# Oracle® Key Vault

## Installation and Upgrade Guide

Release 21.11

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# Preface

Welcome to *Oracle Key Vault Installation and Upgrade Guide*. This guide explains how to install and upgrade Oracle Key Vault.

## Audience

*Oracle Key Vault Installation and Upgrade Guide* is written for Oracle Key Vault administrators who are responsible for installing or upgrading Oracle Key Vault.

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## Related Documents

For more information, see these resources:

- *Oracle Key Vault Administrator's Guide*
- *Oracle Key Vault Root of Trust HSM Configuration Guide*

- *Oracle Key Vault RESTful Services Administrator's Guide*
- *Oracle Key Vault Developer's Guide*
- *Oracle Key Vault Licensing Information*
- *Oracle Key Vault Release Notes*
- *Key Management Interoperability Protocol Specification Version 1.1*

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The following text conventions are used in this document:

| Convention | Meaning |
|---|---|
| **boldface** | Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary. |
| *italic* | Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values. |
| `monospace` | Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter. |

# Changes in This Release for Oracle Key Vault

This Oracle Key Vault release introduces new features that enhance the use of Oracle Key Vault in a large enterprise.

- Changes for Oracle Key Vault Release 21.11
  Oracle Key Vault release 21.11 introduces a new feature.
- Changes for Oracle Key Vault Release 21.10
  Oracle Key Vault release 21.10 introduces several new features.
- Changes for Oracle Key Vault Release 21.6
  Oracle Key Vault release 21.6 introduces new features that affect this guide.
- Changes for Oracle Key Vault Release 21.4
  Oracle Key Vault release 21.4 introduces new features that affect this guide.
- Changes for Oracle Key Vault Release 21.2
  Oracle Key Vault release 21.2 introduces new features that are related to installation and upgrade operations.

## Changes for Oracle Key Vault Release 21.11

Oracle Key Vault release 21.11 introduces a new feature.

- Enhanced Pre-Upgrade Checks
  Starting with the Oracle Key Vault release 21.11, pre-upgrade checks are enhanced to also check for the state of the diagnostics utility.

### Enhanced Pre-Upgrade Checks

Starting with the Oracle Key Vault release 21.11, pre-upgrade checks are enhanced to also check for the state of the diagnostics utility.

If the diagnostics utility is already installed, then the upgrade process stops and raises a warning that the diagnostics utility should be uninstalled. The process will also display the steps on how to uninstall the diagnostics utility.

You can now choose not to proceed with the upgrade after the pre-upgrade checks are completed. Additionally, you can use this to determine the server readiness for upgrade, ahead of the scheduled upgrade.

## Changes for Oracle Key Vault Release 21.10

Oracle Key Vault release 21.10 introduces several new features.

- Configurable Oracle Key Vault Ports
  Starting with Oracle Key Vault release 21.10, you can now configure the ports used to communicate between read/write peers and connect to Oracle Key Vault remotely using SSH.

## Configurable Oracle Key Vault Ports

Starting with Oracle Key Vault release 21.10, you can now configure the ports used to communicate between read/write peers and connect to Oracle Key Vault remotely using SSH.

Oracle Key Vault uses port 1522 to communicate between read/write peers. The SSH service running on port 22 allows for remote administration of Oracle Key Vault. For certain deployments, it may not be possible to configure the network to allow ingress or egress traffic on these default ports. You can now configure these ports to non-default values for cluster operations and administrative maintenance.

# Changes for Oracle Key Vault Release 21.6

Oracle Key Vault release 21.6 introduces new features that affect this guide.

- Ability to Clone an Oracle Key Vault VM
  Starting with Oracle Key Vault release 21.6, a fresh installation of an Oracle Key Vault VM guest can be stored as a `template`, and the VM platform cloning capability can be used to clone Oracle Key Vault cluster nodes.
- Oracle Key Vault Operating System Upgrade to Oracle Linux 8
  In Oracle Key Vault release 21.6, the embedded operating system is upgraded to Oracle Linux 8.

## Ability to Clone an Oracle Key Vault VM

Starting with Oracle Key Vault release 21.6, a fresh installation of an Oracle Key Vault VM guest can be stored as a `template`, and the VM platform cloning capability can be used to clone Oracle Key Vault cluster nodes.

With Oracle Key Vault cluster, using the cloned template, the system administrator can significantly shorten the provisioning time, compared to performing a full installation of each individual cluster node.

Oracle Key Vault supports the cloning feature of the underlying virtualization platform. This eliminates the need to go through the full installation process for each individual cluster node. You can clone an Oracle Key Vault system (installed as a VM) after the installation is complete, but before performing postinstallation tasks. When a clone is started up for the first time, it goes through a series of steps to regenerate system-specific configuration that makes it unique (and separate from all other clones). The (remote) cloning capability provided by virtualization platforms allows to clone from an Oracle Key Vault **Template**, which is an Oracle Key Vault installation that is stopped before this Oracle Key Vault is made unique. It regenerates all of the system-specific configuration; the clone becomes unique by completing the remaining installation steps.

## Oracle Key Vault Operating System Upgrade to Oracle Linux 8

In Oracle Key Vault release 21.6, the embedded operating system is upgraded to Oracle Linux 8.

Before attempting an Oracle Key Vault upgrade confirm with your vendor that your Oracle Key Vault servers (for installations on dedicated hardware) are compatible with Oracle Linux 8 .

# Changes for Oracle Key Vault Release 21.4

Oracle Key Vault release 21.4 introduces new features that affect this guide.

- Ability to Control the Extraction of Symmetric Encryption Keys from Oracle Key Vault
  Starting in Oracle Key Vault release 21.4, to strengthen the protection of symmetric encryption keys, you now can restrict these keys from leaving the Oracle Key Vault cluster boundary.
- Ability to Restrict Oracle Key Vault Administrative Role Grants
  Starting in Oracle Key Vault release 21.4, you can control whether a grantee of an Oracle Key Vault administrative role can grant the role to other Oracle Key Vault users.

## Ability to Control the Extraction of Symmetric Encryption Keys from Oracle Key Vault

Starting in Oracle Key Vault release 21.4, to strengthen the protection of symmetric encryption keys, you now can restrict these keys from leaving the Oracle Key Vault cluster boundary.

This restriction applies to the key material of the symmetric keys, but not its metadata. For example, Transparent Database Encryption (TDE) master encryption keys are stored in Oracle Key Vault. When an endpoint needs to decrypt the key, the PKCS#11 library fetches the TDE master encryption key from Oracle Key Vault to perform the decryption. If your site requires that symmetric keys never leave Oracle Key Vault, then you can configure these keys to remain within Oracle Key Vault during operations. In this case, the PKCS#11 library will send the encrypted data encryption key to Oracle Key Vault. Decryption is then performed within Oracle Key Vault and afterward, the plaintext data encryption key is returned to the PKCS#11 library. The Oracle Key Vault PKCS#11 library performs the encryption and decryption operation within Oracle Key Vault if the TDE master encryption key is restricted to leave Oracle Key Vault, or if it cannot be extracted from Oracle Key Vault.

To control whether symmetric encryption keys can be retrieved (extracted) from Oracle Key Vault, you can use the Oracle Key Vault management console, RESTful services utility commands, the C SDK APIs, and Java SDK APIs.

The following Oracle Key Vault RESTful services utility commands have been updated to accommodate this enhancement:

- `okv managed-object attribute get`
- `okv managed-object attribute get-all`
- `okv managed-object attribute list`
- `okv managed-object attribute modify`
- `okv managed-object key create`
- `okv managed-object key register`
- `okv managed-object object locate`

New APIs for the C SDK to manage extractable attribute:

- `okvAttrAddExtractable`
- `okvAttrAddNeverExtractable`
- `okvAttrGetExtractable`

- `okvAttrGetNeverExtractable`

New APIs for the Java SDK to manage extractable attribute:

- `okvAttrAddExtractable`
- `okvAttrAddNeverExtractable`
- `okvAttrGetExtractable`
- `okvAttrGetNeverExtractable`

**Related Topics**

- Managing the Extraction of Symmetric Keys from Oracle Key Vault
- Configuring the Global Default Extraction for New Symmetric Keys

## Ability to Restrict Oracle Key Vault Administrative Role Grants

Starting in Oracle Key Vault release 21.4, you can control whether a grantee of an Oracle Key Vault administrative role can grant the role to other Oracle Key Vault users.

In previous releases, the Oracle Key Vault administrative roles (System Administrator, Key Administrator, and Audit Manager) could be granted to another Oracle Key Vault user by any user who currently has the role. Starting with this release, when an administrator grants the role to another user, the administrator can restrict how the grantee user can in turn grant the role to other users. This enhancement improves overall user security and helps to adhere to good least privileges practices.

**Related Topics**

- About Administrative Roles in Oracle Key Vault

# Changes for Oracle Key Vault Release 21.2

Oracle Key Vault release 21.2 introduces new features that are related to installation and upgrade operations.

- Changes in the Oracle Key Vault Management Console
  In Oracle Key Vault release 21.2, the Oracle Key Vault management console user interface has had minor changes throughout.

## Changes in the Oracle Key Vault Management Console

In Oracle Key Vault release 21.2, the Oracle Key Vault management console user interface has had minor changes throughout.

These changes are the result of modified terms, updates to the current release, and enhancements for better usability. The overall interface has not had major changes.

# 1 Introduction to Installing and Upgrading Oracle Key Vault

Installing Oracle Key Vault entails ensuring that the environment meets the necessary requirements before you begin the installation and configuration.

## 1.1 About Oracle Key Vault Installation and Upgrade

Oracle Key Vault is a software appliance that is delivered as an ISO image.

The software appliance consists of a pre-configured operating system, an Oracle database, and the Oracle Key Vault application. You can install Oracle Key Vault on-premises on its own dedicated hardware, as a VM guest into your virtualization platform, or as a compute instance in your OCI tenancy (from the Oracle Cloud Marketplace at https://cloudmarketplace.oracle.com/marketplace/app/OracleKeyVault), and as a compute instance in Microsoft Azure and Amazon AWS.

In this release, you can follow the upgrade paths:

- Oracle Key Vault release 21.*x* (for example, 21.2) to the current release, Oracle Key Vault 21.11.

Before you begin the installation or upgrade process for Oracle Key Vault, check the *Oracle Key Vault Release Notes* for any known issues that you should be aware of.

> **Note:**
>
> Introducing changes to the Oracle Key Vault underlying platform is not recommended. Any changes made to the core platform could prevent the Oracle key Vault software appliance to function effectively. If you make any changes, you are at your own risk and Oracle cannot guarantee proper functioning of the software appliance.

## 1.2 Oracle Key Vault Deployment Options

You can deploy an Oracle Key Vault multi-master cluster on dedicated hardware or as VM guests.

- A standalone deployment is simplest to deploy. However, it does not provide continuous availability of the key service in the event an Oracle Key Vault server becomes unavailable. When you first install Oracle Key Vault, it is in a standalone environment. From there, you can configure Oracle Key Vault to be in a multi-master cluster configuration. Oracle recommends that you extend the OKV installation to a multi-master cluster with at least two nodes (one read/write pair).
- A multi-master cluster configuration allows for up to 16 nodes (an Oracle Key Vault server that has been converted to be a member of an Oracle Key Vault multi-master cluster) and is recommended for deployments requiring high availability. This is the recommended deployment for many reasons, such as data compatibility between nodes, fault tolerance, zero data loss, no passive machines in the system, scalability, and maintenance.
- Oracle Key Vault can be deployed on a physical server or a VM guest on a virtualized platform. Some capabilities of the virtualization platforms, such as (live) cloning of the Oracle Key Vault cluster nodes, or pausing of the cluster nodes, can lead to system instabilities and are therefore not supported.
- You can move an Oracle Key Vault server on a virtualized platform to a physical hardware using the below steps.
  In a multi-master cluster environment:
  - Install the Oracle Key Vault server (of the same version) on your preferred compatible hardware
  - Add the new Oracle Key Vault server to the cluster as the new node
  - Delete the existing cluster node that is on the virtualized platform.

  For the standalone deployment:
  - Use the backup to restore into a new standalone Oracle Key Vault server created on a physical hardware.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

## 1.3 Privileges Required for Performing Oracle Key Vault Installations and Upgrades

Oracle Key Vault requires users to have specific privileges to perform installations and upgrades.

You should have the following privileges:

- For a fresh installation: Privileges to log in to the Oracle Software Delivery Cloud portal to download the current Oracle Key Vault installation software.
- The `root` privilege for the server where you will perform the installation or upgrade
- For upgrade of an existing Oracle Key Vault deployment: Privileges to log in to the Oracle Support portal to download the current Oracle Key Vault upgrade software.

- For performing upgrades, in addition to the preceding privileges, you must have the Oracle Key Vault System Administrator role to disable and re-enable the upgraded Oracle Key Vault cluster node.

# 1.4 Oracle Key Vault Pre-Installation Checklist

The pre-installation checklist covers all the requirements to successfully install Key Vault.

**Table 1-1 Oracle Key Vault Pre-Installation Checklist**

| Item# | Check | Task |
|---|---|---|
| 1. [ x ] | New changes or issues that you should be aware of | See *Oracle Key Vault Release Notes* |
| 2. [ x ] | System requirements | Confirm that you have enough CPU, memory, and disk as described in System Requirements. |
| 3. [ x ] | Open all the required network ports in your firewall | For details on network ports, see Network Port Requirements. |
| 4. [ x ] | Supported endpoint platforms | See Supported Endpoint Platforms. |
| 5. [ x ] | Set the `COMPATIBLE` initialization parameter for the online master encryption key (previously TDE direct connect). | Guidance for setting this parameter for Oracle Database 12.1.0.2 or later is in Supported Endpoint Platforms. |
| 6. [ x ] | Get a fixed IP address, network mask, gateway, and NTP addresses from your network administrator. | You will need this information for Step in Installing the Oracle Key Vault Appliance Software |

# 2 Oracle Key Vault Installation Requirements

The Oracle Key Vault installation requirements cover areas such as CPU, memory, disk space, network interfaces, and supported endpoint platforms.

- System Requirements
  System requirements include CPU, memory, disk, network interface, and hardware compatibility.
- Network Port Requirements
  Network port requirements includes requirements for SSH/SCP, SNMP, HTTPS, listeners, KMIP, and TCP ports.
- Supported Endpoint Platforms
  Oracle Key Vault supports both UNIX and Windows endpoint platforms.
- Endpoint Database Requirements
  Administrators can use online master encryption keys and the Oracle Database `COMPATIBLE` initialization parameter to manage Oracle Database endpoints.

## 2.1 System Requirements

System requirements include CPU, memory, disk, network interface, and hardware compatibility.

The Oracle Key Vault installation removes existing software on a server.

You can install Oracle Key Vault on dedicated servers, as guests into your virtualization platform, or as a guest into a compute instance in your Oracle Cloud Infrastructure (OCI) tenancy, deployed in minutes from the Oracle Cloud Marketplace. Visit the following site:

https://cloudmarketplace.oracle.com/marketplace/app/OracleKeyVault

The minimum hardware requirements for deploying Oracle Key Vault on dedicated hardware or as VM guests are:

- **CPU**: Minimum: x86-64 16 cores. Recommended: 24-48 cores with cryptographic acceleration support (Intel AESNI).
- **Memory**: Minimum 16 GB of RAM. Recommended: 32–64 GB.

  > **Note:**
  >
  > – Oracle Key Vault does not support fiber channel storage with multipath for the boot disk.
  >
  > – You can add more RAM to the Oracle Key Vault systems, but you cannot reduce the RAM size lower than the original system configuration. System memory reduction is not supported in Oracle Key Vault.

- **Disk**: Minimum 2 TB. Recommended: 6 TB.

Both BIOS and UEFI boot mode. For a system with a disk size greater than 2 TB, Oracle Key Vault supports booting in UEFI mode only.

- **Network interface**: One or two network interfaces.
- **Hardware Compatibility**: Any Intel x86 64-bit hardware platform supported by Oracle Key Vault's embedded operating system. Oracle Key Vault uses Oracle Linux 8 with the Unbreakable Enterprise Kernel (UEK) version 6. For a list of compatible hardware, refer to Hardware Certification List for Oracle Linux and Oracle VM in the Related Topics. This list contains the minimum version of Oracle Linux certified with the selected hardware. All Oracle Linux updates starting with Oracle Linux release 8 as the minimum are also certified unless otherwise noted. Refer to Oracle Linux documentation for more information on the operating system platform.

  Oracle Key Vault supports both Legacy BIOS and UEFI boot modes. The support for UEFI boot mode allows the installation of Oracle Key Vault on servers that exclusively support UEFI, or when disks larger than 2 TB are used.

  > **Note:**
  >
  > – You can find the supported hardware from the hardware certification list for Oracle Linux and Oracle VM. Filter the results by selecting **All Operating Systems** and choosing **Oracle Linux 8**. However, be aware that Oracle Key Vault does not support the QLogic QL4* family of network cards.
  >
  > – For deployment with a large number of endpoints, the hardware requirement may need to scale to meet the workload.

- **RAID:** Oracle Key Vault does not support software RAID installations. If you require a RAID configuration, enable hardware RAID that presents one disk to Oracle Key Vault.
- **RESTful Services Utility**: If you plan to automate the onboarding of endpoints into Oracle Key Vault with the RESTful services, then ensure that the Java version on the future endpoint where the RESTful script will be executed is at release 1.7.0.21 or later.

  The version of Java that is included in Oracle Database 12.2.0.1 and later is supported by Oracle Key Vault. For these releases, set `JAVA_HOME` to `$ORACLE_HOME/jdk/jre` and add `JAVA_HOME/bin` to your `PATH`.

  For Oracle databases that are earlier than release 12.2.0.1, find the current Java installation as follows:

  ```
  $ namei /usr/bin/java | grep "l java"
  ```

  The output is similar to the following:

  ```
   l java -> /etc/alternatives/java
     l java -> /usr/java/jdk1.8.0_131/jre/bin/java
  ```

  In this example, set `JAVA_HOME=/usr/java/jdk1.8.0_131/jre` and then add `JAVA_HOME/bin` to `PATH: PATH=$PATH:$JAVA_HOME/bin`.

  OpenJDK is not supported.

- **Browser** : Oracle Key Vault supports English as the browser display language.

**Other Installation Considerations:**

- Oracle recommends that you do not install a third-party software on an Oracle Key Vault appliance. For more information, see Additional or Third-Party Software .
- Oracle does not recommend to decrease CPU and RAM allocated to Oracle Key Vault as it is a software appliance. For the multi-master cluster deployment, if you need to decrease RAM or CPU without database endpoint downtime, add the new nodes with the required system configuration to the existing multi-master cluster, and then delete the old nodes. For other deployments, take the backup of Oracle Key Vault server, rebuild the server with required system configuration and restore using the backup with the recommended system configuration.
- Additional or Third-Party Software
  Oracle does not support Oracle Key Vault installations with any third-party software.

**Related Topics**

- Hardware Certification List for Oracle Linux and Oracle VM

## 2.1.1 Additional or Third-Party Software

Oracle does not support Oracle Key Vault installations with any third-party software.

- Oracle recommends that you do not install a third-party software on an Oracle Key Vault appliance. Oracle Key Vault is a security appliance and installing a third-party software interferes with the security of Oracle Key Vault. Installing a third-party software may also affect the operational integrity of the Oracle Key Vault appliance. For example:
  - Installing third-party software may cause an upgrade to fail.
  - Reboot or upgrade of the Oracle Key Vault may override the configuration changes made by a third-party software.
  - Third party software may affect the configuration and operations of Oracle Key Vault in unexpected ways.

# 2.2 Network Port Requirements

Network port requirements includes requirements for SSH/SCP, SNMP, HTTPS, listeners, KMIP, and TCP ports.

Oracle Key Vault and its endpoints use a set of specific ports for communication. Network administrators must ensure that these ports are open.

The following table lists the required network ports for Oracle Key Vault:

**Table 2-1 Ports Required for Oracle Key Vault**

| Port Number | Protocol | Port Type | Descriptions |
|---|---|---|---|
| 22 | SSH/SCP port | TCP | Used by Oracle Key Vault administrators and support personnel to remotely administer Oracle Key Vault. **Note**: You can change the default value of the port. After you change the default value on one node, apply the new port number to all the nodes of the cluster one-by-one. |

**Table 2-1 (Cont.) Ports Required for Oracle Key Vault**

| Port Number | Protocol | Port Type | Descriptions |
|---|---|---|---|
| `161` | SNMP port | UDP | Used by monitoring software to poll Oracle Key Vault for system information. |
| `443` | HTTPS port | TCP | Used by web clients such as browsers and RESTful Administrative commands to communicate with Oracle Key Vault. |
| `5695` | HTTPS port | TCP | Used by RESTful Key Management commands to communicate with Oracle Key Vault. |
| `1522` | Database TCPS listener ports | TCP | In a cluster configuration, listener ports used to communicate between read/write peer nodes.<br>**Note**: You can change the default value of this port. Oracle Key Vault automatically applies the new port number to all the cluster nodes. |
| `7443` | HTTPS port | TCP | The listener port used in a primary-standby configuration to run operating system commands. This port is also used when you add a new node to a cluster. |
| `5696` | KMIP port | TCP | Used by Oracle Key Vault endpoints and third party KMIP clients to communicate with the Oracle Key Vault KMIP server. |
| `7093` | TCP port | TCP | Used by Oracle GoldenGate for transmitting data in a multi-master cluster configuration. |

If you are installing Oracle Key Vault in an OCI Marketplace instance or if you are creating a hybrid multi-master cluster between on-premises and OCI nodes, then consider the following network configuration:

1. Add rules to open the ports listed in the table.
2. Add the following ingress rules:
   - ICMP Type 3, Code 4 (destination unreachable, fragmentation required and `Don't Fragment` flag is set).
   - ICMP Type 8, Code 0 (echo request, destination network is unreachable).
3. If you are using a site-to-site VPN or fastConnect, then ensure that your router allows traffic between the nodes of the multi-master cluster:
   - Add rules to open the ports.
   - In case of highly secured routers, add URL exceptions for your on-premises subnet at layers 3, 4, and 7.
   - Ensure that no packets are interpreted as threats by your routers.

**Note:**

Oracle Key Vault allows the configuration of network ports only for SSH/SCP (default port 22) and Database TCPS listener (default port 1522).

## 2.3 Supported Endpoint Platforms

Oracle Key Vault supports both UNIX and Windows endpoint platforms.

Oracle supports 64-bit Linux endpoints, and only 64-bit endpoints are supported for Oracle databases that use the online master encryption key. The operating systems on which the endpoint runs must be compatible with Transport Layer Security (TLS) 1.2, either directly or with appropriate patches.

The supported endpoint platforms in this release are as follows:

- Oracle Linux (6, 7, 8, and 9)
- ARM64: Oracle Linux (7 and 8)
- Oracle Solaris x86 (10 and 11)
- Oracle Solaris SPARC (10 and 11)
- SUSE Linux Enterprise Server 15
- Red Hat Enterprise Linux 6, 7, and 8
- IBM AIX (7.1, 7.2, and 7.3)
- IBM zLinux (Red Hat Enterprise Server 7, 8, 9; SUSE Linux Enterprise Server 12, 15)
- HP-UX (IA) (11.31)
- Windows Server 2016, and 2019

## 2.4 Endpoint Database Requirements

Administrators can use online master encryption keys and the Oracle Database `COMPATIBLE` initialization parameter to manage Oracle Database endpoints.

Administrators can use the online master encryption key to manage TDE master encryption keys for endpoints that are Oracle Database 12.1.0.2 or later. Administrators who want to use Oracle Key Vault for wallet management only or who are migrating existing wallets deployments to Oracle Key Vault can use the `okvutil upload` command to upload Oracle wallets to Oracle Key Vault.

Administrators who manage endpoints that are Oracle Database may need to set the `COMPATIBLE` initialization parameter.

