration files can be deployed to single or multiple host targets with the option to run pre- and post-scripts.

![Configuration file channels](image)

Figure 30. Configuration file channels

Provisioning

Oracle Enterprise Manager 13c allows the administrator to provision Oracle Linux on bare metal servers. While virtual machines can also be provisioned, that is out of the scope of this paper. The provisioning framework is accessed from either the Enterprise or Oracle Linux Home menu:

![Linux Provisioning via Oracle Linux Home](image)

Figure 31. Linux Provisioning via Oracle Linux Home
The method used to provision Linux on the bare metal server is standard PXE, HTTP, Kickstart, and the use of RPM repositories. The provisioning infrastructure includes a stage server where the server’s installation files are staged, a DHCP server from which the server will get the network information, and a boot server where TFTP boot is configured.

![Figure 32. Bare metal provisioning infrastructure](image)

In the **Deployment** tab, you can add and view bare metal provisioning images.

![Figure 33. Bare metal provisioning images](image)

The images consist of a set of information, for example, the server MAC address and the Linux installation details used to create the Kickstart file. The following screenshots (Figure 34 through Figure 38), show how to configure a bare metal provisioning image. As part of the bare metal provisioning flow, it is also possible to deploy and configure the Oracle Enterprise Manager agent.
Figure 34. Bare metal provisioning image creation (1 of 5)

Figure 35. Bare metal provisioning image creation (2 of 5)
Figure 36. Bare metal provisioning image creation (3 of 5)

Figure 37. Bare metal provisioning image creation (4 of 5)
Monitoring

Oracle Enterprise Manager 13c provides an incident / event framework that the administrator can use to quickly determine any incident or abnormal activity within the data center.

In addition, the per-server view provides more detail about a particular host.
Administration

Oracle Enterprise Manager 13c provides administration features for the following areas accessed via the Host target home page > Administration menu:

- Linux Services
- System Run Levels
- Network Cards
- Hosts Lookup Tables
- NFS Client
User and Group

Figure 41. Administration features

From Oracle Enterprise Manager 13c version 13.3, support for these administration features is for Oracle Linux 6 (OL6) and Oracle Linux 7 (OL7) hosts. Before this release, support is dependent upon the installation of required packages referenced from the advisory notification in Figure 42 below. See Ref 2 for the Oracle Linux 6 (OL6) based packages. Note: Before Oracle Enterprise Manager 13c version 13.3, support is for Oracle Linux 6 (OL6) only.

Required Installations
To administer a host through Enterprise Manager, you will need to install the following scripts. Follow the steps below and click ‘Finish’ button when you are done.

Step 1 Install YAST and EM Wrapper Scripts from https://cfs.oracle.com/projects/yast

Figure 42. Host advisory notification advisory

Operational procedures
Oracle Enterprise Manager 13c provides a library of procedures tailored for specific tasks such as provisioning and patching a database. Administrators can create their own procedures in a shell script or Perl to automate certain operational tasks.
Configuration drift analysis
Oracle Enterprise Manager 13c allows the administrator to compare systems in detail, for example, for compliance purposes or troubleshooting. The following screenshot depicts three systems and reports the differences between them and a reference system from hardware to software configuration.
Compliance

Compliance management provides the ability to evaluate the compliance of targets and systems as they relate to business best practices for configuration, security, and storage. The screenshot below depicts the Oracle Generic Compliance Framework, which provides useful information for monitoring and tracking Linux packages and settings. For example, advice can be given on general security options such as open ports as well as advising of missing patches for Oracle Enterprise Manager and other Oracle products.

![Oracle Generic Compliance Framework](image)

**Figure 45.** Oracle generic compliance framework

The lifecycle management compliance framework within Oracle Enterprise Manager 13c can also be used for real-time monitoring of files. For example, a custom compliance framework can be created to monitor critical Linux network files (such as `/etc/hosts` for example) and alert the user via the framework when these files were edited. Each event can be audited and referenced for future compliance tracking.

![Real-time compliance monitoring of Linux critical network files](image)

**Figure 46.** Real-time compliance monitoring of Linux critical network files

Converged Systems Management

Oracle is one of the few enterprise solution providers to offer so many components of the IT infrastructure, from purpose-built engineered systems to general-purpose solutions. Oracle enhances the user experience by tailoring its virtualization and operating system layer to the hardware and applications it provides.
Some IT operations professionals interact with the operating system during system management tasks, while others may only know the operating system as a wrapper around their application.

As development and operations personnel (DevOps) work more closely together within a data center to accelerate IT projects and vendors provide more converged systems infrastructure, the traditional IT roles once held up as the norm are rapidly changing. Oracle Enterprise Manager 13c’s modular design allows users to choose one point of view or the other, or they can select both.

Oracle Enterprise Manager 13c enables customers to have complete visibility into the Oracle Linux environment. If the IT environment consists of a large investment in Oracle hardware, Oracle Enterprise Manager 13c assists with managing the hardware in addition to Oracle Linux to maintain a single view of the Oracle technology stack. If the IT environment is more focused on Oracle Database and Oracle Applications installed across a variety of hardware systems, Oracle Enterprise Manager 13c is the preferred tool to manage the Oracle Linux layer along with the complete Oracle technology stack. A significant percentage of Oracle Linux customers are also Oracle Database and Oracle Applications customers and, therefore, they are most likely already using Oracle Enterprise Manager 13c in some capacity. Many user flows found within Oracle Enterprise Manager 13c assist in that direction.

References

Integrated Cloud Applications & Platform Services

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