For an endpoint that is Oracle Database release 12.1 or later, set the `COMPATIBLE` initialization parameter to `12.1.0.0` or later. A `COMPATIBLE` setting of 12.1.0.0 or later enables Transparent Data Encryption to work with Oracle Key Vault. For example:

```
SQL> ALTER SYSTEM SET COMPATIBLE = '12.1.0.0' SCOPE=SPFILE;
```

This applies to an Oracle Database endpoint that use the online master encryption key to manage TDE master encryption keys. This compatibility mode setting is not required for Oracle wallet upload or download operations.

Also note that after setting the `COMPATIBLE` parameter to `12.1.0.0`, you cannot set it to a lower value such as `10.2`. After you set the `COMPATIBLE` parameter, you must restart the database.

For Microsoft Windows endpoints, Oracle Key Vault supports the latest available database release versions at the time of the Oracle Key Vault release, including any associated Manufacturing Execution Systems (MES) libraries that may have been upgraded.

# 3 Downloading Oracle Key Vault Software

To install or upgrade the Oracle Key Vault software download the binaries as described in the chapter.

- Downloading the Oracle Key Vault Software for Fresh Installation
  You can use the steps for fresh installation of Oracle Key Vault.
- Downloading the Oracle Key Vault Software for Upgrade
  You can use the steps for downloading and upgrading Oracle Key Vault.

## 3.1 Downloading the Oracle Key Vault Software for Fresh Installation

You can use the steps for fresh installation of Oracle Key Vault.

For a fresh installation, you can download the Oracle Key Vault appliance software from Software Delivery Cloud. You cannot use this package to upgrade Oracle Key Vault. For an upgrade, you can download the Oracle Key Vault upgrade software from the My Oracle Support website.

1. Use a web browser to access the Oracle Software Delivery Cloud portal:

   https://edelivery.oracle.com

2. Click **Sign In**, and if prompted, enter your **User ID** and **Password**.
3. In the **All Categories** menu, select **Release**. In the next field, enter **Oracle Key Vault** and then click **Search**.
4. From the list that is displayed, select **Oracle Key Vault 21.11.0.0.0** or click the **+** icon next to the **Oracle Key Vault 21.11.0.0.0**.

   The download is added to your cart. (To check the cart contents, click **View Items** in the upper right of the screen.)

5. Click **Continue**.
6. On the next page, verify the details of the installation package, and then click **Continue.**
7. In the **Oracle Standard Terms and Restrictions** page, select **I reviewed and accept the Oracle License Agreement.**, and click **Continue**.

   The **Oracle Software Delivery Cloud** page appears, which lists the `V`*`part_number`*`.zip` Oracle Key Vault archive file in **Download** window pane.

8. Click **Download** and select a location to save the `V`*`part_number`*`.zip` archive file.
9. Click **Save**.

   The size of the ISO file is approximately 20 GB, and will take time to download, depending on the network speed. The estimated download time and speed are displayed in the **File Download** dialog box.

10. Unzip the downloaded `V`*`part_number`*`.zip` archive file.

11. Transfer the `Vpart_number.iso` file by using one of the following methods:
    - Burn the `.iso` image onto a bootable DVD.
    - Copy the `.iso` image onto a bootable USB stick.
    - Mount the `.iso` image with your virtualization software, in order to run Oracle Key Vault as a virtual machine, booting from the `.iso` image.

You can now install Oracle Key Vault on the server.

## 3.2 Downloading the Oracle Key Vault Software for Upgrade

You can use the steps for downloading and upgrading Oracle Key Vault.

1. Click the link: https://updates.oracle.com/download/37484096.html

   Alternatively, you can use the steps below to search for a patch:

   a. Go to https://support.oracle.com sign in, and click on the Patches & Updates tab.

   b. Use the **Patch Search** box to find the patch.

   c. Select the **Search** tab.

   d. Ensure that Number/Name or Bug Number (Simple) is selected on the left.

   e. For the top search drop-down list, select **Patch Name** or Number and enter `37484096` in the search box.

   f. Click **Search**.

   g. In the **Patch Name** column on the search results page, click the number for the latest Bundle Patch **ORACLE KEY VAULT 21.11.0.0.0 RELEASE UPDATE** (Patchset).
   A corresponding patch page appears

   h. Click the **View ReadMe** button to open the readme file in a browser.

   i. Click the **Download** button to open the **File Download** page.

   j. Click the **Download File** Metadata link on the bottom left, and then the **Download** button to download the XML metadata file.
   You can use the data in this file to verify the patch files once they are downloaded.

   k. Click the **Return to File Window** link to go back to the **File Download** page.

   l. Click the following `.zip` file to download them on your system:

   ```
   p37484096_2111000_Linux-x86-64.zip
   ```

2. Unzip the downloaded `.zip` file to access the upgrade software.

   After unzipping the downloaded zip file to your destination directory, you will see the following file:

   - The following ISO file includes all the files that are required to perform the upgrade:

     ```
     okv-upgrade-21.11.0.0.0.iso
     ```

   - Refer to, `Readme_OKV_2111.html`.

> **Note:**
>
> Oracle Key Vault should be installed by `iso` package only and not `rpm` package due to many dependencies.

3. You can use the XML metadata file to verify the checksum of the downloaded `.iso` file.
4. On your Linux machine, generate a `sha256` checksum for the `ISO` file.

   ```
   sha256sum okv-upgrade-21.11.0.0.0.iso
   ```

   Ensure that the file checksum matches the following value:

   ```
   e312242f9b7064dd03a0d7d3fc2507c1810eccff29f776ea8389dd37f3f7048c  okv-
   upgrade-21.11.0.0.0.iso
   ```

# 4 Installing Oracle Key Vault

You must download the Oracle Key Vault application software, and then you can perform the installation.

- Downloading the Oracle Key Vault Appliance Software
  You can download executable files for both a fresh Oracle Key Vault installation or an upgrade.
- Installing the Oracle Key Vault Appliance Software
  The Oracle Key Vault installation process installs all the required software components onto a dedicated server or virtual machine.
- Performing Post-Installation Tasks
  After you install Oracle Key Vault, you must complete a set of post-installation tasks.

## 4.1 Downloading the Oracle Key Vault Appliance Software

You can download executable files for both a fresh Oracle Key Vault installation or an upgrade.

For a fresh installation, you can download the Oracle Key Vault appliance software from Software Delivery Cloud. You cannot use this package to upgrade Oracle Key Vault. For an upgrade, you can download the Oracle Key Vault upgrade software from the My Oracle Support website.

1. Use a web browser to access the Oracle Software Delivery Cloud portal:

   https://edelivery.oracle.com

2. Click **Sign In**, and if prompted, enter your **User ID** and **Password**.
3. In the **All Categories** menu, select **Release**. In the next field, enter **Oracle Key Vault** and then click **Search**.
4. From the list that is displayed, select **Oracle Key Vault 21.11.0.0.0** or click the **+Add to Cart** button next to the **Oracle Key Vault 21.11.0.0.0**.

   The download is added to your cart. (To check the cart contents, click **View Cart** in the upper right of the screen.)
5. Click **Checkout**.
6. On the next page, verify the details of the installation package, and then click **Continue**.
7. In the **Oracle Standard Terms and Restrictions** page, select **I have reviewed and accept the terms of the Commercial License, Special Programs License, and/or Trial License**, and click **Continue**.

   The download page appears, which lists the `V`*`part_number`*`.zip` Oracle Key Vault archive file.
8. Click **Download** and select a location to save the `V`*`part_number`*`.zip` archive file.
9. Click **Save**.

The size of the ISO file is approximately 20 GB, and will take time to download, depending on the network speed. The estimated download time and speed are displayed in the **File Download** dialog box.

10. Unzip the downloaded `Vpart_number.zip` archive file.
11. Transfer the `Vpart_number.iso` file by using one of the following methods:
    - Burn the `.iso` image onto a bootable DVD.
    - Copy the `.iso` image onto a bootable USB stick.
    - Mount the `.iso` image with your virtualization software, in order to run Oracle Key Vault as a virtual machine, booting from the `.iso` image.

You now can install Oracle Key Vault on the server.

**Related Topics**

- Downloading the Oracle Key Vault Software for Fresh Installation
  You can use the steps for fresh installation of Oracle Key Vault.

## 4.2 Installing the Oracle Key Vault Appliance Software

The Oracle Key Vault installation process installs all the required software components onto a dedicated server or virtual machine.

The installation process may take from 30 minutes or longer to complete, depending on the server resources where you are installing Oracle Key Vault.
If you are installing Oracle Key Vault on VMware, then set the VMX configuration parameter `disk.EnableUUID` to `TRUE`. In addition, you must set your virtual machine to use EFI boot. In some versions of VMware this is done by selecting the **VM Options** tab, then expanding **Boot Options**, and then setting the firmware to EFI. You must disable secure boot. Without this setting, the Oracle Key Vault installation on VMware will fail.

> **Caution:**
>
> The Oracle Key Vault installation wipes the server, repartitions the disk, and installs a hardened Oracle Linux 8. The installation erases existing software and data on the server.

Ensure that you have met the following prerequisites.

- Ensure that the server meets the recommended requirements.
- Request a fixed IP address, network mask, and gateway address from your network administrator. You will need this information to configure the network.

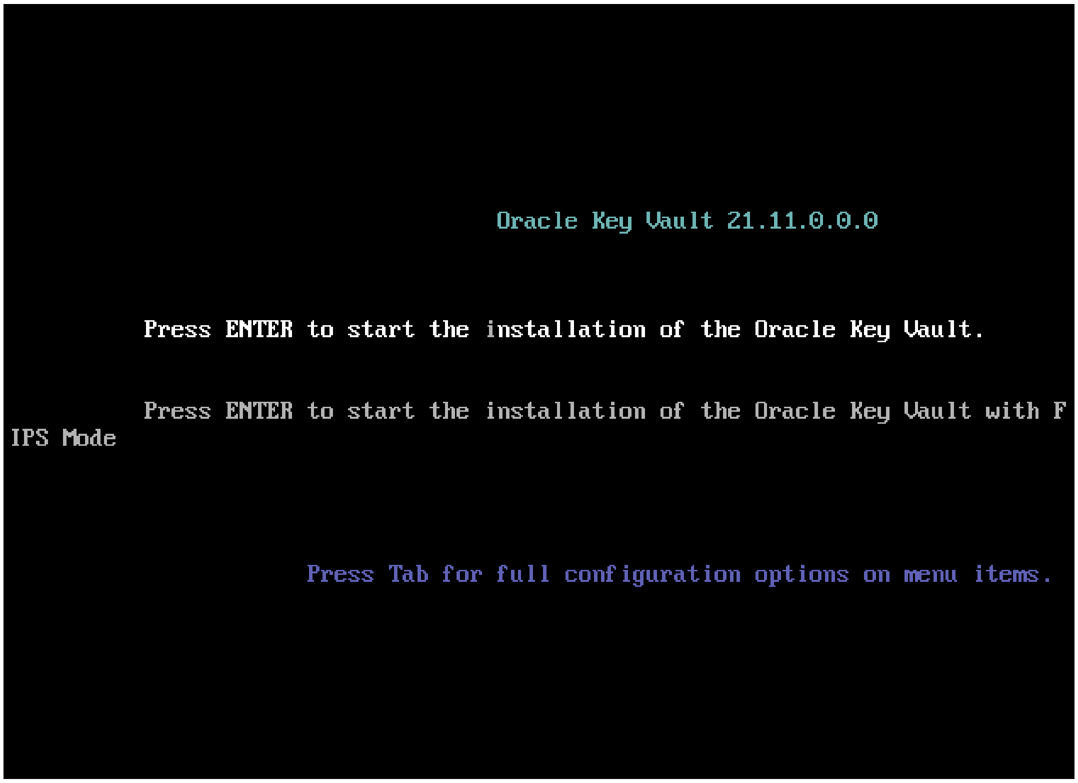
To install the Oracle Key Vault appliance:

1. Make the `.iso` image available to the computer where you want to install it, and then restart the computer.

   The `.iso` image can be made available in any of these ways:

   - Burned onto a bootable DVD
   - Copied onto a bootable USB stick
   - Mounted with your site's virtualization software

You may need to change the boot order of your server to boot from the USB-stick or the DVD. The initialization screen appears, showing the following options:



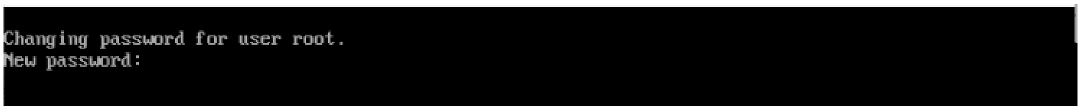
```
                                   Oracle Key Vault 21.11.0.0.0


          Press ENTER to start the installation of the Oracle Key Vault.


          Press ENTER to start the installation of the Oracle Key Vault with F
IPS Mode




                      Press Tab for full configuration options on menu items.
```

2. Using the up and down arrow keys, select the desired installation option or the option to perform a memory test, and then press **Enter**.

   Choosing the first option, **Press Enter to start the installation of Oracle Key Vault**, does not enable FIPS mode on the system.

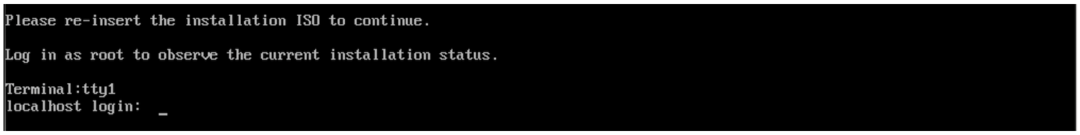
   Choosing the second option, **Press Enter to install the Oracle Key Vault with FIPS mode enabled**, automatically enables FIPS mode on the system.

   The installation begins, and after several minutes, you will be asked to set the `root` user password (with a second time to confirm it). It is important to store the `root` user password securely. You will need it later to authenticate yourself at the Oracle Key Vault management console and complete the post-installation tasks.



```
Changing password for user root.
New password:
```

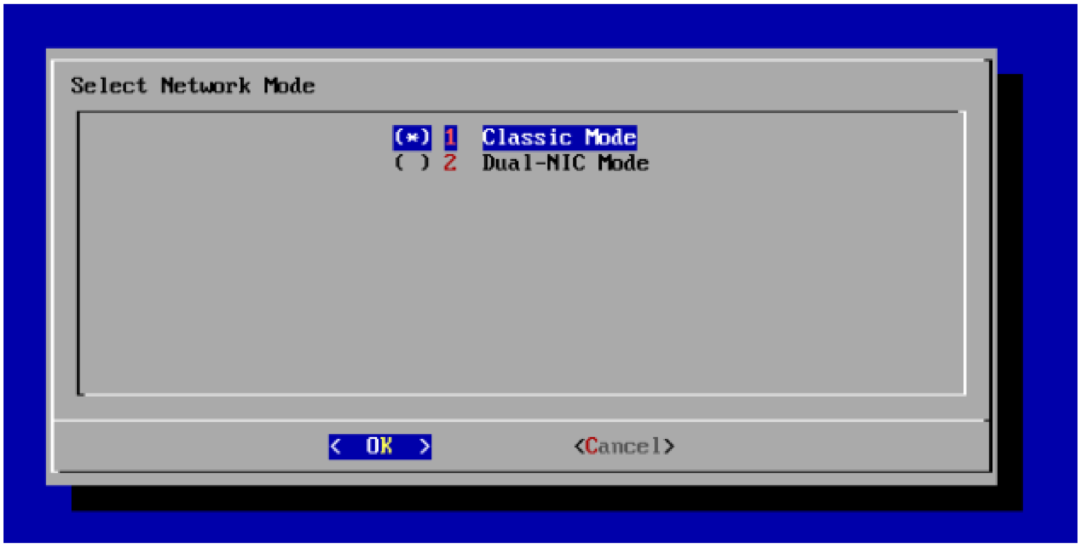
3. After you set the `root` user password, when prompted, log in as the `root` to observe the installation status. At the following prompt, enter `root` , press **Enter**, enter the `root` user password, and then press **Enter** again.



```
Please re-insert the installation ISO to continue.

Log in as root to observe the current installation status.

Terminal:tty1
localhost login:  _
```

4. When prompted, re-insert the ISO disk.

After you re-insert the ISO disk, the Select Network Mode window appears after a couple of minutes.



5. For the network mode, if you want Classic mode, then follow these steps:

   Classic mode, used in previous releases of Oracle Key Vault, allows one network interface to be used. If you later decide to switch to dual NIC mode, then you can do so, but only if you are using a standalone configuration. In a multi-master cluster configuration, to switch to dual NIC mode for a cluster node, you must first delete the node from the cluster, configure the node to use dual NIC mode, and then re-induct the node back into the cluster.

   a. Select **1** to choose Classic mode and then select **OK**.
   b. In the Select default network interface screen, select from the available options, and then select **OK**.
   c. In the Network settings screen, enter the **IP address**, **Network mask**, and **Gateway** settings for the default network interface. The network administrator for your site can provide this information.
   d. Select **OK**.

6. If you want the dual NIC network mode, then follow these steps:

   Dual NIC mode enables you to configure Oracle Key Vault to use two network interfaces, or ethernet ports. It is useful as a guard against physical or software failures and adds redundancy to the network layer. Select the dual NIC mode if there is a greater need for operational continuity and to avoid eviction from the cluster due to prolonged unavailability of the network. Dual NIC mode helps to prevent situations where a node may lose connectivity and risk missing changes that have been made to data in the cluster.

   a. Select **2** to select Dual-NIC mode and then select **OK**.
   b. In the Select Bond Mode screen, select from the bond mode choices for the two network interfaces that you plan to use, and then select **OK**.
      - **Round Robin** configures the network interfaces such that network packets are transmitted and received sequentially from the first available interface through the last. This bonding mode is the default. This mode provides fault tolerance and load balancing and requires the links to be connected to a network switch with EtherChannel support.
      - **Active-Backup** configures the network interfaces as active and backup. Only one interface in the bond is active. A different interface becomes active if, and only if,

the active interface fails. The network communication happens over the active interface. This mode provides fault tolerance and does not require any switch support.

- **802.3ad** creates aggregation groups that share the same speed and duplex settings. Network packets are transmitted and received on all interfaces. This mode provides fault tolerance and load balancing and requires a switch that supports IEEE 802.3ad dynamic link aggregation.

c. In the Select two network interfaces screen, select the two network interfaces that you want, and then select **OK**.

d. In the Network settings screen, enter the **IP address**, **Network mask**, **Gateway**, and **Hostname** settings for the default network interface. The network administrator for your site can provide this information. For the host name, use only lowercase characters. The host name can be the fully qualified host name or the short host name.

e. Select **OK**.

7. The installer installs and configures the operating system, database, and Oracle Key Vault on the server to make it a self-contained hardened appliance. The installation and configuration process can take an hour or longer.

8. When the installation is complete, on the Oracle Key Vault terminal console, log in as root, and set the password of the `support`.

```
passwd support
New password:
Retype new password
passwd: All authentication tokens updated successfully.
```

Once SSH has been enabled, the support user is the only user who can **ssh** into Oracle Key Vault, .

SSH should be disabled, unless upgrade patches are applied, or directed by Oracle Support.

**Note:**

- Oracle does not restrict customer to deploy Oracle Key Vault in virtual environment if the virtual environment reflects an Oracle Key Vault physical server. Some of the supported hypervisor products are Oracle VirtualBox, Hyper-V, VMware, and KVM.
- For installing Oracle Key Vault on Hyper-V, see Hyper-V Installation on Windows.
- Oracle key Vault does not support silent mode installation.

- Requirements for root and support User Passwords
  Ensure that you meet these requirements for `root` and `support` user passwords.

**Related Topics**

- Requirements For Root And Support User Passwords

### 4.2.1 Requirements for root and support User Passwords

Ensure that you meet these requirements for `root` and `support` user passwords.

- The password must have at least 15 characters.
- The password must contain at least one uppercase letter, one lowercase letter, one digit, and one special character.
- The same character cannot repeat consecutively more than 3 times in the password.
- Characters from the same class cannot repeat consecutively more than 4 times in the password. For example, more than 4 lowercase letters in a row.
- The new password must have at least 8 characters that are different from the old password.

## 4.3 Performing Post-Installation Tasks

After you install Oracle Key Vault, you must complete a set of post-installation tasks.

These tasks include configuring the administrative user accounts and their one-time passwords, the recovery passphrase, as well as DNS and NTP settings.

1. Use a web browser to connect to the Oracle Key Vault server.

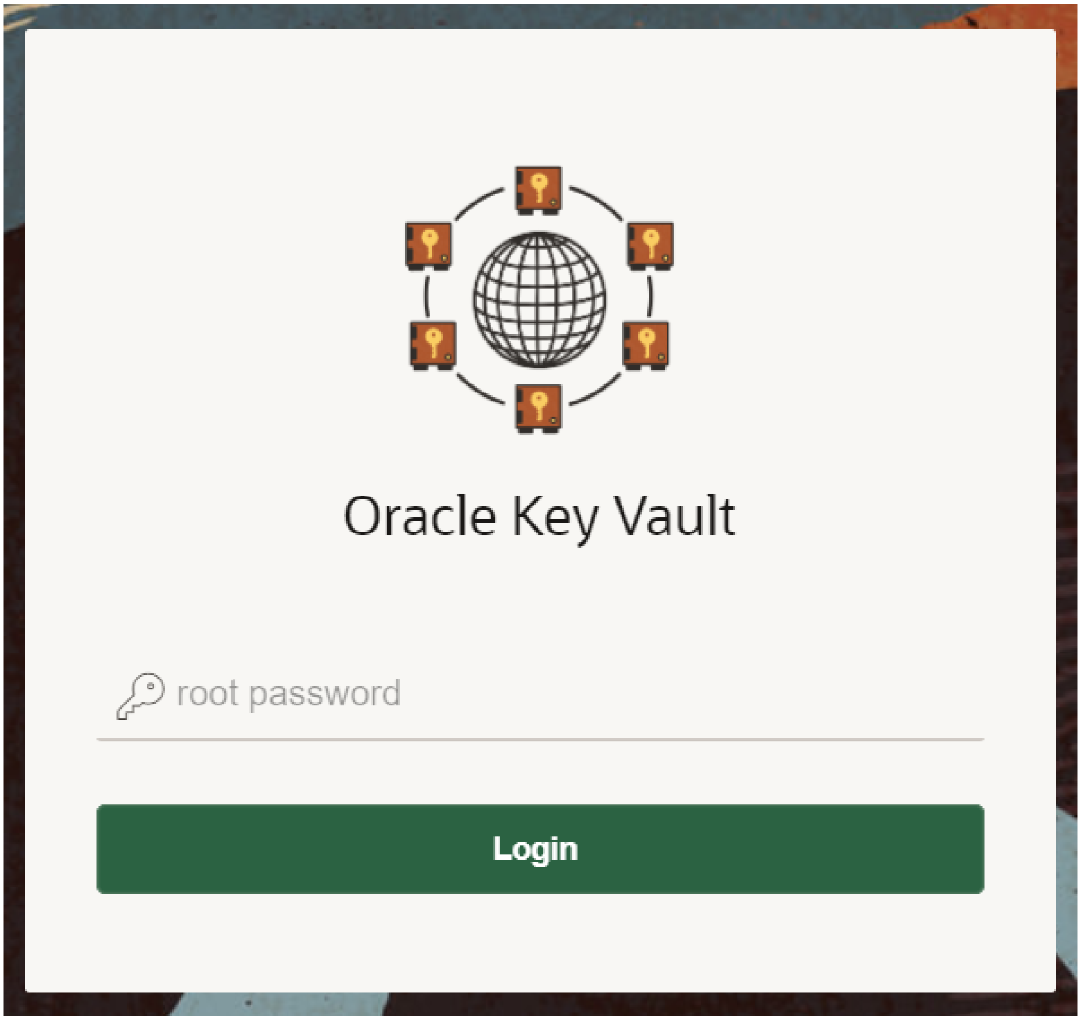
   For example, to connect in to an Oracle Key Vault server whose IP address is 192.0.2.254, enter the following in the address bar:

   ```
   https://192.0.2.254
   ```

2. If the web browser displays a security warning message stating that you are connecting to a website with an untrusted or self-signed security certificate, accept the security warning message and proceed to connect to the Oracle Key Vault server.

   This message is only temporary. When you configure third-party certificates, this message will no longer appear. After completing the post-installation tasks, you can upload a custom certificate or certificate chain that is trusted by the browser, so that you can connect to the Oracle Key Vault server without encountering the security warning message. For more information about uploading a custom certificate, see *Oracle Key Vault Administrator's Guide* .

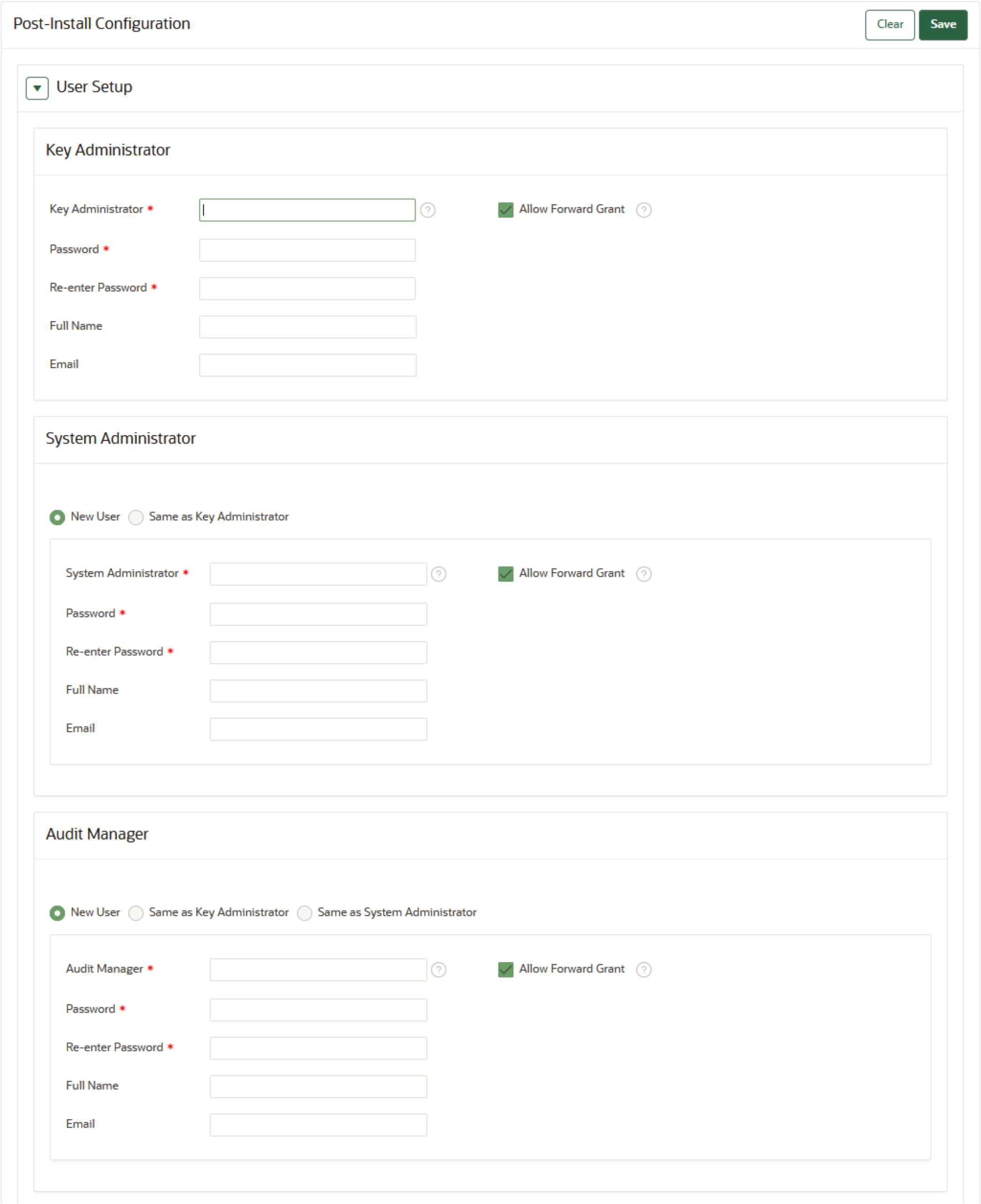
3. In the `root` password screen, enter the `root` password.



The `root` password screen is displayed when you connect to the Oracle Key Vault server for the first time, in order to complete the post-installation tasks. After you complete the post-installation tasks, the Oracle Key Vault login screen is displayed when you access the Oracle Key Vault management console through the web browser.

After you log in with the `root` user password, the Post-Install Configuration screen is displayed.

4. In the **User Setup** pane, create three administrative user accounts for the Key Administrator, System Administrator, and Audit Manager.



Post-Install Configuration

▾ User Setup

Key Administrator

Key Administrator * | ☑ Allow Forward Grant
Password *
Re-enter Password *
Full Name
Email

System Administrator

● New User ○ Same as Key Administrator

System Administrator * | ☑ Allow Forward Grant
Password *
Re-enter Password *
Full Name
Email

Audit Manager

● New User ○ Same as Key Administrator ○ Same as System Administrator

Audit Manager * | ☑ Allow Forward Grant
Password *
Re-enter Password *
Full Name
Email

- Enter the user name and password, the full name (optional), and email (optional) for each administrative user account.

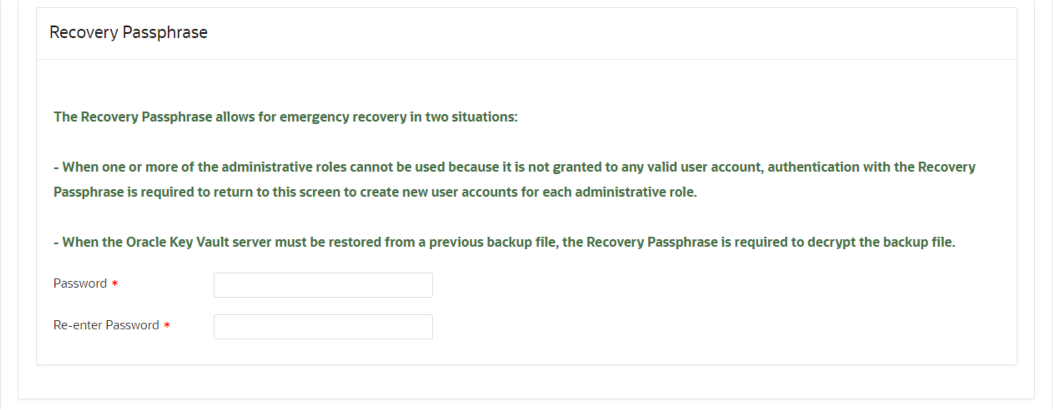
  Note that the passwords are one-time use passwords which must be changed when the user logs in the first time.

- Ideally, create a different user account for each of these administrative roles for a strict separation of duties, or combine roles as necessary.

- Ensure that passwords are between 8 and 30 characters in length and contain at least one of each of the following: an uppercase letter, a lowercase letter, a number, and a special character from the set: period (`.`), comma (`,`), underscore (_), plus sign (+), colon (`:`), exclamation mark (`!`). In addition, the passphrase may include a space character ( ) provided it is not used as the first or last character of the passphrase.

- If you want the user to be able to grant their role to other users, then select the **Allow Forward Grant** check box.

5. In the **Recovery Passphrase** section, create the recovery password.



Recovery Passphrase

The Recovery Passphrase allows for emergency recovery in two situations:

- When one or more of the administrative roles cannot be used because it is not granted to any valid user account, authentication with the Recovery Passphrase is required to return to this screen to create new user accounts for each administrative role.

- When the Oracle Key Vault server must be restored from a previous backup file, the Recovery Passphrase is required to decrypt the backup file.

Password *

Re-enter Password *

The recovery passphrase must be between 8 and 30 characters in length and may only contain uppercase letters, lowercase letters, numbers, and special characters from the set: period (`.`), comma (`,`), underscore (`_`), plus sign (`+`), colon (`:`), exclamation mark (`!`). Recovery passphrase must contain at least one of each of the following: an uppercase letter, a lowercase letter, a number, and a special character from the allowed set of special characters.

For greater security, Oracle recommends that you make the recovery passphrase longer and more complex. Because this is a critical password, you must properly secure and safeguard the recovery password. The recovery password is required in the following scenarios:

- In an emergency, when there are no administrative users available to access Oracle Key Vault
- To restore Oracle Key Vault data from a backup
- To reset the recovery password
- Induct a new node into a multi-master cluster
- To configure a hardware security module (HSM)

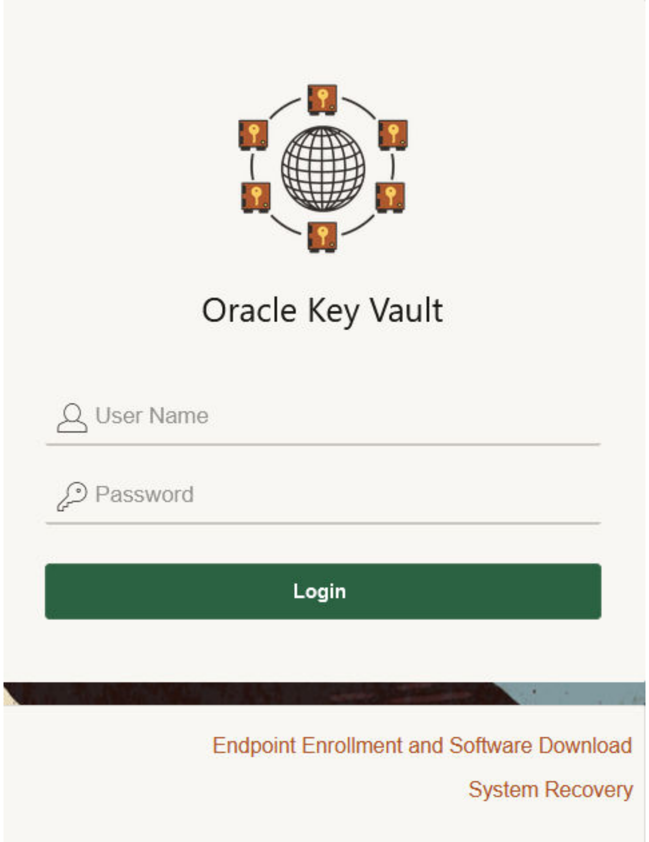
> **Caution:**
>
> **It is important to establish a secure process for the storage and retrieval of the recovery passphrase, including older recovery passphrases. The only way to recover from a lost recovery passphrase is to re-install Key Vault. Note also that the `root` and `support` user passwords expire after 365 days. If you log in to the Oracle Key Vault management console within 120 days before the expiration, you will see an alert that the password expires in *remaining_number_of_days* days. If you log in after the expiration date, then you can use the old password only to log in and change the password to a new one.**

6. Set the DNS IP addresses.

   Oracle recommends that you set this IP address at this stage. Your network administrator can supply this address. You can only set the NTP server names after you save the changes on this page, including the DNS addresses.

7. Click **Save** in the upper right corner of the **Post-Install Configuration** screen.

   The Oracle Key Vault management console login screen is displayed:



8. Configure the system time.

   Oracle recommends that when you configure the system time, to configure all three NTP servers, using their host names. When you do so, ensure that you select the **Synchronize Periodically** option.

9. Configure system alerts, and if necessary, email so that the appropriate users can receive these alerts.

   Oracle recommends that users who receive these alerts take action on them as soon as possible. For example, critical alerts, such as the Oracle Key Vault server certificate expiration alert, can result in downtime if they are not addressed in a timely fashion.

You can now log in to the Oracle Key Vault management console with the credentials of any of the user accounts that were created during the post-installation process.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

# 5 Cloning Oracle Key Vault Installation

Perform the installation procedure for Oracle Key Vault before proceeding for VM cloning.

## 5.1 Cloning Oracle Key Vault Virtual Machines

Oracle Key Vault Vitual Machines (VM) can be cloned to reduce the installation time on each VM. You create a base VM to clone it to any number of VM's.

Create a base VM by performing the installation procedure for Oracle Key Vault following Installing the Oracle Key Vault Appliance Software, but do not go through the post-install steps.

1. Install Oracle Key Vault as a **base VM**. The **base VM** refers to the VM that is used for cloning other VMs.

   > **Note:**
   >
   > This process takes about 30 minutes or longer to get completed.

2. Log into terminal console of the **base VM** as a root user.
3. Run the script to set up the configuration to make sure that all system-specific configuration is regenerated on the next boot.

   ```
   # /usr/local/okv/bin/okv_enable_vm_clone
   ```

   The script marks the **base VM** as the **clonable** and shuts down the system.

   Note: This script sets up the configuration to make sure that all system-specific configuration is regenerated on the next boot. The system will be made **clonable**, and once the configuration completes the system automatically shuts down.
4. Start cloning the VM after the base VM shuts down.
5. Access the terminal console of the cloned VM after the cloned VM is booted for the first time.
   a. Set the password for the root user.
   b. Configure the network (IP Address, gateway, network mask and host name).
6. Oracle Key Vault begins the process of generating system-specific application configuration.
7. Once completed the system gets rebooted automatically to complete the process.

   The cloning is now marked as **complete**.

> **Note:**
>
> If you access the Oracle Key Vault management console of the clone while the cloning process is in progress, the post-install tasks cannot be completed. Oracle Key Vault displays a message to log into the terminal console and follow directions to complete the post-clone configuration.

8. Complete the post-installation steps on the clone VM, see Performing Post-Installation Tasks.

## 5.2 Guidelines for Cloning on Virtual Machines

Consider these Oracle Key Vault guidelines for managing Cloning on Virtual Machines.

- You can clone an Oracle Key Vault VM only if you have NOT completed the post-install tasks.
- The **base VM** serves as a template for cloning further VMs.
- Do not boot the base VM once you have marked the base VM as clonable and shut it down.
- In case, you do boot the base VM, it can no longer be used for cloning.
- It is recommended not to use the system again for cloning.
- When the cloned VM starts, you can change its IP address and root password (both are inherited from the base VM), and complete the post-install steps.

# 6 Upgrading a Standalone Oracle Key Vault Server

This upgrade includes the Oracle Key Vault server software and utilities that control the associated endpoint software

## 6.1 About Upgrading a Standalone Oracle Key Vault Server

To benefit from new features and security enhancements, Oracle recommends that you upgrade Oracle Key Vault server to the latest release.

You must upgrade in the following order: first perform a full backup of Oracle Key Vault, upgrade the Oracle Key Vault server, upgrade the endpoint software, and lastly, perform another full backup of the upgraded server. Note that upgrading requires a restart of the Oracle Key Vault server.

Oracle recommends using a multi-master cluster deployment for production use. During upgrade of a multi-master cluster, there is no downtime of databases or business applications. A two-node cluster provides read-only availability, and four or more node clusters provide continuous read-write availability. You can enable the persistent cache feature to enable endpoints to continue operation during the upgrade process.

When you upgrade the Oracle Key Vault server software, to access the latest enhancements, also upgrade the endpoint software. While endpoint software from the previous Oracle Key Vault release will continue to function with the upgraded Oracle Key Vault server, new endpoint functionality may not work.

Before you begin the upgrade, refer to Oracle Key Vault Release Notes for additional information about performing upgrades.

**Related Topics**

- *Oracle Key Vault Release Notes*
- *Oracle Key Vault Administrator's Guide*

## 6.2 Step 1: Back Up the Server Before You Upgrade

Before you upgrade the Oracle Key Vault server, perform a one-time backup to a remote destination so that you can recover data in case the upgrade fails.

> **Caution:**
>
> Do not bypass this step. Back up the server before you perform the upgrade so that your data is safe and recoverable.

## 6.3 Step 2: Perform Pre-Upgrade Tasks for the Standalone Oracle Key Vault

To ensure a smooth upgrade to Oracle Key Vault, you should prepare the server you are upgrading.

1. In the server where Oracle Key Vault is installed, log in as user `support`, and then switch to the `root` user.
2. Ensure that the server meets the minimum disk space requirements for an upgrade. For example, 6 GB of free space in the `/usr/local/dbfw/tmp` directory. See the Oracle Key Vault Readme for this release to determine the disk space requirements for the upgrade.
3. Ensure that you disable diagnostics and clean up disk space in `/usr/local/dbfw/tmp` before you upgrade by performing the following steps:

   If the Oracle Key Vault system being upgraded is from release 21.6 or later, log in to the Oracle Key Vault management console as a user with the System Administrator role, and navigate to the **System** tab, and then click the **Diagnostics** button.

If the Diagnostics Package Files pane is displayed, then click **Clear** to disable diagnostics. Note that the **Diagnostics Package Files** pane will be displayed only if the diagnostics bundle was previously generated, and the files were not cleared.

If the Diagnostics Package Files pane is not displayed, or if the diagnostics bundle was previously generated using the **dbfw-diagnostics-package.rb** utility, then log in to the Oracle Key Vault system and run the following commands to disable diagnostics and clean up disk space in `/usr/local/dbfw/tmp`:

a. SSH into the Oracle Key Vault system as user `support`, then switch to user `root`:

```
ssh support@<OKV_IP_Address>
su - root
```

b. Delete the generated diagnostics zip file and remove the package using the following commands:

```
/usr/local/dbfw/bin/priv/dbfw-diagnostics-package.rb --clean
/usr/local/dbfw/bin/priv/dbfw-diagnostics-package.rb --remove
```

4. Check the boot partition size. If any of the nodes in question have a boot partition that is less than 500 MB, then you cannot upgrade that system to the new release. You can check this size as follows:

   a. Mount the `/boot` partition.

   ```
   # mount /boot
   ```

   b. Check the `Size` column given by the following command:

   ```
   # df -h /boot
   ```

   c. Unmount the `/boot` partition:

   ```
   # umount /boot
   ```

   If the boot partition given by this command shows less than 488 MB, then you cannot upgrade to the current release. Oracle recommends that you restore a backup of the current configuration to a freshly installed system of the same release as the current system, and upgrade that to the new release instead.

5. If Oracle Key Vault is using the BIOS boot mode, then ensure that the disk size is not greater than 2 TB. If this is the case, then you cannot upgrade to the current release. Oracle recommends that you restore a backup of the current configuration onto a system with a disk that is less than 2 TB in size, and upgrade that to the new release instead.

6. If you need to increase available disk space, then remove the temporary jar files located in `/usr/local/okv/ssl`. *Be careful in doing so.* If you accidentally delete any files other than the jar files in `/usr/local/okv/ssl`, then the Oracle Key Vault server becomes non-functional.

7. Increase your disk space by extending the `vg_root` size:

   You must increase the disk space by extending `vg_root` before you perform the upgrade.

8. Ensure that no full or incremental backup jobs are running. Delete all scheduled full or incremental backup jobs before the upgrade.

9. Plan for downtime according to the following specifications:

| Oracle Key Vault Usage | Downtime required |
|---|---|
| Wallet upload or download | NO |
| Java Keystore upload or download | NO |
| Transparent Data Encryption (TDE) direct connect | YES (NO with persistent cache) |
| Primary Server Upgrade in a primary-standby deployment | YES (NO with persistent cache) |

10. Plan for downtimes.

    If Oracle Key Vault uses an online master encryption key, then plan for a downtime of 15 minutes during the Oracle Database endpoint software upgrades. Database endpoints can be upgraded in parallel to reduce total downtime.

11. If the Oracle Key Vault system has a syslog destination configured, ensure that the remote syslog destination is reachable from the Oracle Key Vault system, and that logs are being correctly forwarded. If the remote syslog destination is not reachable from the Oracle Key Vault system, then the upgrade process can become much slower than normal.

12. If Oracle Audit Vault was integrated with Oracle Key Vault release 21.2 or earlier, then do the following to disable and remove the Oracle Audit Vault integration:

    a. Disable the Oracle Audit Vault integration: Log into the Oracle Key Vault management console as a System Administrator, select the **System** tab and then **Settings** from the left navigation bar. In the Monitoring and Alerts pane, select Audit Vault. In the Audit Vault integration pane that appears, disable AVDF. Click **Save**.

    b. Log in to the Oracle Key Vault server through SSH as user `support`, switch user `su` to `root` and then switch user `su` to `oracle`.

    c. Stop the agent by executing the following command:

    ```
    agent_installation_directory/bin/agentctl stop
    ```

    d. Log in to the Oracle Audit Vault Server console as an Oracle Audit Vault administrator.

    e. Delete the corresponding agent and target.

    f. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

    g. Delete the installation directory for the Oracle Audit Vault agent.

13. If you are performing an upgrade while using an HSM as a Root of Trust, then consult *Oracle Key Vault Root of Trust HSM Configuration Guide* for any additional steps that may be needed.

14. Ensure that the Oracle Key Vault server certificate has not expired, nor is close to expiry, before you begin the upgrade.

    You can find how much time the Oracle Key Vault server certificate has before it expires by checking the **OKV Server Certificate Expiration** setting on the Configure Alerts page in the Oracle Key Vault management console.

15. Ensure that the backup of the `orapwdbfwdb` file matches the original file.

    a. SSH into the Oracle Key Vault system as user `support`, then switch to user `root`:

    ```
    ssh support@<OKV_IP_Address>
    su - root
    ```

b. Verify that the backup file exists:

```
su - oracle
ls -ltr /var/lib/oracle/okv_orapwd_backup_dir/orapwdbfwdb
```

c. If the backup file exists, then perform the following steps:

- Compare the original file with the backup file:

  ```
  diff /var/lib/oracle/dbfw/dbs/orapwdbfwdb /var/lib/oracle/
  okv_orapwd_backup_dir/orapwdbfwdb
  ```

- If there is a difference between the files, then update the backup file by copying the original file:

  ```
  cp /var/lib/oracle/dbfw/dbs/orapwdbfwdb /var/lib/oracle/
  okv_orapwd_backup_dir/orapwdbfwdb
  ```

**Related Topics**

- Step 3: Add Disk Space to Extend the vg_root for the Release 21.11 Upgrade
  Before upgrading from Oracle Key Vault release 12.2 or 18 to 21, you need to extend the `vg_root` to increase disk space.
- *Oracle Key Vault Administrator's Guide*

## 6.4 Step 3: Add Disk Space to Extend the vg_root for the Release 21.11 Upgrade

Before upgrading from Oracle Key Vault release 12.2 or 18 to 21, you need to extend the `vg_root` to increase disk space.

If you are upgrading from an earlier Oracle Key Vault release 21.*x* and have already extended the `vg_root`, then you can bypass this step.

Before you start this procedure, ensure that all endpoints have persistent cache enabled and in use.

1. Log in to the server for which you will perform the upgrade and switch user as `root`.
2. Ensure that the persistent cache settings for Oracle Key Vault have been set.

   You will need to ensure that the persistent cache has been enabled because in a later step in this procedure, you must shut down the server. Shutting down the Oracle Key Vault server will incur downtime. To avoid any downtime, Oracle recommends that you turn on persistent cache.
3. Run the `vgs` command to determine the free space.

   ```
   vgs
   ```

   The `VFree` column shows how much free space you have (for example, 21 GB).
4. Power off the server in order to add a new disk.

   ```
   /sbin/shutdown -h now
   ```

5. Add a new disk to the server with a capacity of 100 GB or greater.
6. Start the server.
7. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

8. Stop the Oracle Key Vault services.

   ```
   service tomcat stop;
   service httpd stop;
   service kmipus stop;
   service kmip stop;
   service okvogg stop;
   service javafwk stop;
   service monitor stop;
   service controller stop;
   service dbfwlistener stop;
   service dbfwdb stop;
   service rsyslog stop;
   ```

9. Run the `fdisk -l` command to find if there are any available partitions on the new disk.

   ```
   fdisk -l
   ```

   At this stage, there should be no available partitions.
10. Run the `fdisk` *`disk_device_to_be_added`* command to create the new partition.

    For example, to create a disk device named `/dev/sdb`:

    ```
    fdisk /dev/sdb
    ```

    In the prompts that appear, enter the following commands in sequence:

    - `n` for new partition
    - `p` for primary
    - `1` for partition number
    - Accept the default values for cylinder (press **Enter** twice).
    - `w` to write and exit
11. Use the `pvcreate` *`disk_device_partition`* command to add the newly added disk to the physical volume.

    For example, for a disk device named `/dev/sdb1`, which is the name of the disk partition that you created (based on the name used for the disk device that was added).

    ```
    pvcreate /dev/sdb1
    ```

Output similar to the following appears:

```
Physical volume "/dev/sdb1" successfully created
```

12. Use the `vgextend vg_root` *`disk_device_partition`* command to extend the logical volume with this disk space that you just added.

    For example, for the partition `/dev/sdb1`, you would run:

    ```
    vgextend vg_root /dev/sdb1
    ```

    Output similar to the following appears:

    ```
    Volume group "vg_root" successfully extended
    ```

13. Run the `vgs` command again to ensure that `VFree` shows an increase of 100 GB or more (depending on the size of the disk that was added).

    ```
    vgs
    ```

    Output similar to the following appears:

    ```
    VG       #PV #LV #SN Attr   VSize   VFree
    vg_root    2  12   0 wz--n- 598.75g <121.41g
    ```

14. Restart the Oracle Key Vault server.

    ```
    /sbin/reboot
    ```

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

# 6.5 Step 4: Upgrade the Oracle Key Vault Server

You can upgrade a standalone Oracle Key Vault server deployment.

- About Upgrading an Oracle Key Vault Server
  In a standalone deployment you must upgrade a single Oracle Key Vault server.
- Upgrading a Standalone Oracle Key Vault Server
  A single Oracle Key Vault server in a standalone deployment is sometimes used in test and development environments for functional testing.

## 6.5.1 About Upgrading an Oracle Key Vault Server

In a standalone deployment you must upgrade a single Oracle Key Vault server.

Note that persistent caching enables endpoints to continue to be operational during the upgrade process.

> **Note:**
>
> If you are upgrading from a system with 4 GB RAM, first add 12 GB or more of additional RAM, following instructions for your specific hardware, before upgrading. Ensure that the persistent cache is enabled and set to sufficiently large values before attempting such operations so as to not incur endpoint downtime.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

## 6.5.2 Upgrading a Standalone Oracle Key Vault Server

A single Oracle Key Vault server in a standalone deployment is sometimes used in test and development environments for functional testing.

1. Ensure that you have backed up the server you are upgrading so your data is safe and recoverable.

   Do not proceed without completing this step.
2. Log into the Oracle Key Vault management console as a user who has the System Administrator role.
3. Ensure that SSH access is enabled.

   Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **IP address(es)** and then enter only the IP addresses that you need, or select **All**. Click **Save**.
4. Ensure you have enough space in the destination directory for the upgrade ISO files.

   Do not copy this file to any location other than the `/var/lib/oracle` directory.
5. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

   If the SSH connection times out while you are executing any step of the upgrade, then the operation will not complete successfully. Oracle recommends that you ensure that you use the appropriate values for the `ServerAliveInterval` and `ServerAliveCountMax` options for your SSH sessions to avoid upgrade failures.Using the `tmux` command prevents network disconnections interrupting the upgrade. If the session terminates, resume as follows:

   ```
   root# tmux a
   ```
6. Copy the upgrade ISO file to the destination directory using **Secure Copy Protocol** or other secure transmission method.

> **Note:**
>
> The upgrade ISO file is **not** the installation ISO file that you downloaded from eDelivery. You can download the Oracle Key Vault 21.11 upgrade software from https://updates.oracle.com/download/37484096.html.

```
root# scp user_name@remote_host:remote_path/okv-upgrade-21.11.0.0.0.iso /var/lib/
oracle/
```

In this specification:

- `remote_host` is the IP address of the computer containing the ISO upgrade file.
- `remote_path` is the directory of the ISO upgrade file. Do not copy this file to any location other than the `/var/lib/oracle` directory.

7. As `root`, make the upgrade accessible by using the `mount` command:

   ```
   root# mount -o loop,ro /var/lib/oracle/okv-upgrade-21.11.0.0.0.iso /images
   ```

8. Clear the cache using the `clean all` command:

   ```
   root# yum -c /images/upgrade.repo clean all
   ```

9. Apply the upgrade with the `upgrade.rb` command:

   ```
   root# ruby /images/upgrade.rb --confirm
   ```

   If the system is successfully upgraded, then the command will display the following message:

   ```
   Reboot now to continue the upgrade process.
   ```

   If you see an error message, then check the log file `/var/log/messages` for additional information.

   If the upgrade of the Oracle Key Vault system fails with the following message:

   ```
   Failed to apply update: The Oracle Key Vault upgrade has detected
   issues with FIPS mode. Please consult the Oracle Key Vault upgrade
   documentation or contact Oracle Support.
   ```

   Perform the following steps:

   a. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

      ```
      ssh support@<Oracle_Key_Vault_IP_address>
          su - root
      ```

   b. Run the following command:

      ```
      /images/preupgrade/okv_check_fips_status_utility fix_fips_mode_consistency
      ```

   c. Follow the instructions displayed in the output and reboot the system when prompted.

   d. After the system has successfully rebooted, SSH into the system again. As user `root`, mount the upgrade ISO and run the following command to verify that there is no FIPS mode inconsistency on the system:

      ```
      /images/preupgrade/okv_check_fips_status_utility check_for_fips_mode_consistency
      ```

      The return value 0 indicates that there is no more FIPS inconsistency.

The return value 1 indicates that there is FIPS mode inconsistency. Run the following command to correct it:

```
/images/preupgrade/okv_check_fips_status_utility fix_fips_mode_consistency
```

10. Restart the Oracle Key Vault server by running the `reboot` command:

    ```
    # reboot
    ```

    On the first restart of the computer after the upgrade, assuming that the upgrade ISO file was copied to the `/var/lib/oracle` directory, the system will automatically mount `/var/lib/oracle/okv-upgrade-21.11.0.0.0.iso` and finish the upgrade process. (If the ISO is not auto-mounted, then the upgrade process will prompt for the ISO to be re-attached.) This can take a few hours. Do not shut down the system during this time.

    The upgrade is complete when the screen shows the following text: `Oracle Key Vault Server` *`version`*`. This appliance was upgraded from` *`previous_release_version`*. The revision reflects the upgraded release.

11. Confirm that Oracle Key Vault has been upgraded to the correct version.

    a. Log in to the Oracle Key Vault management console as a user who has the System Administrator role.

    b. Select the **System** tab, and then select **Status**.

    c. Verify that the version displayed is the latest release number.

       The release number is also at the bottom of each page, to the right of the copyright information.

12. If your site uses the Commercial National Security Algorithm (CNSA) suite, then re-install these algorithms onto the standalone server.

13. Restart the Oracle Key Vault system.

    ```
    root# /sbin/reboot
    ```

14. Delete the upgrade ISO from the Oracle Key Vault server that was just upgraded.

    For example:

    ```
    root# /bin/rm -f /var/lib/oracle/okv-upgrade-21.11.0.0.0.iso
    ```

15. Disable SSH access.

    Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **Disabled**. Click **Save**.

- Correct System Inconsistencies Before Upgrade
  You can correct the system inconsistencies before upgrading to the latest Oracle Key Vault release.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*
- *Oracle Key Vault Root of Trust HSM Configuration Guide*

### 6.5.2.1 Correct System Inconsistencies Before Upgrade

You can correct the system inconsistencies before upgrading to the latest Oracle Key Vault release.

If your upgrade path includes Oracle Key Vault release 21.1 or 21.2 and while running the system at Oracle Key Vault release 21.1 or 21.2 you have enabled or disabled FIPS mode, the upgrade to Oracle Key Vault 21.11 may result in an error. The error is because all components in Oracle Key Vault do not have the same mode when it comes to FIPS, that is, they are not all enabled or all disabled. All the system components should work with the similar FIPS mode, that is, all the components should be with FIPS mode enabled or disabled before you can proceed with upgrade.
You get the following error on upgrade if FIPS mode is not consistent in Oracle Key Vault,

```
 # ruby /images/upgrade.rb --confirm

Power loss during upgrade may cause data loss. Do not power
off during upgrade.
Verifying boot partition before upgrade
Failed to apply update:
The Oracle Key Vault upgrade has detected issues with FIPS mode.
Please consult the Oracle Key Vault upgrade documentation or contact Oracle
Support.
```

Before you upgrade, follow the steps to fix the inconsistent state of FIPS.

1. SSH into the Oracle Key Vault system as user support, then switch to user `root`.

   ```
   ssh support@<Oracle_Key_Vault_IP_address>
   su - root
   ```

2. Run the following commands:

   ```
   su - oracle -c "/usr/local/okv/bin/fips_nzzt_enable"
   su - oracle -c "/usr/local/okv/bin/fips_ogg_enable"
   FIPS_ENABLED in /usr/local/okv/etc/okv_security.conf updated from "0" to
   "1":
   sed -i "/^FIPS_ENABLED=/cFIPS_ENABLED=\"1\"" /usr/local/okv/etc/
   okv_security.conf
   ```

3. Reboot the system.
4. Upgrade the system after the reboot is complete.

## 6.6 Step 5: If Necessary, Add Disk Space to Extend Swap Space

If necessary, extend the swap space. Oracle Key Vault release 21.11 requires a hard disk size greater than or equal to 2 TB in size with approximately 64 GB of swap space.

If your system does not meet this requirement, follow these instructions to extend the swap space. You can check how much swap space you have by running the `swapon -s` command. By default, Oracle Key Vault releases earlier than release 18.1 were installed with approximately 4 GB of swap space. After you complete the upgrade to release 18.1 or later, Oracle recommends that you increase the swap space allocation for the server on which you upgraded Oracle Key Vault. A new Oracle Key Vault installation is automatically configured with sufficient swap space. However, if you upgraded from a previous release, and your system does not have the desired amount of swap space configured, then you must manually add disk space to extend the swap space, particularly if the intention is to convert the upgraded server into the first node of a multi-master cluster.

1. Log in to the server in which you upgraded Oracle Key Vault and connect as `root`.

2. Check the current amount of swap space.

   ```
   [root@my_okv_server support]# swapon -s
   ```

   Output similar to the following appears. This example shows that the system has 4 GB of swap space.

   ```
   Filename Type Size Used Priority
   /dev/dm-0 partition 4194300 3368 -1
   ```

   There **must** be 64 GB of swap space if the disk is greater than 1 TB in size.

3. Run the `vgs` command to determine how much free space is available.

   ```
   vgs
   ```

   The `VFree` column shows how much free space you have (for example, 21 GB).

4. Power off the server in order to add a new disk.

   ```
   /sbin/shutdown -h now
   ```

5. Add a new disk to the server of a size that will bring the VFree value to over 64 GB.
6. Start the server.
7. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

8. Run the `fdisk -l` command to find if there are any available partitions on the new disk.

   ```
   fdisk -l
   ```

   At this stage, there should be no available partitions.

9. Run the `fdisk` *`disk_device_to_be_added`* command to create the new partition.

   For example, to create a disk device named `/dev/sdc`:

   ```
   fdisk /dev/sdc
   ```

   In the prompts that appear, enter the following commands in sequence:

   - `n` for new partition
   - `p` for primary (the primary partition)
   - `1` for partition number
   - Accept the default values for cylinder (press **Enter** twice).
   - `w` to write and exit

10. Use the `pvcreate` *`disk_device_partition`* command to add the newly added disk to the physical volume.

For example, for a disk device named `/dev/sdc1`, which is the name of the disk partition that you created (based on the name used for the disk device that was added).

```
pvcreate /dev/sdc1
```

Output similar to the following appears:

```
Physical volume "/dev/sdc1" successfully created
```

11. Use the `vgextend vg_root` *`disk_device_partition`* command to extend the logical volume with this disk space that you just added.

    For example, for the partition `/dev/sdc1`, you would run:

    ```
    vgextend vg_root /dev/sdc1
    ```

    Output similar to the following appears:

    ```
    Volume group "vg_root" successfully extended
    ```

12. Run the `vgs` command again to ensure that `VFree` shows an increase of 64 GB.

    ```
    vgs
    ```

13. Disable swapping.

    ```
    [root@my_okv_server support]# swapoff -v /dev/vg_root/lv_swap
    ```

14. To extend the swap space, run the `lvresize` command.

    ```
    [root@my_okv_server support]# lvresize -L +60G /dev/vg_root/lv_swap
    ```

    Output similar to the following appears:

    ```
    Size of logical volume vg_root/lv_swap changed from 4.00 GiB (128 extents)
    to 64.00 GiB (2048 extents)
    Logical volume lv_swap successfully resized.
    ```

15. Format the newly added swap space.

    ```
    [root@my_okv_server support]# mkswap /dev/vg_root/lv_swap
    ```

    Output similar to the following appears:

    ```
    mkswap: /dev/vg_root/lv_swap: warning: don't erase bootbits sectors
    on whole disk. Use -f to force.
    Setting up swapspace version 1, size = 67108860 KiB
    no label, UUID=fea7fc72-0fea-43a3-8e5d-e29955d46891
    ```

16. Enable swapping again.

    ```
    [root@my_okv_server support]# swapon -v /dev/vg_root/lv_swap
    ```

17. Verify the amount of swap space that is available.

    ```
    [root@my_okv_server support]# swapon -s
    ```

    Output similar to the following appears:

    ```
    Filename Type Size Used Priority
    /dev/dm-0 partition 67108860 0 -1
    ```

18. Restart the Oracle Key Vault server.

    ```
    /sbin/reboot
    ```

## 6.7 Step 6: If Necessary, Remove Old Kernels

Oracle recommends that you clean up the older kernels that were left behind after the upgrade.

While the older kernel is not in use, it may be marked as an issue by some code analysis tools.

1. Log in to the Oracle Key Vault server as the `support` user.
2. Switch to the `root` user.

   ```
   su - root
   ```

3. Mount `/boot` if it was not mounted on the system.
   a. Check if the `/boot` is mounted. The following command should display `/boot` information if it was mounted.

      ```
      df -h /boot;
      ```

   b. Mount it if `/boot` is not mounted.

      ```
      /bin/mount /boot;
      ```

      For EFI-based systems, you may need to mount `/boot/efi` if it is not already mounted.

      ```
      /bin/mount /boot/efi
      ```

4. Check the installed kernels and the running kernel.
   a. Search for any kernels that are installed.

      ```
      rpm -q kernel-uek | sort;
      ```

      The following example output shows that two kernels are installed:

      ```
      kernel-uek-5.4.17-2136.318.7.2.el8uek.x86_64
      kernel-uek-5.4.17-2136.329.3.1.el8uek.x86_64
      ```

   b. Check the latest kernel.

      ```
      uname -r;
      ```

      The following output shows an example of a kernel version that was installed at the time:

      ```
      5.4.17-2136.329.3.1.el8uek.x86_64
      ```

This example assumes `5.4.17-2136.329.3.1.el8uek.x86_64` as the latest version (newer versions may be available by now). Based on the output from the commands above, remove the older kernel `(kernel-uek-5.4.17-2136.318.7.2.el8uek.x86_64)`. You should remove all kernels that are older than the latest kernel.

5. Remove the older kernel and its associated RPMs.

   For example, to remove the `kernel-uek-5.4.17-2136.318.7.2.el8uek.x86_64`

   ```
   # yum --disablerepo=* remove `rpm -qa|grep kernel-uek-5.4.17-2136.318.7.2.el8uek`
   ```

   Output similar to the following appears:

   ```
     Resolving Dependencies
   -->   Running transaction check
   ---> Package kernel-uek.x86_64 0:4.14.35-2047.504.2.el7uek will be erased
   ---> Package kernel-uek-devel.x86_64 0:4.14.35-2047.504.2.el7uek will be erased
   --> Finished Dependency Resolution
   Dependencies resolved.
   ================================================================================
    Package Arch Version Repository Size
   ================================================================================
   Removing:
    kernel-uek x86_64 5.4.17-2136.318.7.2.el8uek @avdf-base-os 135 M

   Transaction Summary
   ================================================================================
   Remove 1 Package

   Freed space: 135 M
   Is this ok [y/N]:
   ```

6. Enter `y` to accept the deletion output.
7. Repeat these steps starting with Step 4 for all kernels that are older than the latest kernel.

## 6.8 Step 7: If Necessary, Remove SSH-Related DSA Keys

You should remove SSH-related DSA keys left behind after the upgrade, because they can cause problems with some code analysis tools.

1. Log in to the Oracle Key Vault management console as a user with the System Administrator role.
2. Enable SSH.

   Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **IP address(es)** and then enter only the IP addresses that you need, or select **All**. Click **Save**.
3. Log in to the Oracle Key Vault support account using SSH as the `support` user and then switch to the `root` user.

   ```
   ssh support@OracleKeyVault_serverIPaddress

   su - root
   ```

4. Change directory to `/etc/ssh`.

   ```
   cd /etc/ssh
   ```

5. Rename the following keys.

```
mv ssh_host_dsa_key.pub ssh_host_dsa_key.pub.retire
mv ssh_host_dsa_key ssh_host_dsa_key.retire
```

6. Disable SSH access.

   Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **Disabled**. Click **Save**.

## 6.9 Step 8: Upgrade the Endpoint Software

When you upgrade the Oracle Key Vault server software appliance, also upgrade the endpoint software to get access to the latest enhancements.

Oracle Key Vault client software is backward-compatible. While older versions of Oracle Key Vault client software are fully functional with an upgraded Oracle Key Vault server, some new Oracle Key Vault features are only available with the current client software.
You can upgrade an endpoint by upgrading the endpoint software or re-enrolling the endpoint. Upgrading the endpoint software does not affect the existing endpoint certificate or `okvclient.ora`, the endpoint configuration file. Re-enrolling an endpoint invalidates an existing endpoint certificate, and a new endpoint certificate as well as `okvclient.ora` are installed. Oracle recommends that you upgrade the endpoint software for minor version upgrades (for example, from 21.x to 21.y) and consider re-enrolling the endpoint when upgrading across major versions (for example, from 18.x to 21.y).

Before an endpoint that uses Oracle Key Vault for TDE key management can take advantage of new Oracle Key Vault features, for example non-extractable TDE master keys, it must be upgraded to match the new Oracle Key Vault release.

1. For the endpoint upgrade of a TDE-enabled database, the database instance must be shut down to install the latest `PKCS#11` library. Oracle recommends upgrading all endpoints for TDE-enabled databases on the same host together. Review the instructions in step 6 before proceeding with the upgrade of endpoints for TDE-enabled databases.

   You can upgrade an endpoint by updating the endpoint software or by re-enrolling the endpoint. Perform steps 2 - 4 to update the endpoint software.
   Or

   Perform step 5 to re-enroll the endpoint.

2. Download the endpoint software (`okvclient.jar`) and install it in your existing endpoint directory path as follows:

   a. Go to the Oracle Key Vault management console login screen.

   b. Click the **Endpoint Enrollment and Software Download** link.

   c. In the **Download Endpoint Software Only** section, select the appropriate platform from the drop-down list.

   d. Click the **Download** button to download the `okvclient.jar` file.

3. Identify the path to your existing endpoint installation that you are about to upgrade. For example, `/etc/ORACLE/KEYSTORES/okv` (where `/etc/ORACLE/KEYSTORES is WALLET_ROOT` of your database, or the softlink in `$ORACLE_BASE/okv/$ORACLE_SID` points to).

4. Install the endpoint software by running the following command:

   ```
   java -jar okvclient.jar -d existing_endpoint_directory_path
   ```

For example:

```
java -jar okvclient.jar -d /etc/ORACLE/KEYSTORES/okv
```

If you are installing the `okvclient.jar` file for an endpoint that has Oracle Database 23ai, then include the `-arch db23ai` option during the installation. The new endpoint software for Oracle Database 23ai is required to support new features such as using OpenSSL for FIPS mode and the new version of local auto login wallets in Oracle Database 23ai. The new endpoint software for Oracle Database 23ai is supported on the Linux-x64 platform only.

For example:

```
Java -jar okvclient.jar -d /home/oracle/okvutil -arch db23ai
```

5. Perform the following steps to re-enroll the endpoint software, which also generates a new endpoint certificate. The easiest way to re-enroll an endpoint is by using the following commands of the RESTful services utility:
   a. Re-enroll the endpoint by using the following RESTful services utility command:

      ```
      okv admin endpoint re-enroll
      ```

   b. Back up the `OKV_HOME` directory and delete the files under `OKV_HOME`:

      ```
      cp -R $OKV_HOME $OKV_HOME_bkp_date +%Y%m%d
      ```

   c. Go to the `$OKV_HOME` directory and remove all the files.
   d. For Oracle Database 21c and earlier:
      Download and install the endpoint software by using the following RESTful services utility command:

      ```
      okv admin endpoint provision
      ```

      For Oracle Database 23ai:

      Download and install the endpoint software by using the following RESTful services utility command:

      ```
      okv admin endpoint provision --arch db23ai
      ```

   Re-enrolling an endpoint generates a new `okvclient.jar` file and installs the file in the OKV_HOME directory but maintains the relationship between the endpoint and its default wallet.

   > **Note:**
   >
   > To re-enroll an endpoint without using RESTful services utility, follow the steps described in How to Re-enroll an Endpoint.

6. Install the updated PKCS#11 library file.

This step is needed only for online TDE master encryption key management by Oracle Key Vault. If an endpoint uses online TDE master encryption key management by Oracle Key Vault, then you must upgrade the PKCS#11 library while upgrading the endpoint software. For Oracle Database 21c and earlier:

Ensure that database instance is shut down before installing the PKCS#11 library in the location /opt/oracle/extapi/64/hsm/oracle/1.0.0.

- **On UNIX/Linux platforms**: Run root.sh from the bin directory of endpoint installation directory to copy the latest liborapkcs.so file for Oracle Database endpoints.

  ```
  $ sudo /etc/ORACLE/KEYSTORES/okv/bin/root.sh
  ```

  Or

  ```
  $ su - root
  # /etc/ORACLE/KEYSTORES/okv/bin/root.sh
  ```

- **On Windows platforms**: Run root.bat from the bin directory of endpoint installation directory to copy the latest liborapkcs.dll file for Oracle Database endpoints. You will be prompted for the version of the database in use.

  ```
  bin\root.bat
  ```

If you are upgrading multiple endpoints for TDE-enabled databases on a host, you must install the latest Oracle Key Vault PKCS#11 library only once on the host computer.

On the host, perform the following steps when upgrading multiple endpoints for TDE-enabled databases:

- Complete the upgrade of all Oracle Key Vault endpoints for the TDE-enabled databases.
- Shut down corresponding TDE-enabled database instances.
- Execute the root.sh or root.bat script to install the latest Oracle Key Vault PKCS#11 library.

**For Oracle Database 23ai:** Oracle recommends that you install the latest liborapkcs.so file in a fixed custom location using the root.sh script.

This enables upgrading the liborapkcs.so file in future without encountering database downtime.

The fixed custom location is in the following format:

```
/opt/oracle/extapi/64/pkcs11/okv/<okv_version>/lib
```

For example, in the Oracle Key Vault 21.11 release, the location is

```
/opt/oracle/extapi/64/pkcs11/okv/21.11.0.0.0/lib
```

- **On UNIX/Linux platforms**: Run `root.sh` from the `bin` directory of the endpoint installation directory to copy the latest `liborapkcs.so` file for Oracle Database endpoints.

  ```
  $ sudo /etc/ORACLE/KEYSTORES/okv/bin/root.sh --
  okv_pkcs11_library_location
  ```

  Or

  ```
  $ su - root
  # /etc/ORACLE/KEYSTORES/okv/bin/root.sh -okv_pkcs11_library_location
  ```

If you are upgrading multiple endpoints for TDE-enabled databases on a host, you must install the latest Oracle Key Vault `PKCS#11` library only once for the endpoint software version.

On the host where there are multiple endpoints for TDE-enabled Oracle database 23ai, each database can upgrade their endpoint software separately and switch to using the upgraded liborapkcs.so library by setting up the database initialization parameter `PKCS11_LIBRARY_LOCATION` to point to the upgraded library.

> **Note:**
>
> Installing the `liborapkcs.so` library in a legacy location is also supported with Oracle Database 23ai databases. However, Oracle does not recommend it.

7. Update the SDK software.

   If you have already deployed the SDK software, Oracle recommends that you redeploy the SDK software in the same location after you complete the upgrade to Oracle Key Vault release 21.10. This enables you to have access to the new SDK APIs that were introduced since the Oracle Key Vault version that you are upgrading from.

   a. Go to the Oracle Key Vault management console login screen.

   b. Click the **Endpoint Enrollment and Software Download** link.

   c. c. In the Download Software Development Kit section, select the appropriate language and platform for your site.

   d. Click the **Download** button to get the SDK zip file.

   e. Identify the existing location where SDK software was already deployed.

   f. Navigate to the directory in which you saved the SDK zip file.

   g. Unzip the SDK zip file.

      For example, on Linux, to unzip the Java SDK zip file, use the following command:

      ```
      unzip -o okv_jsdk.zip -d existing_endpoint_sdk_directory_path
      ```

      For the C SDK zip file, use this command:

      ```
      unzip -o okv_csdk.zip -d existing_endpoint_sdk_directory_path
      ```

   h. Do not exit this page.

8. If you had deployed the RESTful services utility in the previous release, then re-deploy the latest `okvrestclipackage.zip` file.

   The latest `okvrestclipackage.zip` file enables you to have access to the new RESTful services utility commands that were introduced since the Oracle Key Vault version that you are upgrading from.

   You can use `wget` or `curl` to download `okvrestclipackage.zip`.

   ```
   wget --no-check-
   certificate https://Oracle_Key_Vault_IP_address:5695/
   okvrestclipackage.zip curl -O -
   k https://Oracle_Key_Vault_IP_address:5695/okvrestservices.jar
   ```

9. Start the Oracle Databases if the upgrade of Oracle Key Vault endpoints for all of the TDE enabled databases on this host machine is complete.

   At this stage, the endpoint is fully upgraded.

   For Oracle Database 23ai which is using the custom path for installing the `liborapkcs.so` library from step 6 above, perform the following additional steps.

   a. Log in to the CDB Root as a user who has been granted the `ALTER SYSTEM` privilege.

   b. Set the static initialization parameter `PKCS11_LIBRARY_LOCATION` to point to the upgraded `liborapkcs.so` library.

      For example:

      ```
      ALTER SYSTEM SET
      PKCS11_LIBRARY_LOCATION='/opt/oracle/extapi/64/pkcs11/okv/
      21.11.0.0.0/lib/liborapkcs.so' SCOPE=SPFILE SID='*';
      ```

   After the database restart, the database will switch to using the new upgraded library from the custom path. The database is also set to switch to new libraries in future without encountering downtime.

   After you upgrade Oracle Key Vault to a new release in future (for example 21.xx.0.0.0), the `root.sh` file in the upgraded endpoint can be used to copy the `liborapkcs.so` library to the new path `/opt/oracle/extapi/64/pkcs11/21.12.0.0.0/lib`. The database can switch to the new library by using the `SWITCHOVER` command.

   For example:

   ```
   ADMINISTER KEY MANAGEMENT SWITCHOVER TO LIBRARY
   '/opt/oracle/extapi/64/pkcs11/okv/21.12.0.0.0/lib/liborapkcs.so'
   FOR ALL CONTAINERS;
   ```

10. If your site requires that you restrict TDE master encryption keys from leaving Oracle Key Vault and if you are using an Oracle Real Application Clusters (Oracle RAC) environment, then perform the following steps on each Oracle RAC node:

    a. Perform the endpoint upgrade on each Oracle RAC node.

    b. Set the extractable attribute value for symmetric keys.

       By default, the extractable attribute value is `true`, which means that the key material of symmetric keys can be extracted from Oracle Key Vault during certain operations. If you want to prevent symmetric keys from being extracted, then you must set this value to `false`. You can set an extractable attribute value as follows:

- Set the default value for the extractable attribute of new symmetric keys in the endpoint settings. Endpoint-specific setting overrides the global endpoint settings.
- Explicitly specify the value of the extractable attribute when creating or registering a new symmetric key.
- Modify the extractable attribute of an existing symmetric key.

See *Oracle Key Vault Administrator's Guide*.

c. As a user who has the SYSDBA or SYSKM administrative privilege, perform a rekey operation in the Oracle RAC node. Use the following syntax:

```
ADMINISTER KEY MANAGEMENT SET [ENCRYPTION] KEY
[FORCE KEYSTORE][USING TAG 'tag_name']
IDENTIFIED BY [EXTERNAL STORE | keystore_password]
[WITH BACKUP [USING backup_identifier']];
```

See *Oracle Database Advanced Security Guide* for more information about rekeying a TDE master encryption key.

11. If your site requires that you restrict TDE master encryption keys from leaving Oracle Key Vault and if you are using an Oracle Data Guard environment, then do the following on the primary and standby databases:

a. Perform the endpoint upgrade on the primary and standby databases.

b. Set the extractable attribute value for symmetric keys.

By default, the extractable attribute value is `true`, which means that the key material of symmetric keys can be extracted from Oracle Key Vault during certain operations. If you want to prevent symmetric keys from being extracted, then you must set this value to `false`. You can set an extractable attribute value as follows:

- Set the default value for the extractable attribute of new symmetric keys in the endpoint settings. Endpoint-specific setting overrides the global endpoint settings.
- Explicitly specify the value of the extractable attribute when creating or registering a new symmetric key.
- Modify the extractable attribute of an existing symmetric key.

See *Oracle Key Vault Administrator's Guide*.

c. As a user who has the SYSDBA or SYSKM administrative privilege, perform a rekey operation in the primary and standby databases. Use the following syntax:

```
ADMINISTER KEY MANAGEMENT SET [ENCRYPTION] KEY
[FORCE KEYSTORE]
[USING TAG 'tag_name']
IDENTIFIED BY [EXTERNAL STORE | keystore_password]
[WITH BACKUP [USING 'backup_identifier'']];
```

See *Oracle Database Advanced Security Guide* for more information about rekeying a TDE master encryption key.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

## 6.10 Step 9: Back Up the Upgraded Oracle Key Vault Server

You must perform server backup and user password tasks after completing a successful upgrade.

1. Take a full backup of the upgraded Oracle Key Vault Server Database to a new remote destination. Avoid using the old backup destination for the new backups.
2. Schedule a new periodic incremental backup to the new destination defined in the preceding step.
3. Change the Oracle Key Vault administrative passwords.

   Password hashing has been upgraded to a more secure standard than in earlier releases. This change affects the operating system passwords, `support` and `root`. You must change Oracle Key Vault administrative passwords after the upgrade to take advantage of the more secure hash.

# 7 Upgrading Oracle Key Vault from an Earlier 21.*x* Release in a Multi-Master Cluster Environment

Similar to a standalone or primary-standby upgrade for release 21.*x*, this type of upgrade includes the Oracle Key Vault server software and endpoint software-related utilities.

- About Upgrading Oracle Key Vault from an Earlier 21.x Release in a Multi-Master Cluster Environment
  To perform this upgrade, you must upgrade each multi-master cluster node.
- Step 1: Perform Pre-Upgrade Tasks for the Upgrade from the Earlier 21.x Release
  Similar to a standalone or primary-standby environment, you must perform pre-upgrade tasks such as backing up the Oracle Key Vault server.
- Step 2: Upgrade Each Multi-Master Cluster Node
  To upgrade the multi-master cluster, you must upgrade each multi-master cluster node, one after the other.
- Step 3: If Necessary, Change the Network Interface for Upgraded Nodes
  Nodes that were created in Oracle Key Vault releases earlier than release 21.1 use Classic mode, in which only one network interface was used.
- Step 4: Check the Node Version and the Cluster Version
  After you complete the upgrade of at least one node, you can log into any of the upgraded nodes to check the node and cluster versions.
- Step 5: If Necessary, Add Disk Space to Extend Swap Space
  If necessary, extend the swap space on each node. Oracle Key Vault release 21.11 requires a hard disk size greater than or equal to 1 TB in size with approximately 64 GB of swap space.
- Step 6: If Necessary, Remove Old Kernels
  For each multi-master cluster node, Oracle recommends that you clean up the older kernels that were left behind after the upgrade.
- Step 7: If Necessary, Remove SSH-Related DSA Keys
  For each multi-master cluster node, you should remove SSH-related DSA keys left behind after the upgrade.
- Step 8: Upgrade the Endpoint Software
  When you upgrade the Oracle Key Vault server software appliance, also upgrade the endpoint software to get access to the latest enhancements.

## 7.1 About Upgrading Oracle Key Vault from an Earlier 21.*x* Release in a Multi-Master Cluster Environment

To perform this upgrade, you must upgrade each multi-master cluster node.

For Oracle Key Vault 21.11 you need to upgrade to 21.x. If you are using the version earlier than 21.x, make sure to upgrade the version to 21.x first before proceeding with the version update to 21.11.

The upgrade process involves performing the upgrade on each multi-master cluster node. After you have begun a cluster upgrade, ensure that you upgrade all the nodes in the cluster one after the other, without too much intervening time between upgrades of two nodes.

Upgrading an Oracle Key Vault multi-master cluster includes upgrading each cluster node to the new later version. You must upgrade all nodes to the same Oracle Key Vault version. You should first upgrade the read-only nodes of the cluster, and then upgrade the read-write pairs. As each cluster node is upgraded, its node version is updated to the new version of the Oracle Key Vault. After you complete the upgrade of all cluster nodes, the cluster version is updated to the new version of the Oracle Key Vault. You can check the node version or the cluster version by selecting the **Cluster** tab, then in the left navigation bar, selecting **Management**. Oracle Key Vault multi-master cluster upgrade is considered complete when node version and cluster version at each cluster node is updated to the latest version of Oracle Key Vault.

Before you perform the upgrade, note the following:

- Perform the entire upgrade process on *all* multi-master cluster nodes, without interruption. That is, after you have started the cluster upgrade process, ensure that you try and upgrade all nodes, individually one after the other or in read-write pairs. Do not perform any critical operations or make configuration changes to Oracle Key Vault until you have completed upgrading all the nodes in your environment.
- Be aware that you cannot use any new features that were introduced in this release until you have completed upgrading all of the multi-master cluster nodes. An error is returned when such features are used from the node that has been upgraded. Oracle recommends that you plan the upgrade of all cluster nodes close to each other to ensure availability of the new features sooner.
- Starting in Oracle Key Vault release 21.2, expiration alerts for deactivated or destroyed objects are not generated. If you are upgrading from Oracle Key Vault release 21.1 or earlier, then the following behavior is expected:
  - As each cluster node is upgraded, Oracle Key Vault deletes all expiration alerts for any certificate and secret objects, as well as for key objects that have been revoked or destroyed.
  - Cluster nodes that have not been upgraded yet will continue to generate alerts for these same objects, and also send email notifications for these alerts. This behavior that results in deletion and recreation of alerts may repeat until the last cluster node is upgraded.
  - After the upgrade is complete, expiration alerts for the certificate and secret objects will have the alert type of `Certificate Object Expiration` and `Secret Object Expiration`, respectively.

**Related Topics**

- Step 4: Check the Node Version and the Cluster Version
  After you complete the upgrade of at least one node, you can log into any of the upgraded nodes to check the node and cluster versions.

## 7.2 Step 1: Perform Pre-Upgrade Tasks for the Upgrade from the Earlier 21.*x* Release

Similar to a standalone or primary-standby environment, you must perform pre-upgrade tasks such as backing up the Oracle Key Vault server.

If you plan to perform an upgrade of the Oracle Key Vault server, then disable the diagnostics packaging utility by ensuring that there are no files available to download. This can be confirmed by checking if the **Diagnostics** page has a section called **Diagnostics Package Files**. If it does, click **Clear** to disable the utility.

1. In the server where Oracle Key Vault is installed, log in as user `support`, and then switch to the `root` user.
2. Back up the server so that you can recover data in case the upgrade fails.
3. Ensure that no full or incremental backup jobs are running. Delete all scheduled full or incremental backup jobs before the upgrade.
4. Ensure that the server meets the minimum disk space requirements for an upgrade. For example, 6 GB of free space in the `/usr/local/dbfw/tmp` directory. See the Oracle Key Vault Readme for this release to determine the disk space requirements for the upgrade.
5. Ensure that you disable diagnostics and clean up disk space in `/usr/local/dbfw/tmp` before you upgrade by performing the following steps:

   If the Oracle Key Vault system being upgraded is from release 21.6 or later, log in to the Oracle Key Vault management console as a user with the System Administrator role, and navigate to the **System** tab, and then click the **Diagnostics** button.

   If the Diagnostics Package Files pane is displayed, then click **Clear** to disable diagnostics. Note that the **Diagnostics Package Files** pane will be displayed only if the diagnostics bundle was previously generated, and the files were not cleared.

   If the Diagnostics Package Files pane is not displayed, or if the diagnostics bundle was previously generated using the **dbfw-diagnostics-package.rb** utility, then log in to the Oracle Key Vault system and run the following commands to disable diagnostics and clean up disk space in `/usr/local/dbfw/tmp`:

   a. SSH into the Oracle Key Vault system as user `support`, then switch to user `root`:

      ```
      ssh support@<OKV_IP_Address>
      su - root
      ```

   b. Delete the generated diagnostics zip file and remove the package using the following commands:

      ```
      /usr/local/dbfw/bin/priv/dbfw-diagnostics-package.rb --clean
      /usr/local/dbfw/bin/priv/dbfw-diagnostics-package.rb --remove
      ```

6. Plan for downtime according to the following specifications:

| Oracle Key Vault Usage | Downtime required |
|---|---|
| Wallet upload or download | NO |
| Java Keystore upload or download | NO |

| Oracle Key Vault Usage | Downtime required |
|---|---|
| Transparent Data Encryption (TDE) direct connect | YES (NO with persistent cache) |
| Primary Server Upgrade in a primary-standby deployment | YES (NO with persistent cache) |

The Oracle Key Vault client software is backward-compatible. Older Oracle Key Vault client software versions are completely functional with the upgraded Oracle Key Vault server, the new features of Oracle Key Vault are only available with the current client software. TDE-enabled databases before 21c need to restart to load the updated Oracle Key Vault PKCS#11 library that is deployed as part of the Oracle Key Vault client software upgrade. Oracle Database 21c and later can dynamically load the new Oracle Key Vault PKCS#11 library, without downtime. Database endpoints can be upgraded in parallel to reduce total downtime.

7. If the Oracle Key Vault system has a syslog destination configured, ensure that the remote syslog destination is reachable from the Oracle Key Vault system, and that logs are being correctly forwarded. If the remote syslog destination is not reachable from the Oracle Key Vault system, then the upgrade process can become much slower than normal.
8. Check the disk size before you begin the upgrade. If any of the nodes in question have a disk size that is greater than 2 TB and uses BIOS boot mode, then you cannot upgrade that system to the new release. Oracle recommends that you remove the node from the cluster and if possible, replace it with a node whose disk is less than 2 TB in size.
9. If you need to increase available disk space, then remove the temporary jar files located in `/usr/local/okv/ssl`. *Be careful in doing so.* If you accidentally delete any files other than the jar files in `/usr/local/okv/ssl`, then the Oracle Key Vault server becomes non-functional.
10. Check the boot partition size. If any of the nodes in question have a boot partition that is less than 500 MB, then you cannot upgrade that system to the new release. You can check this size as follows:

    a. Mount the `/boot` partition.

    ```
    /bin/mount /boot
    ```

    b. Check the `Size` column given by the following command:

    ```
    /bin/df -h /boot
    ```

    c. Unmount the `/boot` partition:

    ```
    /bin/umount /boot
    ```

    If the boot partition given by this command shows less than 488 MB, then you cannot upgrade to the current release. Oracle recommends that you remove the node from the cluster and if possible, replace it with a node that has been freshly installed with the same Oracle Key Vault version as the rest of the cluster nodes.
11. Increase the **Maximum Disable Node Duration** setting as appropriate so that any disabled cluster nodes have sufficient time to be upgraded then enabled back into the cluster. Note that increasing the **Maximum Disable Node Duration** setting also increases disk space usage.
12. Plan to disable one node at a time.
13. If Oracle Audit Vault was integrated with Oracle Key Vault in Oracle Key Vault release 21.2 or earlier, then do the following to disable and remove the Oracle Audit Vault integration:

   a. Disable the Oracle Audit Vault integration: Log into the Oracle Key Vault management console as a System Administrator, select the **System** tab and then **Settings** from the left navigation bar. In the Monitoring and Alerts pane, select Audit Vault. In the Audit Vault integration pane that appears, disable Oracle Audit Vault. Click **Save**.
   b. Log in to the Oracle Key Vault server through SSH as user `support`, switch user `su` to `root` and then switch user `su` to `oracle`.
   c. Stop the agent by executing the following command:

      ```
      agent_installation_directory/bin/agentctl stop
      ```

   d. Log in to the Oracle Audit Vault Server console as an Oracle Audit Vault administrator.
   e. Delete the corresponding agent and target.
   f. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.
   g. Delete the installation directory for the Oracle Audit Vault agent.

14. Ensure that the Oracle Key Vault server certificate has not expired, nor is close to expiry, before you begin the upgrade.

    You can find how much time the Oracle Key Vault server certificate has before it expires by checking the **OKV Server Certificate Expiration** setting on the Configure Alerts page in the Oracle Key Vault management console.

15. If you are performing an upgrade while using an HSM as a Root of Trust, then consult *Oracle Key Vault Root of Trust HSM Configuration Guide* for any additional steps that may be needed.

16. Ensure that the backup of the `orapwdbfwdb` file matches the original file.

    a. SSH into the Oracle Key Vault system as user `support`, then switch to user `root`:

       ```
       ssh support@<OKV_IP_Address>
       su - root
       ```

    b. Verify that the backup file exists:

       ```
       su - oracle
       ls -ltr /var/lib/oracle/okv_orapwd_backup_dir/orapwdbfwdb
       ```

    c. If the backup file exists, then perform the following steps:

       - Compare the original file with the backup file:

         ```
         diff /var/lib/oracle/dbfw/dbs/orapwdbfwdb /var/lib/oracle/
         okv_orapwd_backup_dir/orapwdbfwdb
         ```

       - If there is a difference between the files, then update the backup file by copying the original file:

         ```
         cp /var/lib/oracle/dbfw/dbs/orapwdbfwdb /var/lib/oracle/
         okv_orapwd_backup_dir/orapwdbfwdb
         ```

**Related Topics**

- Step 3: Add Disk Space to Extend the vg_root for the Release 21.11 Upgrade
  Before upgrading from Oracle Key Vault release 12.2 or 18 to 21, you need to extend the `vg_root` to increase disk space.
- Step 2: Perform Pre-Upgrade Tasks for the Standalone Oracle Key Vault
  To ensure a smooth upgrade to Oracle Key Vault, you should prepare the server you are upgrading.
- *Oracle Key Vault Administrator's Guide*

# 7.3 Step 2: Upgrade Each Multi-Master Cluster Node

To upgrade the multi-master cluster, you must upgrade each multi-master cluster node, one after the other.

Do not use other Oracle Key Vault features until you have completed upgrading ***all*** multi-master cluster nodes. Ensure that you have successfully backed up Oracle Key Vault before you begin the upgrade of the multi-master cluster nodes.

1. Ensure that you have performed the pre-upgrade steps.
2. Disable the multi-master cluster node.
   a. Log into the cluster node that you want to upgrade as a user with the System Administrator role.
   b. Select the **Cluster** tab, and then select **Management** from the left navigation bar.
   c. Under Cluster Details, in the **Select Node** column, select the check box of the node to disable.
   d. Click **Disable**.

      In the node’s **Management** page (under the **Cluster** tab), the node's status will change from `DISABLING` to `DISABLED`.
3. Ensure that SSH access is enabled for the node.

   Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **IP address(es)** and then enter only the IP addresses that you need, or select **All**. Click **Save**.
4. Ensure that you have enough space in the destination directory for the upgrade ISO files.
5. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

   If the SSH connection times out while you are executing any step of the upgrade, then the operation will not complete successfully. Oracle recommends that you ensure that you use the appropriate values for the `ServerAliveInterval` and `ServerAliveCountMax` options for your SSH sessions to avoid upgrade failures.
   Using the `tmux` command prevents network disconnections interrupting the upgrade. If the session terminates, resume as follows:

   ```
   tmux a
   ```

6. Copy the upgrade ISO file to the destination directory using SCP or other secure transmission method.

   ```
   scp remote_host:remote_path/okv-upgrade-disc-
   new_software_release.iso /var/lib/oracle
   ```

   In this specification:

   - *remote_host* is the IP address of the computer containing the ISO upgrade file.
   - *remote_path* is the directory of the ISO upgrade file. Do not copy this file to any location other than the /var/lib/oracle directory.

7. Make the upgrade accessible by using the `mount` command:

   ```
   /bin/mount -o loop,ro /var/lib/oracle/okv-upgrade-disc-
   new_software_release.iso /images
   ```

8. Clear the cache using the `clean all` command:

   ```
   yum -c /images/upgrade.repo clean all
   ```

9. Apply the upgrade with the `upgrade.rb` command:

   ```
   root# ruby /images/upgrade.rb --confirm
   ```

   If the system is successfully upgraded, then the command will display the following message:

   ```
   Reboot now to continue the upgrade process.
   ```

   If you see an error message, then check the log file `/var/log/messages` for additional information.

   If the upgrade of the Oracle Key Vault system fails with the following message:

   ```
   Failed to apply update: The Oracle Key Vault upgrade has detected
   issues with FIPS mode. Please consult the Oracle Key Vault upgrade
   documentation or contact Oracle Support.
   ```

   Perform the following steps:

   a. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

      ```
      ssh support@<Oracle_Key_Vault_IP_address>
          su - root
      ```

   b. Run the following command:

      ```
      /images/preupgrade/okv_check_fips_status_utility fix_fips_mode_consistency
      ```

   c. Follow the instructions displayed in the output and reboot the system when prompted.

   d. After the system has successfully rebooted, SSH into the system again. As user `root`, mount the upgrade ISO and run the following command to verify that there is no FIPS mode inconsistency on the system:

      ```
      /images/preupgrade/okv_check_fips_status_utility check_for_fips_mode_consistency
      ```

The return value 0 indicates that there is no more FIPS inconsistency.

The return value 1 indicates that there is FIPS mode inconsistency. Run the following command to correct it:

```
/images/preupgrade/okv_check_fips_status_utility fix_fips_mode_consistency
```

10. Restart the Oracle Key Vault server by running the `reboot` command:

    ```
    # reboot
    ```

    On the first restart of the computer after the upgrade, the system will apply the necessary changes. This can take a few hours. Do not shut down the system during this time. The upgrade of the cluster node is completed when the screen with heading: `Oracle Key Vault Server` *`new_software_release`* appears, with *`new_software_release`* reflecting the release number of the upgraded version. Following the heading appears the menu item **Display Appliance Info**. Select **Display Appliance Info** and press the **Enter** key to see the IP address settings for the appliance.

11. If you are performing an HSM upgrade using Entrust (formerly nCipher), then perform the additional steps described in *Oracle Key Vault Root of Trust HSM Configuration Guide*.

12. After the node has been successfully upgraded, re-enable it.

    a. Log into the Oracle Key Vault node that you just upgraded as a user who has the System Administrator role.

    b. Select the **Cluster** tab, and then select **Management** from the left navigation bar.

    c. In the Cluster Details section, under **Name**, click the name of the node that you had disabled.

    d. Click **Enable**.

       After you re-enable the disabled multi-master cluster node, its status changes from `DISABLED` to `ENABLING`, then to `ACTIVE`. The status of the node will remain at `ENABLING` and will not change to `ACTIVE` unless bidirectional replication between it and all other nodes is occurring successfully.

13. As necessary, disable SSH access on this node.

    Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **Disabled**. Click **Save**.

14. After you have successfully completed this procedure, repeat these upgrade steps on all multi-master cluster nodes.

## 7.4 Step 3: If Necessary, Change the Network Interface for Upgraded Nodes

Nodes that were created in Oracle Key Vault releases earlier than release 21.1 use Classic mode, in which only one network interface was used.

If you prefer to use dual NIC network mode, which supports the use two network interfaces, then you can switch the node to use this mode, from the command line.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

## 7.5 Step 4: Check the Node Version and the Cluster Version

After you complete the upgrade of at least one node, you can log into any of the upgraded nodes to check the node and cluster versions.

Oracle Key Vault tracks the version information of each cluster node as well as the version of the cluster as a whole. The node version represents the version of the Oracle Key Vault software on a given node. When a node is upgraded, its node version is updated to the new version of the Oracle Key Vault software. The cluster version is derived from the version information of the cluster nodes and is set to the minimum version of any cluster node. During cluster upgrade, node version is updated as each cluster node is upgraded to the later version. When all of the cluster nodes have been upgraded, the cluster version is then updated to the new version. (The Cluster Version and Node Version fields are available in Oracle Key Vault release 18.2 or later.)

1. Log in to the Oracle Key Vault management console as a user who has the System Administrator role.
2. Select the **Cluster** tab.
3. In the left navigation bar, select **Management**.
4. Check the following areas:
   - To find the node version, check the Cluster Details area.
   - To find the cluster version, check the Cluster Information area.

## 7.6 Step 5: If Necessary, Add Disk Space to Extend Swap Space

If necessary, extend the swap space on each node. Oracle Key Vault release 21.11 requires a hard disk size greater than or equal to 1 TB in size with approximately 64 GB of swap space.

If your system does not meet this requirement, follow these instructions to extend the swap space. You can check how much swap space you have by running the `swapon -s` command. By default, Oracle Key Vault releases earlier than release 18.1 were installed with approximately 4 GB of swap space. After you complete the upgrade to release 18.1 or later, Oracle recommends that you increase the swap space allocation for the server on which you upgraded Oracle Key Vault. A new Oracle Key Vault installation is automatically configured with sufficient swap space. However, if you upgraded from a previous release, and your system does not have the desired amount of swap space configured, then you must manually add disk space to extend the swap space, particularly if the intention is to convert the upgraded server into the first node of a multi-master cluster.

1. Log in to the server in which you upgraded Oracle Key Vault and connect as `root`.
2. Check the current amount of swap space.

   ```
   [root@my_okv_server support]# swapon -s
   ```

   Output similar to the following appears. This example shows that the system has 4 GB of swap space.

   ```
   Filename Type Size Used Priority
   /dev/dm-0 partition 4194300 3368 -1
   ```

   There **must** be 64 GB of swap space if the disk is greater than 1 TB in size.

3. Run the `vgs` command to determine how much free space is available.

   ```
   vgs
   ```

   The `VFree` column shows how much free space you have (for example, 21 GB).

4. Power off the server in order to add a new disk.

   ```
   /sbin/shutdown -h now
   ```

5. Add a new disk to the server of a size that will bring the VFree value to over 64 GB.
6. Start the server.
7. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

8. Run the `fdisk -l` command to find if there are any available partitions on the new disk.

   ```
   fdisk -l
   ```

   At this stage, there should be no available partitions.

9. Run the `fdisk` *`disk_device_to_be_added`* command to create the new partition.

   For example, to create a disk device named `/dev/sdc`:

   ```
   fdisk /dev/sdc
   ```

   In the prompts that appear, enter the following commands in sequence:

   - `n` for new partition
   - `p` for primary
   - `1` for partition number
   - Accept the default values for cylinder (press **Enter** twice).
   - `w` to write and exit

10. Use the `pvcreate` *`disk_device_partition`* command to add the newly added disk to the physical volume.

    For example, for a disk device named `/dev/sdc1`, which is the name of the disk partition that you created (based on the name used for the disk device that was added).

    ```
    pvcreate /dev/sdc1
    ```

    Output similar to the following appears:

    ```
    Physical volume "/dev/sdc1" successfully created
    ```

11. Use the `vgextend vg_root` *`disk_device_partition`* command to extend the logical volume with this disk space that you just added.

For example, for the partition /dev/sdc1, you would run:

```
vgextend vg_root /dev/sdc1
```

Output similar to the following appears:

```
Volume group "vg_root" successfully extended
```

12. Run the vgs command again to ensure that VFree shows an increase of 64 GB.

    ```
    vgs
    ```

13. Disable swapping.

    ```
    [root@my_okv_server support]# swapoff -v /dev/vg_root/lv_swap
    ```

14. To extend the swap space, run the lvresize command.

    ```
    [root@my_okv_server support]# lvresize -L +60G /dev/vg_root/lv_swap
    ```

    Output similar to the following appears:

    ```
    Size of logical volume vg_root/lv_swap changed from 4.00 GiB (128 extents)
    to 64.00 GiB (2048 extents)
    Logical volume lv_swap successfully resized.
    ```

15. Format the newly added swap space.

    ```
    [root@my_okv_server support]# mkswap /dev/vg_root/lv_swap
    ```

    Output similar to the following appears:

    ```
    mkswap: /dev/vg_root/lv_swap: warning: don't erase bootbits sectors
    on whole disk. Use -f to force.
    Setting up swapspace version 1, size = 67108860 KiB
    no label, UUID=fea7fc72-0fea-43a3-8e5d-e29955d46891
    ```

16. Enable swapping again.

    ```
    [root@my_okv_server support]# swapon -v /dev/vg_root/lv_swap
    ```

17. Verify the amount of swap space that is available.

    ```
    [root@my_okv_server support]# swapon -s
    ```

    Output similar to the following appears:

    ```
    Filename Type Size Used Priority
    /dev/dm-0 partition 67108860 0 -1
    ```

18. Restart the Oracle Key Vault server.

    ```
    /sbin/reboot
    ```

    For primary-standby deployments, ensure that the primary and standby nodes sync up before proceeding further with next steps.

## 7.7 Step 6: If Necessary, Remove Old Kernels

For each multi-master cluster node, Oracle recommends that you clean up the older kernels that were left behind after the upgrade.

While the older kernel is not in use, it may be marked as an issue by some code analysis tools.

1. Log in to the Oracle Key Vault server as the `support` user.
2. Switch to the `root` user.

    ```
    su - root
    ```

3. Mount `/boot` if it was not mounted on the system.
    1. Check if the `/boot` is mounted. The following command should display `/boot` information if it was mounted.

        ```
        df -h /boot;
        ```

    2. Mount it if `/boot` is not mounted.

        ```
        /bin/mount /boot;
        ```

4. Check the installed kernels and the running kernel.
    1. Search for any kernels that are installed.

        ```
        rpm -q kernel-uek | sort
        ```

        The following example output shows that two kernels are installed:

        ```
        kernel-uek-4.14.35-2047.504.2.el7uek.x86_64
        kernel-uek-5.4.17-2136.329.3.1.el8uek.x86_64
        ```

    2. Check the latest kernel.

        ```
        uname -r
        ```

        The following output shows an example of a kernel version that was installed at the time:

        ```
        5.4.17-2136.304.4.5.el7uek.x86_64
        ```

        This example assumes `5.4.17-2136.304.4.5.el7uek.x86_64` as the latest version (newer versions may be available by now). Based on the output from the commands above, remove the older kernel `(kernel-uek-4.14.35-2047.504.2.el7uek.x86_64).` You should remove all kernels that are older than the latest kernel.

5. Remove the older kernel and its associated RPMs.

    For example, to remove the `kernel-uek-4.14.35-2047.504.2.el7uek.x86_64 kernel:`

    ```
    yum --disablerepo=* remove `rpm -qa|grep 4.14.35-2047.504.2.el7uek`
    ```

    Output similar to the following appears:

```
  Resolving Dependencies
-->   Running transaction check
---> Package kernel-uek.x86_64 0:4.14.35-2047.504.2.el7uek will be erased
---> Package kernel-uek-devel.x86_64 0:4.14.35-2047.504.2.el7uek will be erased
--> Finished Dependency Resolution

Dependencies Resolved

======================================================================================
============================
 Package               Arch        Version
Repository                          Size
======================================================================================
============================
Removing:
 kernel-uek          x86_64         4.14.35-2047.504.2.el7uek
@anaconda/7.7                        58 M
 kernel-uek-devel    x86_64         4.14.35-2047.504.2.el7uek       @avs-ol-
dependencies                 63 M

Transaction Summary
======================================================================================
============================
Remove        2 Package(s)

Installed size: 121 M
Is this ok [y/N]:
```

6. Enter `y` to accept the deletion output.
7. Repeat these steps starting with Step 4 for all kernels that are older than the latest kernel.

## 7.8 Step 7: If Necessary, Remove SSH-Related DSA Keys

For each multi-master cluster node, you should remove SSH-related DSA keys left behind after the upgrade.

1. Log in to the Oracle Key Vault management console as a user with the System Administrator role.
2. Enable SSH.

   Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **IP address(es)** and then enter only the IP addresses that you need, or select **All**. Click **Save**.
3. Log in to the Oracle Key Vault support account using SSH as the `support` user and then switch to the `root` user.

   ```
   ssh support@OracleKeyVault_serverIPaddress

   su - root
   ```
4. Change directory to `/etc/ssh`.

   ```
   cd /etc/ssh
   ```
5. Rename the following keys.

   ```
   mv ssh_host_dsa_key.pub ssh_host_dsa_key.pub.retire
   mv ssh_host_dsa_key ssh_host_dsa_key.retire
   ```
6. Disable SSH access.

Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **Disabled**. Click **Save**.

## 7.9 Step 8: Upgrade the Endpoint Software

When you upgrade the Oracle Key Vault server software appliance, also upgrade the endpoint software to get access to the latest enhancements.

Oracle Key Vault client software is backward-compatible. While older versions of Oracle Key Vault client software are fully functional with an upgraded Oracle Key Vault server, some new Oracle Key Vault features are only available with the current client software.
You can upgrade an endpoint by upgrading the endpoint software or re-enrolling the endpoint. Upgrading the endpoint software does not affect the existing endpoint certificate or `okvclient.ora`, the endpoint configuration file. Re-enrolling an endpoint invalidates an existing endpoint certificate, and a new endpoint certificate as well as `okvclient.ora` are installed. Oracle recommends that you upgrade the endpoint software for minor version upgrades (for example, from 21.x to 21.y) and consider re-enrolling the endpoint when upgrading across major versions (for example, from 18.x to 21.y).

Before an endpoint that uses Oracle Key Vault for TDE key management can take advantage of new Oracle Key Vault features, for example non-extractable TDE master keys, it must be upgraded to match the new Oracle Key Vault release.

1. For the endpoint upgrade of a TDE-enabled database, the database instance must be shut down to install the latest `PKCS#11` library. Oracle recommends upgrading all endpoints for TDE-enabled databases on the same host together. Review the instructions in step 6 before proceeding with the upgrade of endpoints for TDE-enabled databases.

   You can upgrade an endpoint by updating the endpoint software or by re-enrolling the endpoint. **Perform steps 2 - 4** to update the endpoint software.
   Or

   **Perform step 5** to re-enroll the endpoint.

2. Download the endpoint software (`okvclient.jar`) and install it in your existing endpoint directory path as follows:

   a. Go to the Oracle Key Vault management console login screen.

   b. Click the **Endpoint Enrollment and Software Download** link.

   c. In the **Download Endpoint Software Only** section, select the appropriate platform from the drop-down list.

   d. Click the **Download** button to download the `okvclient.jar` file.

3. Identify the path to your existing endpoint installation that you are about to upgrade. For example, `/etc/ORACLE/KEYSTORES/okv` (where `/etc/ORACLE/KEYSTORES is WALLET_ROOT` of your database, or the softlink in `$ORACLE_BASE/okv/$ORACLE_SID` points to).

4. Install the endpoint software by running the following command:

   ```
   java -jar okvclient.jar -d existing_endpoint_directory_path
   ```

   For example:

   ```
   java -jar okvclient.jar -d /etc/ORACLE/KEYSTORES/okv
   ```

If you are installing the `okvclient.jar` file for an endpoint that has Oracle Database 23ai, then include the `-arch db23ai` option during the installation. The new endpoint software for Oracle Database 23ai is required to support new features such as using OpenSSL for FIPS mode and the new version of local auto login wallets in Oracle Database 23ai. The new endpoint software for Oracle Database 23ai is supported on the Linux-x64 platform only.

For example:

```
Java -jar okvclient.jar -d /home/oracle/okvutil -arch db23ai
```

If you are installing the `okvclient.jar` file on a Windows endpoint system that has Oracle Database 11.2.0.4 only, then include the `–db112` option. This option is not necessary for any other combination of endpoint platform or Oracle Database version.

For example:

```
java -jar okvclient.jar -d /home/oracle/okvutil -v -db112
```

5. Perform the following steps to re-enroll the endpoint software, which also generates a new endpoint certificate. The easiest way to re-enroll an endpoint is by using the following commands of the RESTful services utility:

   a. Re-enroll the endpoint by using the following RESTful services utility command:

      ```
      okv admin endpoint re-enroll
      ```

   b. Back up the `OKV_HOME` directory and delete the files under `OKV_HOME`:

      ```
      cp -R $OKV_HOME $OKV_HOME_bkp_date +%Y%m%d
      ```

   c. Go to the `$OKV_HOME` directory and remove all the files.

   d. For Oracle Database 21c and earlier:
      Download and install the endpoint software by using the following RESTful services utility command:

      ```
      okv admin endpoint provision
      ```

      For Oracle Database 23ai:

      Download and install the endpoint software by using the following RESTful services utility command:

      ```
      okv admin endpoint provision --arch db23ai
      ```

   Re-enrolling an endpoint generates a new `okvclient.jar` file and installs the file in the OKV_HOME directory but maintains the relationship between the endpoint and its default wallet.

   > **Note:**
   >
   > To re-enroll an endpoint without using RESTful services utility, follow the steps described in How to Re-enroll an Endpoint.

6. Install the updated PKCS#11 library file.

   This step is needed only for online TDE master encryption key management by Oracle Key Vault. If an endpoint uses online TDE master encryption key management by Oracle Key Vault, then you must upgrade the `PKCS#11` library while upgrading the endpoint software. For Oracle Database 21c and earlier:

   Ensure that database instance is shut down before installing the PKCS#11 library in the location `/opt/oracle/extapi/64/hsm/oracle/1.0.0`.

   - **On UNIX/Linux platforms**: Run `root.sh` from the `bin` directory of endpoint installation directory to copy the latest `liborapkcs.so` file for Oracle Database endpoints.

     ```
     $ sudo /etc/ORACLE/KEYSTORES/okv/bin/root.sh
     ```

     Or

     ```
     $ su - root
     # /etc/ORACLE/KEYSTORES/okv/bin/root.sh
     ```

   - **On Windows**: Run `root.bat` from the `bin` directory of endpoint installation directory to copy the latest `liborapkcs.dll` file for Oracle Database endpoints. You will be prompted for the version of the database in use.

     ```
     bin\root.bat
     ```

   If you are upgrading multiple endpoints for TDE-enabled databases on a host, you must install the latest Oracle Key Vault PKCS#11 library only once on the host computer.

   On the host, perform the following steps when upgrading multiple endpoints for TDE-enabled databases:

   - Complete the upgrade of all Oracle Key Vault endpoints for the TDE-enabled databases.
   - Shut down corresponding TDE-enabled database instances.
   - Execute the `root.sh` or `root.bat` script to install the latest Oracle Key Vault `PKCS#11` library.

   For Oracle Database 23ai: Oracle recommends to install the latest `liborapkcs.so` file in a fixed custom location using the `root.sh` script.

   This enables upgrading the `liborapkcs.so` file in future without encountering database downtime.

   The fixed custom location is in the following format:

   ```
   /opt/oracle/extapi/64/pkcs11/okv/<okv_version>/lib
   ```

   For example, in the Oracle Key Vault 21.11 release, the location is

   ```
   /opt/oracle/extapi/64/pkcs11/okv/21.11.0.0.0/lib
   ```

- **On UNIX/Linux platforms**: Run `root.sh` from the `bin` directory of the endpoint installation directory to copy the latest `liborapkcs.so` file for Oracle Database endpoints.

  ```
  $ sudo /etc/ORACLE/KEYSTORES/okv/bin/root.sh --
  okv_pkcs11_library_location
  ```

  Or

  ```
  $ su - root
  # /etc/ORACLE/KEYSTORES/okv/bin/root.sh -okv_pkcs11_library_location
  ```

If you are upgrading multiple endpoints for TDE-enabled databases on a host, you must install the latest Oracle Key Vault `PKCS#11` library only once for the endpoint software version.

On the host where there are multiple endpoints for TDE-enabled Oracle database 23ai, each database can upgrade their endpoint software separately and switch to using the upgraded liborapkcs.so library by setting up the database initialization parameter `PKCS11_LIBRARY_LOCATION` to point to the upgraded library.

> **Note:**
>
> Installing the `liborapkcs.so` library in a legacy location is also supported with Oracle Database 23ai databases. However, it is not recommended.

7. Update the SDK software.

   If you have already deployed the SDK software, Oracle recommends that you redeploy the SDK software in the same location after you complete the upgrade to Oracle Key Vault release 21.10. This enables you to have access to the new SDK APIs that were introduced since the Oracle Key Vault version that you are upgrading from.

   a. Go to the Oracle Key Vault management console login screen.

   b. Click the **Endpoint Enrollment and Software Download** link.

   c. c. In the Download Software Development Kit section, select the appropriate language and platform for your site.

   d. Click the **Download** button to get the SDK zip file.

   e. Identify the existing location where SDK software was already deployed.

   f. Navigate to the directory in which you saved the SDK zip file.

   g. Unzip the SDK zip file.

      For example, on Linux, to unzip the Java SDK zip file, use the following command:

      ```
      unzip -o okv_jsdk.zip -d existing_endpoint_sdk_directory_path
      ```

      For the C SDK zip file, use this command:

      ```
      unzip -o okv_csdk.zip -d existing_endpoint_sdk_directory_path
      ```

   h. Do not exit this page.

8. If you had deployed the RESTful services utility in the previous release, then re-deploy the latest `okvrestclipackage.zip` file.

   The latest `okvrestclipackage.zip` file enables you to have access to the new RESTful services utility commands that were introduced since the Oracle Key Vault version that you are upgrading from.

   You can use `wget` or `curl` to download `okvrestclipackage.zip`.

   ```
   wget --no-check-
   certificate https://Oracle_Key_Vault_IP_address:5695/
   okvrestclipackage.zip curl -O -
   k https://Oracle_Key_Vault_IP_address:5695/okvrestservices.jar
   ```

   Start the Oracle Databases if the upgrade of Oracle Key Vault endpoints for all of the TDE enabled databases on this host machine is complete.

   For Oracle Database 23ai which is using the custom path for installing the `liborapkcs.so` library from step 6 above, perform the following additional steps.

   a. Log in to the CDB Root as a user who has been granted the `ALTER SYSTEM` privilege.

   b. Set the static initialization parameter `PKCS11_LIBRARY_LOCATION` to point to the upgraded `liborapkcs.so` library.

      For example:

      ```
      ALTER SYSTEM SET
      PKCS11_LIBRARY_LOCATION='/opt/oracle/extapi/64/pkcs11/okv/
      21.11.0.0.0/lib/liborapkcs.so' SCOPE=SPFILE SID='*';
      ```

9. After the database restart, the database will switch to using the new upgraded library from the custom path. The database is also now set to switch to newer libraries in future without encountering downtime.

   After you upgrade Oracle Key Vault to a new release in future (for example 21.xx.0.0.0), the `root.sh` file in the upgraded endpoint can be used to copy the `liborapkcs.so` library to the new path `/opt/oracle/extapi/64/pkcs11/21.12.0.0.0/lib`. The database can switch to the new library by using the `SWITCHOVER` command.
   For example:

   ```
   ADMINISTER KEY MANAGEMENT SWITCHOVER TO LIBRARY
   '/opt/oracle/extapi/64/pkcs11/okv/21.12.0.0.0/lib/liborapkcs.so'
   FOR ALL CONTAINERS;
   ```

   At this stage, the endpoint is fully upgraded.

10. If your site requires that you restrict TDE master encryption keys from leaving Oracle Key Vault and if you are using an Oracle Real Application Clusters (Oracle RAC) environment, then perform the following steps on each Oracle RAC node:

    a. Perform the endpoint upgrade on each Oracle RAC node.

    b. Set the extractable attribute value for symmetric keys.

       By default, the extractable attribute value is `true`, which means that the key material of symmetric keys can be extracted from Oracle Key Vault during certain operations. If you want to prevent symmetric keys from being extracted, then you must set this value to `false`. You can set an extractable attribute value as follows:

  - Set the default value for the extractable attribute of new symmetric keys in the endpoint settings. Endpoint-specific setting overrides the global endpoint settings.
  - Explicitly specify the value of the extractable attribute when creating or registering a new symmetric key.
  - Modify the extractable attribute of an existing symmetric key.

  See *Oracle Key Vault Administrator's Guide*.

c. As a user who has the `SYSDBA` or `SYSKM` administrative privilege, perform a rekey operation in the Oracle RAC node. Use the following syntax:

```
ADMINISTER KEY MANAGEMENT SET [ENCRYPTION] KEY
[FORCE KEYSTORE][USING TAG 'tag_name']
IDENTIFIED BY [EXTERNAL STORE | keystore_password]
[WITH BACKUP [USING backup_identifier']];
```

  See *Oracle Database Advanced Security Guide* for more information about rekeying a TDE master encryption key.

11. If your site requires that you restrict TDE master encryption keys from leaving Oracle Key Vault and if you are using an Oracle Data Guard environment, then do the following on the primary and standby databases:

    a. Perform the endpoint upgrade on the primary and standby databases.

    b. Set the extractable attribute value for symmetric keys.

    By default, the extractable attribute value is `true`, which means that the key material of symmetric keys can be extracted from Oracle Key Vault during certain operations. If you want to prevent symmetric keys from being extracted, then you must set this value to `false`. You can set an extractable attribute value as follows:

    - Set the default value for the extractable attribute of new symmetric keys in the endpoint settings. Endpoint-specific setting overrides the global endpoint settings.
    - Explicitly specify the value of the extractable attribute when creating or registering a new symmetric key.
    - Modify the extractable attribute of an existing symmetric key.

    See *Oracle Key Vault Administrator's Guide*.

    c. As a user who has the `SYSDBA` or `SYSKM` administrative privilege, perform a rekey operation in the primary and standby databases. Use the following syntax:

```
ADMINISTER KEY MANAGEMENT SET [ENCRYPTION] KEY
[FORCE KEYSTORE]
[USING TAG 'tag_name']
IDENTIFIED BY [EXTERNAL STORE | keystore_password]
[WITH BACKUP [USING 'backup_identifier'']];
```

    See *Oracle Database Advanced Security Guide* for more information about rekeying a TDE master encryption key.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

# 8 Upgrading a Primary-Standby Oracle Key Vault Server

This upgrade includes the Oracle Key Vault server software and utilities that control the associated endpoint software

## 8.1 About Upgrading a Primary-Standby Oracle Key Vault Server

To benefit from new features and security enhancements, Oracle recommends that you upgrade Oracle Key Vault server to the latest release.

You must upgrade in the following order: first perform a full backup of Oracle Key Vault, upgrade the Oracle Key Vault primary-standby server pair, upgrade the endpoint software, and last, perform another full backup of the upgraded server. Note that upgrading requires a restart of the Oracle Key Vault server.

Oracle recommends using multi-master cluster deployment for production use. During upgrade of a multi-master cluster, there is no downtime of databases or business applications. A 2-node cluster provides read-only availability, and 4 or more node clusters provide continuous read-write availability. You can enable the persistent cache feature to enable endpoints to continue operation during the upgrade process.

When you upgrade the Oracle Key Vault server software, to access the latest enhancements, also upgrade the endpoint software. While endpoint software from the previous Oracle Key Vault release will continue to function with the upgraded Oracle Key Vault server, new endpoint functionality may not work.

Before you begin the upgrade, refer to *Oracle Key Vault Release Notes* for additional information about performing upgrades.

**Related Topics**

- *Oracle Key Vault Release Notes*

## 8.2 Step 1: Back Up the Server Before You Upgrade

Before you upgrade the Oracle Key Vault server, perform a one-time backup to a remote destination so that you can recover data in case the upgrade fails.

> **Caution:**
>
> Do not bypass this step. Back up the server before you perform the upgrade so that your data is safe and recoverable.

## 8.3 Step 2: Perform Pre-Upgrade Tasks for the Primary-Standby Oracle Key Vault

To ensure a smooth upgrade to Oracle Key Vault, you should prepare the server you are upgrading.

1. In the server where Oracle Key Vault is installed, log in as user `support`, and then switch to the `root` user.
2. Ensure that the server meets the minimum disk space requirements for an upgrade. For example, 6 GB of free space in the `/usr/local/dbfw/tmp` directory. See the Oracle Key Vault Readme for this release to determine the disk space requirements for the upgrade.
3. Ensure that you disable diagnostics and clean up disk space in `/usr/local/dbfw/tmp` before you upgrade by performing the following steps:

   If the Oracle Key Vault system being upgraded is from release 21.6 or later, log in to the Oracle Key Vault management console as a user with the System Administrator role, and navigate to the **System** tab, and then click the **Diagnostics** button.

   If the Diagnostics Package Files pane is displayed, then click **Clear** to disable diagnostics. Note that the **Diagnostics Package Files** pane will be displayed only if the diagnostics bundle was previously generated, and the files were not cleared.

If the Diagnostics Package Files pane is not displayed, or if the diagnostics bundle was previously generated using the **dbfw-diagnostics-package.rb** utility, then log in to the Oracle Key Vault system and run the following commands to disable diagnostics and clean up disk space in `/usr/local/dbfw/tmp`:

a. SSH into the Oracle Key Vault system as user `support`, then switch to user `root`:

```
ssh support@<OKV_IP_Address>
su - root
```

b. Delete the generated diagnostics zip file and remove the package using the following commands:

```
/usr/local/dbfw/bin/priv/dbfw-diagnostics-package.rb --clean
/usr/local/dbfw/bin/priv/dbfw-diagnostics-package.rb --remove
```

4. Check the boot partition size. If any of the nodes in question have a boot partition that is less than 500 MB, then you cannot upgrade that system to the new release. You can check this size as follows:

   a. Mount the `/boot` partition.

   ```
   # mount /boot
   ```

   b. Check the `Size` column given by the following command:

   ```
   # df -h /boot
   ```

   c. Unmount the `/boot` partition:

   ```
   # umount /boot
   ```

   If the boot partition given by this command shows less than 488 MB, then you cannot upgrade to the current release. Oracle recommends that you restore a backup of the current configuration to a freshly installed system of the same release as the current system, and upgrade that to the new release instead.

5. If Oracle Key Vault is using the BIOS boot mode, then ensure that the disk size is not greater than 2 TB. If this is the case, then you cannot upgrade to the current release. Oracle recommends that you restore a backup of the current configuration onto a system with a disk that is less than 2 TB in size, and upgrade that to the new release instead.

6. If you need to increase available disk space, then remove the temporary jar files located in `/usr/local/okv/ssl`. *Be careful in doing so.* If you accidentally delete any files other than the jar files in `/usr/local/okv/ssl`, then the Oracle Key Vault server becomes non-functional.

7. Increase your disk space by extending the `vg_root` size.

   You must increase the disk space by extending `vg_root` before you perform the upgrade.

8. Ensure that no full or incremental backup jobs are running. Delete all scheduled full or incremental backup jobs before the upgrade.

9. Plan for downtime according to the following specifications:

| Oracle Key Vault Usage | Downtime required |
|---|---|
| Wallet upload or download | NO |
| Java Keystore upload or download | NO |
| Transparent Data Encryption (TDE) direct connect | YES (NO with persistent cache) |
| Primary Server Upgrade in a primary-standby deployment | YES (NO with persistent cache) |

10. Plan for downtimes.
    - If Oracle Key Vault uses an online master encryption key, then plan for a downtime of 15 minutes during the Oracle Database endpoint software upgrades. Database endpoints can be upgraded in parallel to reduce total downtime.
    - Plan for a downtime of a few hours. The persistent cache allows you to upgrade Oracle Key Vault servers without database downtime. The default duration of the persistent cache from the moment the Oracle Key Vault server becomes unavailable is 1,440 minutes (one day).
11. If the Oracle Key Vault system has a syslog destination configured, ensure that the remote syslog destination is reachable from the Oracle Key Vault system, and that logs are being correctly forwarded. If the remote syslog destination is not reachable from the Oracle Key Vault system, then the upgrade process can become much slower than normal.
12. If Oracle Audit Vault was integrated with Oracle Key Vault in Oracle Key Vault release 21.2 or earlier, then do the following on the primary server (but not the standby) to disable and remove the Oracle Audit Vault integration:
    a. Disable the Oracle Audit Vault integration: Log into the Oracle Key Vault management console as a System Administrator, select the **System** tab and then **Settings** from the left navigation bar. In the Monitoring and Alerts pane, select Audit Vault. In the Audit Vault integration pane that appears, disable Oracle Audit Vault. Click **Save**.

    b. Perform the remaining steps in this procedure on each server where the Oracle Audit Vault integration was configured.

    c. Log in to the Oracle Key Vault server through SSH as user `support`, switch user `su` to `root` and then switch user `su` to `oracle`.

    d. Stop the agent by executing the following command:

    ```
    agent_installation_directory/bin/agentctl stop
    ```

    e. Log in to the Oracle Audit Vault Server console as an Oracle Audit Vault administrator.

    f. Delete the corresponding agent and target.

    g. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

    h. Delete the installation directory for the Oracle Audit Vault agent.
13. Ensure that the Oracle Key Vault server certificate has not expired, nor is close to expiry, before you begin the upgrade.

    You can find how much time the Oracle Key Vault server certificate has before it expires by checking the **OKV Server Certificate Expiration** setting on the Configure Alerts page in the Oracle Key Vault management console.
14. If you are performing an upgrade while using an HSM as a Root of Trust, then consult *Oracle Key Vault Root of Trust HSM Configuration Guide* for any additional steps that may be needed.

15. Ensure that the backup of the `orapwdbfwdb` file matches the original file.
    a. SSH into the Oracle Key Vault system as user `support`, then switch to user `root`:

    ```
    ssh support@<OKV_IP_Address>
    su - root
    ```

    b. Verify that the backup file exists:

    ```
    su - oracle
    ls -ltr /var/lib/oracle/okv_orapwd_backup_dir/orapwdbfwdb
    ```

    c. If the backup file exists, then perform the following steps:
    - Compare the original file with the backup file:

      ```
      diff /var/lib/oracle/dbfw/dbs/orapwdbfwdb /var/lib/oracle/
      okv_orapwd_backup_dir/orapwdbfwdb
      ```

    - If there is a difference between the files, then update the backup file by copying the original file:

      ```
      cp /var/lib/oracle/dbfw/dbs/orapwdbfwdb /var/lib/oracle/
      okv_orapwd_backup_dir/orapwdbfwdb
      ```

**Related Topics**

- Step 3: Add Disk Space to Extend the vg_root for the Release 21.11 Upgrade
  Before upgrading to Oracle Key Vault release 21.11, you will need to extend the `vg_root` to increase disk space.
- *Oracle Key Vault Administrator's Guide*

## 8.4 Step 3: Add Disk Space to Extend the vg_root for the Release 21.11 Upgrade

Before upgrading to Oracle Key Vault release 21.11, you will need to extend the `vg_root` to increase disk space.

If you are upgrading from an earlier Oracle Key Vault release 21.*x* release and have already extended the `vg_root`, then you can bypass this step.

Before you start this procedure, ensure that all endpoints have persistent cache enabled and in use.

1. Log in to the server for which you will perform the upgrade and switch user as `root`.
2. Ensure that the persistent cache settings for Oracle Key Vault have been set.

   You will need to ensure that the persistent cache has been enabled because in a later step in this procedure, you must shut down the server. Shutting down the Oracle Key Vault server will incur downtime. To avoid any downtime, Oracle recommends that you turn on persistent cache.
3. Run the `vgs` command to determine the free space

   ```
   vgs
   ```

The `VFree` column shows how much free space you have (for example, 21 GB).

4. Power off the server in order to add a new disk

   ```
   /sbin/shutdown -h now
   ```

5. Add a new disk to the server with a capacity of 100 GB or greater

6. Start the server.

7. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

8. Stop the Oracle Key Vault services.

   ```
   service tomcat stop;
   service httpd stop;
   service kmipus stop;
   service kmip stop;
   service okvogg stop;
   service javafwk stop;
   service monitor stop;
   service controller stop;
   service dbfwlistener stop;
   service dbfwdb stop;
   service rsyslog stop;
   ```

9. Run the `fdisk -l` command to find if there are any available partitions on the new disk.

   ```
   fdisk -l
   ```

   At this stage, there should be no available partitions.

10. Run the `fdisk` *`disk_device_to_be_added`* command to create the new partition.

    For example, to create a disk device named `/dev/sdb`:

    ```
    fdisk /dev/sdb
    ```

    In the prompts that appear, enter the following commands in sequence:

    - `n` for new partition
    - `p` for primary
    - `1` for partition number
    - Accept the default values for cylinder (press **Enter** twice).
    - `w` to write and exit

11. Use the `pvcreate` *`disk_device_partition`* command to add the newly added disk to the physical volume.

For example, for a disk device named /dev/sdb1, which is the name of the disk partition that you created (based on the name used for the disk device that was added).

```
pvcreate /dev/sdb1
```

Output similar to the following appears:

```
Physical volume "/dev/sdb1" successfully created
```

12. Use the `vgextend vg_root` *`disk_device_partition`* command to extend the logical volume with this disk space that you just added.

    For example, for the partition /dev/sdb1, you would run:

    ```
    vgextend vg_root /dev/sdb1
    ```

    Output similar to the following appears:

    ```
    Volume group "vg_root" successfully extended
    ```

13. Run the `vgs` command again to ensure that `VFree` shows an increase of 100 GB.

    ```
    vgs
    ```

    Output similar to the following appears:

    ```
    VG      #PV #LV #SN Attr   VSize   VFree
    vg_root   2  12   0 wz--n- 598.75g <121.41g
    ```

14. Restart the Oracle Key Vault server.

    ```
    /sbin/reboot
    ```

    For primary-standby deployments, ensure that the primary and standby nodes sync up before proceeding further with next steps.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

## 8.5 Step 4: Upgrade the Oracle Key Vault Primary-Standby Pair

You can upgrade a pair of Oracle Key Vault servers in a primary-standby deployment.

- About Upgrading an Oracle Key Vault Server Primary-Standby Pair
  In a primary-standby deployment you must upgrade both primary and standby Oracle Key Vault servers.
- Upgrading a Pair of Primary-Standby Oracle Key Vault Servers
  You should allocate several hours to upgrade the primary server after upgrading the standby.

## 8.5.1 About Upgrading an Oracle Key Vault Server Primary-Standby Pair

In a primary-standby deployment you must upgrade both primary and standby Oracle Key Vault servers.

Note that persistent caching enables endpoints to continue to be operational during the upgrade process.

> **Note:**
>
> If you are upgrading from a system with 4 GB RAM, first add an additional 12 GB memory to the system before upgrading.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*About the Persistent Encryption Master Key Cache

## 8.5.2 Upgrading a Pair of Primary-Standby Oracle Key Vault Servers

You should allocate several hours to upgrade the primary server after upgrading the standby.

You must perform the upgrade of standby and primary servers in one session with as little time between the standby and primary upgrade. The upgrade time is approximate and a function of the volume of data stored and managed by Oracle Key Vault. For large volumes of data, the upgrade time may be longer than several hours.

1. For both primary and standby servers in the primary-standby configuration, prepare for upgrade.
   - Ensure that both the primary and standby systems have at least 16 GB memory.
   - Add disk space to extend the `vg_root`.
   - While the upgrade is in progress, do not change any settings or perform any other operations that are not part of the upgrade instructions below.
   - Upgrade the Oracle Key Vault server during a planned maintenance window because the upgrade process requires the endpoints to be shut down during the upgrade, if no persistent cache has been configured. With persistent cache enabled, endpoints will continue to be operational during the upgrade process.
2. Ensure that you have backed up the server you are upgrading so your data is safe and recoverable.

   Ensure that in the time between the backup and shutting down the Oracle Key Vault servers for upgrade, that no databases perform a set or rekey operation (for example, using the `ADMINISTER KEY MANAGEMENT` statement), since these new keys will not be included in the backup.

   Do not proceed without completing this step.
3. First, upgrade the standby server while the primary server is running.
   a. Log into the Oracle Key Vault management console as a user who has the System Administrator role.
   b. Ensure that SSH access is enabled.
   c. Ensure you have enough space in the destination directory for the upgrade ISO files.

d. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

```
ssh support@okv_server_IP_address
su - root
```

If the SSH connection times out while you are executing any step of the upgrade, then the operation will not complete successfully. Oracle recommends that you ensure that you use the appropriate values for the `ServerAliveInterval` and `ServerAliveCountMax` options for your SSH sessions to avoid upgrade failures.

Using the `tmux` command prevents network disconnections interrupting the upgrade. If the session terminates, resume as follows:

```
root# tmux a
```

e. Copy the upgrade ISO file to the destination directory using **Secure Copy Protocol** or other secure transmission method.

Note that the upgrade ISO file is **not** the installation ISO file that you downloaded from eDelivery. You can download the Oracle Key Vault upgrade software from the My Oracle Support website at https://support.oracle.com/portal/.

```
root# scp remote_host:remote_path/okv-upgrade-disc-
new_software_release.iso /var/lib/oracle
```

In this specification:

- `remote_host` is the IP address of the computer containing the ISO upgrade file.
- `remote_path` is the directory of the ISO upgrade file. Do not copy this file to any location other than the `/var/lib/oracle` directory.

f. Make the upgrade accessible by using the `mount` command:

```
root# /bin/mount -o loop,ro /var/lib/oracle/okv-upgrade-disc-
new_software_release.iso /images
```

g. Clear the cache using the `clean all` command:

```
root# yum -c /images/upgrade.repo clean all
```

h. Apply the upgrade with the `upgrade.rb` command:

```
root# ruby /images/upgrade.rb --confirm
```

If the system is successfully upgraded, then the command will display the following message:

```
Reboot now to continue the upgrade process.
```

If you see an error message, then check the log file `/var/log/messages` for additional information.

If the upgrade of the Oracle Key Vault system fails with the following message:

```
Failed to apply update: The Oracle Key Vault upgrade has
detected issues with FIPS mode. Please consult the Oracle Key
Vault upgrade documentation or contact Oracle Support.
```

Perform the following steps:

        i. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

        ```
        ssh support@<Oracle_Key_Vault_IP_address>
            su - root
        ```

        ii. Run the following command:

        ```
        /images/preupgrade/okv_check_fips_status_utility fix_fips_mode_consistency
        ```

        iii. Follow the instructions displayed in the output and reboot the system when prompted.

        iv. After the system has successfully rebooted, SSH into the system again. As user `root`, mount the upgrade ISO and run the following command to verify that there is no FIPS mode inconsistency on the system:

        ```
        /images/preupgrade/okv_check_fips_status_utility
        check_for_fips_mode_consistency
        ```

        The return value 0 indicates that there is no more FIPS inconsistency.

        The return value 1 indicates that there is FIPS mode inconsistency. Run the following command to correct it:

        ```
        /images/preupgrade/okv_check_fips_status_utility fix_fips_mode_consistency
        ```

    i. Restart the Oracle Key Vault server by running the `reboot` command:

    ```
    # reboot
    ```

    On the first restart of the computer after the upgrade, the system will apply the necessary changes. This can take a few hours. Do not shut down the system during this time.

    The upgrade is completed when the screen with heading: `Oracle Key Vault Server` *`new_software_release`* appears. The revision should reflect the upgraded release.

4. Ensure that the upgraded standby Oracle Key Vault server is restarted and running.
5. Upgrade the primary Oracle Key Vault server following same steps that you followed for the standby server in Step 3.

   After both the standby and primary Oracle Key Vault servers are upgraded, the two servers will automatically synchronize.
6. Log in to the Oracle Key Vault management console as a user with the System Administrator role.
7. Select the **System** tab, and then **Status**.
8. Verify that the **Version** field displays the new software version.
9. If your site uses the Commercial National Security Algorithm (CNSA) suite, then re-install these algroithms onto the primary and standby servers.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

## 8.6 Step 5: If Necessary, Add Disk Space to Extend Swap Space

If necessary, extend the swap space on both the primary and standby servers.

Oracle Key Vault release 21.11 requires a hard disk size greater than or equal to 1 TB in size with approximately 64 GB of swap space. If your system does not meet this requirement, follow these instructions to extend the swap space. You can check how much swap space you have by running the `swapon -s` command. By default, Oracle Key Vault releases earlier than release 18.1 were installed with approximately 4 GB of swap space. After you complete the upgrade to release 18.1 or later, Oracle recommends that you increase the swap space allocation for the server on which you upgraded Oracle Key Vault. A new Oracle Key Vault installation is automatically configured with sufficient swap space. However, if you upgraded from a previous release, and your system does not have the desired amount of swap space configured, then you must manually add disk space to extend the swap space, particularly if the intention is to convert the upgraded server into the first node of a multi-master cluster.

1. Log in to the server in which you upgraded Oracle Key Vault and connect as `root`.
2. Check the current amount of swap space.

   ```
   [root@my_okv_server support]# swapon -s
   ```

   Output similar to the following appears. This example shows that the system has 4 GB of swap space.

   ```
   Filename Type Size Used Priority
   /dev/dm-0 partition 4194300 3368 -1
   ```

   There **must** be 64 GB of swap space if the disk is greater than 1 TB in size.
3. Run the `vgs` command to determine how much free space is available.

   ```
   vgs
   ```

   The `VFree` column shows how much free space you have (for example, 21 GB).
4. Power off the server in order to add a new disk.

   ```
   /sbin/shutdown -h now
   ```

5. Add a new disk to the server of a size that will bring the VFree value to over 64 GB.
6. Start the server.
7. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

8. Run the `fdisk -l` command to find if there are any available partitions on the new disk.

   ```
   fdisk -l
   ```

At this stage, there should be no available partitions.

9. Run the `fdisk` *`disk_device_to_be_added`* command to create the new partition.

   For example, to create a disk device named `/dev/sdc`:

   ```
   fdisk /dev/sdc
   ```

   In the prompts that appear, enter the following commands in sequence:

   - `n` for new partition
   - `p` for primary (for primary partition)
   - `1` for partition number
   - Accept the default values for cylinder (press **Enter** twice).
   - `w` to write and exit

10. Use the `pvcreate` *`disk_device_partition`* command to add the newly added disk to the physical volume.

    For example, for a disk device named `/dev/sdc1`, which is the name of the disk partition that you created (based on the name used for the disk device that was added).

    ```
    pvcreate /dev/sdc1
    ```

    Output similar to the following appears:

    ```
    Physical volume "/dev/sdc1" successfully created
    ```

11. Use the `vgextend vg_root` *`disk_device_partition`* command to extend the logical volume with this disk space that you just added.

    For example, for the partition `/dev/sdc1`, you would run:

    ```
    vgextend vg_root /dev/sdc1
    ```

    Output similar to the following appears:

    ```
    Volume group "vg_root" successfully extended
    ```

12. Run the `vgs` command again to ensure that `VFree` shows an increase of 64 GB.

    ```
    vgs
    ```

13. Disable swapping.

    ```
    [root@my_okv_server support]# swapoff -v /dev/vg_root/lv_swap
    ```

14. To extend the swap space, run the `lvresize` command.

    ```
    [root@my_okv_server support]# lvresize -L +60G /dev/vg_root/lv_swap
    ```

Output similar to the following appears:

```
Size of logical volume vg_root/lv_swap changed from 4.00 GiB (128 extents)
to 64.00 GiB (2048 extents)
Logical volume lv_swap successfully resized.
```

15. Format the newly added swap space.

```
[root@my_okv_server support]# mkswap /dev/vg_root/lv_swap
```

    Output similar to the following appears:

```
mkswap: /dev/vg_root/lv_swap: warning: don't erase bootbits sectors
on whole disk. Use -f to force.
Setting up swapspace version 1, size = 67108860 KiB
no label, UUID=fea7fc72-0fea-43a3-8e5d-e29955d46891
```

16. Enable swapping again.

```
[root@my_okv_server support]# swapon -v /dev/vg_root/lv_swap
```

17. Verify the amount of swap space that is available.

```
[root@my_okv_server support]# swapon -s
```

    Output similar to the following appears:

```
Filename Type Size Used Priority
/dev/dm-0 partition 67108860 0 -1
```

18. Restart the Oracle Key Vault server.

```
/sbin/reboot
```

    For primary-standby deployments, ensure that the primary and standby nodes sync up before proceeding further with next steps.

## 8.7 Step 6: If Necessary, Remove Old Kernels

Oracle recommends that for both the primary and standby servers, you clean up the older kernels that were left behind after the upgrade.

While the older kernel is not in use, it may be marked as an issue by some code analysis tools.

1. Log in to the Oracle Key Vault server as the `support` user.
2. Switch to the `root` user.

```
su - root
```

3. Mount `/boot` if it was not mounted on the system.
    a. Check if the `/boot` is mounted. The following command should display `/boot` information if it was mounted.

```
df -h /boot;
```

b. Mount it if `/boot` is not mounted.

```
/bin/mount /boot;
```

For EFI-based systems, you may need to mount `/boot/efi` if it is not already mounted.

```
/bin/mount /boot/efi
```

4. Check the installed kernels and the running kernel.

a. Search for any kernels that are installed.

```
rpm -q kernel-uek | sort;
```

The following example output shows that two kernels are installed:

```
kernel-uek-4.1.12-103.9.4.el6uek.x86_64
kernel-uek-4.1.12-112.16.7.el6uek.x86_64
```

b. Check the latest kernel.

```
uname -r;
```

The following output shows an example of a kernel version that was installed at the time:

```
4.1.12-112.16.7.el6uek.x86_64
```

This example assumes that `4.1.12-112.16.7.el6uek.x86_64` is the latest version, but newer versions may be available by now. Based on this output, you will need to remove the `kernel-uek-4.1.12-103.9.4.el6uek.x86_64` kernel. You should remove all kernels that are older than the latest kernel.

5. Remove the older kernel and its associated RPMs.

For example, to remove the `kernel-uek-4.1.12-103.9.4.el6uek.x86_64` kernel:

```
yum --disablerepo=* remove `rpm -qa | grep 4.1.12-103.9.4.el6uek`;
```

Output similar to the following appears:

```
Loaded plugins: security
Setting up Remove Process
Resolving Dependencies
--> Running transaction check
---> Package kernel-uek.x86_64 0:4.1.12-103.9.4.el6uek will be erased
---> Package kernel-uek-devel.x86_64 0:4.1.12-103.9.4.el6uek will be erased
---> Package kernel-uek-firmware.noarch 0:4.1.12-103.9.4.el6uek will be erased
--> Finished Dependency Resolution

Dependencies Resolved

=====================================================================================
============================
 Package               Arch    Version
Repository                                            Size
=====================================================================================
============================
Removing:
 kernel-uek            x86_64  4.1.12-103.9.4.el6uek  @anaconda-
OracleLinuxServer-201410181705.x86_64/6.6  241 M
 kernel-uek-devel      x86_64  4.1.12-103.9.4.el6uek  @anaconda-
OracleLinuxServer-201410181705.x86_64/6.6   38 M
 kernel-uek-firmware   noarch  4.1.12-103.9.4.el6uek  @anaconda-
```

```
OracleLinuxServer-201410181705.x86_64/6.6  2.9 M

Transaction Summary
=====================================================================================
============================
Remove        3 Package(s)

Installed size: 282 M
Is this ok [y/N]:
```

6. Enter `y` to accept the deletion output.
7. Repeat these steps starting with Step 4 for all kernels that are older than the latest kernel.

## 8.8 Step 7: If Necessary, Remove SSH-Related DSA Keys

For both the primary and standby servers, you should remove SSH-related DSA keys left behind after the upgrade, because they can cause problems with some code analysis tools.

1. Log in to the Oracle Key Vault management console as a user with the System Administrator role.
2. Enable SSH.

   Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **IP address(es)** and then enter only the IP addresses that you need, or select **All**. Click **Save**.
3. Log in to the Oracle Key Vault support account using SSH as the `support` user and then switch to the `root` user.

   ```
   ssh support@OracleKeyVault_serverIPaddress

   su - root
   ```
4. Change directory to `/etc/ssh`.

   ```
   cd /etc/ssh
   ```
5. Rename the following keys.

   ```
   mv ssh_host_dsa_key.pub ssh_host_dsa_key.pub.retire
   mv ssh_host_dsa_key ssh_host_dsa_key.retire
   ```
6. Disable SSH access.

   Log in to the Oracle Key Vault management console as a user who has the System Administrator role. Select the **System** tab, then **Settings**. In the Network Details area, click **SSH Access**. Select **Disabled**. Click **Save**.

## 8.9 Step 8: Upgrade the Endpoint Software

When you upgrade the Oracle Key Vault server software appliance, also upgrade the endpoint software to get access to the latest enhancements.

Oracle Key Vault client software is backward-compatible. While older versions of Oracle Key Vault client software are fully functional with an upgraded Oracle Key Vault server, some new Oracle Key Vault features are only available with the current client software.
You can upgrade an endpoint by upgrading the endpoint software or re-enrolling the endpoint. Upgrading the endpoint software does not affect the existing endpoint certificate or `okvclient.ora`, the endpoint configuration file. Re-enrolling an endpoint invalidates an

existing endpoint certificate, and a new endpoint certificate as well as `okvclient.ora` are installed. Oracle recommends that you upgrade the endpoint software for minor version upgrades, and consider re-enrolling the endpoint when upgrading across major versions.

Before an endpoint that uses Oracle Key Vault for TDE key management can take advantage of new Oracle Key Vault features, for example non-extractable TDE master keys, it must be upgraded to match the new Oracle Key Vault release.

1. For the endpoint upgrade of a TDE-enabled database, the database instance must be shut down to install the latest `PKCS#11` library. Oracle recommends upgrading all endpoints for TDE-enabled databases on the same host together. Review the instructions in step 6 before proceeding with the upgrade of endpoints for TDE-enabled databases.

   You can upgrade an endpoint by updating the endpoint software or by re-enrolling the endpoint. Perform steps 2 to 4 to update the endpoint software.
   Or

   Perform step 5 to re-enroll the endpoint.

2. Download the endpoint software (`okvclient.jar`) and install it in your existing endpoint directory path as follows:

   a. Go to the Oracle Key Vault management console login screen.

   b. Click the **Endpoint Enrollment and Software Download** link.

   c. In the **Download Endpoint Software Only** section, select the appropriate platform from the drop-down list.

   d. Click the **Download** button to download the `okvclient.jar` file.

3. Identify the path to your existing endpoint installation that you are about to upgrade. For example, `/etc/ORACLE/KEYSTORES/okv` (where `/etc/ORACLE/KEYSTORES` is WALLET_ROOT of your database, or the softlink in `$ORACLE_BASE/okv/$ORACLE_SID` points to).

4. Install the endpoint software by running the following command:

   ```
   java -jar okvclient.jar -d existing_endpoint_directory_path
   ```

   For example:

   ```
   java -jar okvclient.jar -d /etc/ORACLE/KEYSTORES/okv
   ```

   If you are installing the `okvclient.jar` file for an endpoint that has Oracle Database 23ai, then include the `-arch db23ai` option during the installation. The new endpoint software for Oracle Database 23ai is required to support new features such as using OpenSSL for FIPS mode and the new version of local auto login wallets in Oracle Database 23ai. The new endpoint software for Oracle Database 23ai is supported on the Linux-x64 platform only.

   For example:

   ```
   Java -jar okvclient.jar -d /home/oracle/okvutil -arch db23ai
   ```

5. Perform the following steps to re-enroll the endpoint software, which also generates a new endpoint certificate. The easiest way to re-enroll an endpoint is by using the following commands of the RESTful services utility:

a. Re-enroll the endpoint by using the following RESTful services utility command:

```
okv admin endpoint re-enroll
```

b. Back up the `OKV_HOME` directory and delete the files under `OKV_HOME`:

```
cp -R $OKV_HOME $OKV_HOME_bkp_date +%Y%m%d
```

c. Go to the `$OKV_HOME` directory and remove all the files.

d. For Oracle Database 21c and earlier:
Download and install the endpoint software by using the following RESTful services utility command:

```
okv admin endpoint provision
```

For Oracle Database 23ai:

Download and install the endpoint software by using the following RESTful services utility command:

```
okv admin endpoint provision --arch db23ai
```

Re-enrolling an endpoint generates a new okvclient.jar file and installs the file in the OKV_HOME directory but maintains the relationship between the endpoint and its default wallet.

> **Note:**
>
> To re-enroll an endpoint without using RESTful services utility, follow the steps described in How to Re-enroll an Endpoint.

6. Install the updated PKCS#11 library file.

This step is needed only for online TDE master encryption key management by Oracle Key Vault. If an endpoint uses online TDE master encryption key management by Oracle Key Vault, then you must upgrade the `PKCS#11` library while upgrading the endpoint software.
For Oracle Database 21c and earlier:

Ensure that database instance is shut down before installing the PKCS#11 library in the location `/opt/oracle/extapi/64/hsm/oracle/1.0.0`.

- **On UNIX/Linux platforms**: Run `root.sh` from the `bin` directory of endpoint installation directory to copy the latest `liborapkcs.so` file for Oracle Database endpoints.

```
$ sudo /etc/ORACLE/KEYSTORES/okv/bin/root.sh
```

Or

```
$ su - root
# /etc/ORACLE/KEYSTORES/okv/bin/root.sh
```

- **On Windows platforms**: Run root.bat from the bin directory of endpoint installation directory to copy the latest liborapkcs.dll file for Oracle Database endpoints. You will be prompted for the version of the database in use.

  ```
  bin\root.bat
  ```

If you are upgrading multiple endpoints for TDE-enabled databases on a host, you must install the latest Oracle Key Vault PKCS#11 library only once on the host computer.

On the host, perform the following steps when upgrading multiple endpoints for TDE-enabled databases:

- Complete the upgrade of all Oracle Key Vault endpoints for the TDE-enabled databases.
- Shut down corresponding TDE-enabled database instances.
- Run the root.sh or root.bat script to install the latest Oracle Key Vault PKCS#11 library.

For Oracle Database 23ai:

Oracle recommends that you install the latest liborapkcs.so file in a fixed custom location using the root.sh script to enable upgrading the liborapkcs.so file in future without encountering database downtime.

The fixed custom location is in the following format:

```
/opt/oracle/extapi/64/pkcs11/okv/<okv_version>/lib
```

For example, in the Oracle Key Vault 21.11 release, the location is

```
/opt/oracle/extapi/64/pkcs11/okv/21.11.0.0.0/lib
```

- **On UNIX/Linux platforms**: Run root.sh from the bin directory of the endpoint installation directory to copy the latest liborapkcs.so file for Oracle Database endpoints.

  ```
  $ sudo /etc/ORACLE/KEYSTORES/okv/bin/root.sh --
  okv_pkcs11_library_location
  ```

  Or

  ```
  $ su - root
  # /etc/ORACLE/KEYSTORES/okv/bin/root.sh -okv_pkcs11_library_location
  ```

If you are upgrading multiple endpoints for TDE-enabled databases on a host, you must install the latest Oracle Key Vault PKCS#11 library only once for the endpoint software version.

On the host where there are multiple endpoints for TDE-enabled Oracle database 23ai, each database can upgrade their endpoint software separately and switch to using the upgraded liborapkcs.so library by setting up the database initialization parameter PKCS11_LIBRARY_LOCATION to point to the upgraded library.

> **Note:**
>
> Installing the `liborapkcs.so` library in a legacy location is also supported with Oracle Database 23ai databases. However, Oracle does not recommend it.

7. Update the SDK software.

   If you have already deployed the SDK software, Oracle recommends that you redeploy the SDK software in the same location after you complete the upgrade to Oracle Key Vault release 21.10. This enables you to have access to the new SDK APIs that were introduced since the Oracle Key Vault version that you are upgrading from.

   a. Go to the Oracle Key Vault management console login screen.

   b. Click the **Endpoint Enrollment and Software Download** link.

   c. c. In the Download Software Development Kit section, select the appropriate language and platform for your site.

   d. Click the **Download** button to get the SDK zip file.

   e. Identify the existing location where SDK software was already deployed.

   f. Navigate to the directory in which you saved the SDK zip file.

   g. Unzip the SDK zip file.

      For example, on Linux, to unzip the Java SDK zip file, use the following command:

      ```
      unzip -o okv_jsdk.zip -d existing_endpoint_sdk_directory_path
      ```

      For the C SDK zip file, use this command:

      ```
      unzip -o okv_csdk.zip -d existing_endpoint_sdk_directory_path
      ```

   h. Do not exit this page.

8. If you had deployed the RESTful services utility in the previous release, then re-deploy the latest `okvrestclipackage.zip` file.

   The latest `okvrestclipackage.zip` file enables you to have access to the new RESTful services utility commands that were introduced since the Oracle Key Vault version that you are upgrading from.

   You can use `wget` or `curl` to download `okvrestclipackage.zip`.

   ```
   wget --no-check-
   certificate https://Oracle_Key_Vault_IP_address:5695/
   okvrestclipackage.zip curl -O -
   k https://Oracle_Key_Vault_IP_address:5695/okvrestservices.jar
   ```

   Start the Oracle Databases if the upgrade of Oracle Key Vault endpoints for all of the TDE enabled databases on this host machine is complete.

   For Oracle Database 23ai which is using the custom path for installing the `liborapkcs.so` library from step 6 above, perform the following additional steps.

   a. Log in to the CDB Root as a user who has been granted the `ALTER SYSTEM` privilege.

b. Set the static initialization parameter `PKCS11_LIBRARY_LOCATION` to point to the upgraded `liborapkcs.so` library.

   For example:

   ```
   ALTER SYSTEM SET
   PKCS11_LIBRARY_LOCATION='/opt/oracle/extapi/64/pkcs11/okv/
   21.11.0.0.0/lib/liborapkcs.so' SCOPE=SPFILE SID='*';
   ```

9. After the database restart, the database will switch to using the new upgraded library from the custom path. The database is also now set to switch to newer libraries in future without encountering downtime.

   After you upgrade the Oracle Key Vault to a new release in future (for example 21.xx.0.0.0), the `root.sh` file in the upgraded endpoint can be used to copy the `liborapkcs.so` library to the new path `/opt/oracle/extapi/64/pkcs11/21.12.0.0.0/lib`. The database can switch to the new library by using the `SWITCHOVER` command.

   For example:

   ```
   ADMINISTER KEY MANAGEMENT SWITCHOVER TO LIBRARY
   '/opt/oracle/extapi/64/pkcs11/okv/21.12.0.0.0/lib/liborapkcs.so'
   FOR ALL CONTAINERS;
   ```

   At this stage, the endpoint is fully upgraded.

10. If your site requires that you restrict TDE master encryption keys from leaving Oracle Key Vault and if you are using an Oracle Real Application Clusters (Oracle RAC) environment, then perform the following steps on each Oracle RAC node:

    a. Perform the endpoint upgrade on each Oracle RAC node.

    b. Set the extractable attribute value for symmetric keys.

       By default, the extractable attribute value is `true`, which means that the key material of symmetric keys can be extracted from Oracle Key Vault during certain operations. If you want to prevent symmetric keys from being extracted, then you must set this value to `false`. You can set an extractable attribute value as follows:

       - Set the default value for the extractable attribute of new symmetric keys in the endpoint settings. Endpoint-specific setting overrides the global endpoint settings.
       - Explicitly specify the value of the extractable attribute when creating or registering a new symmetric key.
       - Modify the extractable attribute of an existing symmetric key.

       See *Oracle Key Vault Administrator's Guide*.

    c. As a user who has the `SYSDBA` or `SYSKM` administrative privilege, perform a rekey operation in the Oracle RAC node. Use the following syntax:

       ```
       ADMINISTER KEY MANAGEMENT SET [ENCRYPTION] KEY
       [FORCE KEYSTORE][USING TAG 'tag_name']
       IDENTIFIED BY [EXTERNAL STORE | keystore_password]
       [WITH BACKUP [USING backup_identifier']];
       ```

       See *Oracle Database Advanced Security Guide* for more information about rekeying a TDE master encryption key.

11. If your site requires that you restrict TDE master encryption keys from leaving Oracle Key Vault and if you are using an Oracle Data Guard environment, then do the following on the primary and standby databases:

    a. Perform the endpoint upgrade on the primary and standby databases.

    b. Set the extractable attribute value for symmetric keys.

       By default, the extractable attribute value is `true`, which means that the key material of symmetric keys can be extracted from Oracle Key Vault during certain operations. If you want to prevent symmetric keys from being extracted, then you must set this value to `false`. You can set an extractable attribute value as follows:

       - Set the default value for the extractable attribute of new symmetric keys in the endpoint settings. Endpoint-specific setting overrides the global endpoint settings.
       - Explicitly specify the value of the extractable attribute when creating or registering a new symmetric key.
       - Modify the extractable attribute of an existing symmetric key.

       See *Oracle Key Vault Administrator's Guide*.

    c. As a user who has the `SYSDBA` or `SYSKM` administrative privilege, perform a rekey operation in the primary and standby databases. Use the following syntax:

       ```
       ADMINISTER KEY MANAGEMENT SET [ENCRYPTION] KEY
       [FORCE KEYSTORE]
       [USING TAG 'tag_name']
       IDENTIFIED BY [EXTERNAL STORE | keystore_password]
       [WITH BACKUP [USING 'backup_identifier'']];
       ```

       See *Oracle Database Advanced Security Guide* for more information about rekeying a TDE master encryption key.

**Related Topics**

- *Oracle Key Vault Administrator's Guide*

## 8.10 Step 9: Back Up the Upgraded Oracle Key Vault Server

You must perform server backup and user password tasks after completing a successful upgrade.

1. Take a full backup of the upgraded Oracle Key Vault Server Database to a new remote destination. Avoid using the old backup destination for the new backups.
2. Schedule a new periodic incremental backup to the new destination defined in the preceding step.
3. Change the Oracle Key Vault administrative passwords.

   Password hashing has been upgraded to a more secure standard than in earlier releases. This change affects the operating system passwords, `support` and `root`. You must change Oracle Key Vault administrative passwords after the upgrade to take advantage of the more secure hash.

# 9 Getting Started Using Oracle Key Vault After the Installation or Upgrade

After you complete the installation or upgrade, you can log in to the Oracle Key Vault management console and begin to use Oracle Key Vault functionality.

- Logging In to the Oracle Key Vault Management Console
  To use Oracle Key Vault, you can log in to the Oracle Key Vault management console.
- Overview of the Oracle Key Vault Management Console
  The Oracle Key Vault management console provides a graphical user interface for Oracle Key Vault users.
- Performing Actions and Searches
  The Oracle Key Vault management console enables you to perform standard actions and search operations, as well as get help information.

## 9.1 Logging In to the Oracle Key Vault Management Console

To use Oracle Key Vault, you can log in to the Oracle Key Vault management console.

1. Open a web browser.
2. Connect using an HTTPS connection and the IP address of Oracle Key Vault.

   For example, to log in to a server whose IP address is 192.0.2.254, enter:

   ```
   https://192.0.2.254
   ```
3. After the login screen appears, enter your user name and password.
4. Click **Login**.

## 9.2 Overview of the Oracle Key Vault Management Console

The Oracle Key Vault management console provides a graphical user interface for Oracle Key Vault users.

The Oracle Key Vault management console is a browser-based console that connects to the server using the `https` secure communication channel. It provides the graphical user interface for Oracle Key Vault, where users can perform tasks such as the following:

- Setting up and managing the cluster
- Creating and managing users, endpoints, and their respective groups
- Creating and managing virtual wallets and security objects
- Setting system settings, like network and other services
- Setting up primary-standby
- Performing backups

## 9.3 Performing Actions and Searches

The Oracle Key Vault management console enables you to perform standard actions and search operations, as well as get help information.

Many of the tab and menu pages contain an **Actions** menu or **Search** bars that allow you to search and perform actions on lists and the results of searches. The **Help** selection of the **Actions** list provides detailed help for using these features.

- Actions Menus
  The actions available from an **Actions** drop-down menu can vary but typically include a set of standard menu items.
- Search Bars
  Along with **Actions** menus, many tabs in the Oracle Key Vault management console contain search bars.

### 9.3.1 Actions Menus

The actions available from an **Actions** drop-down menu can vary but typically include a set of standard menu items.

These items are as follows:

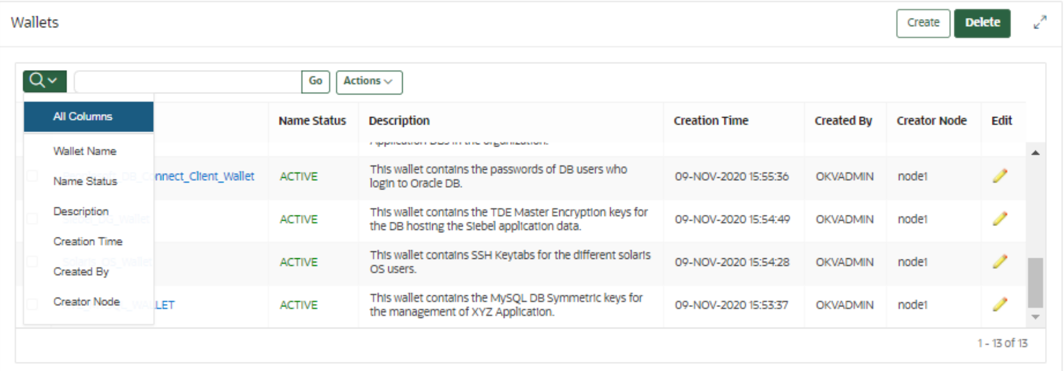
- **Select Columns:** Select which column should be displayed.
- **Filter:** Filter by column or row and a user-defined expression.
- **Rows Per Page:** Choose how many rows you want to view .
- **Format:** Choose formatting such as **Sort**, **Control Break**, **Highlight**, **Compute**, **Aggregate**, **Chart**, and **Group By**.
- **Save Report:** Save reports.
- **Reset:** Reset the report settings, removing any customizations.
- **Help:** Get information about these actions.
- **Download:** Download the result set in CSV or HTML.

### 9.3.2 Search Bars

Along with **Actions** menus, many tabs in the Oracle Key Vault management console contain search bars.

This demonstration searches for wallets, but the process is the same for other searches, except that the column headings are different. Wildcard characters are not supported, but the search does match any letter or phrase that you enter. You can use the **Filter** menu item under **Actions** to further fine-tune the search.

1. Enter a name or other identifier in the search field or (optionally) place your cursor on the magnifying icon in the Search bar to select one of the table headings (in this case, **All Columns**, **Wallet Name**, **Name Status**, **Description**, **Creation Time**, **Created By**, and **Creator Node**) and then enter a search term.



| | Name Status | Description | Creation Time | Created By | Creator Node | Edit |
|---|---|---|---|---|---|---|
| nnect_Client_Wallet | ACTIVE | This wallet contains the passwords of DB users who login to Oracle DB. | 09-NOV-2020 15:55:36 | OKVADMIN | node1 | ✎ |
| | ACTIVE | This wallet contains the TDE Master Encryption keys for the DB hosting the Siebel application data. | 09-NOV-2020 15:54:49 | OKVADMIN | node1 | ✎ |
| | ACTIVE | This wallet contains SSH Keytabs for the different solaris OS users. | 09-NOV-2020 15:54:28 | OKVADMIN | node1 | ✎ |
| LET | ACTIVE | This wallet contains the MySQL DB Symmetric keys for the management of XYZ Application. | 09-NOV-2020 15:53:37 | OKVADMIN | node1 | ✎ |

2. Click **Go**.

   A new wallet list appears, displaying the wallets that meet the search criteria. A filter icon (a funnel) indicates that a search has been performed and displays the search criteria.

3. You can select or deselect the filter icon to disable search and view the entire list.

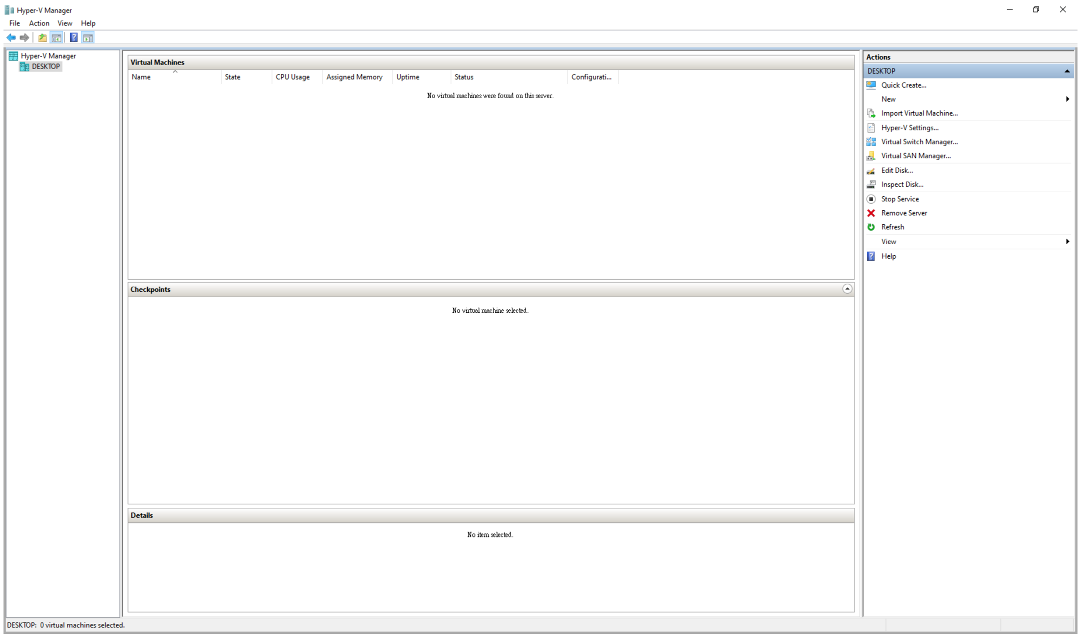
# A
# Hyper-V Installation on Windows

## A.1 Hyper-V Installation

You can install Oracle Key Vault on Hyper-V using the provided information.

To install Oracle Key Vault on Hyper-V.

1. Open the Hyper-V Manager.



No virtual machines were found on this server.

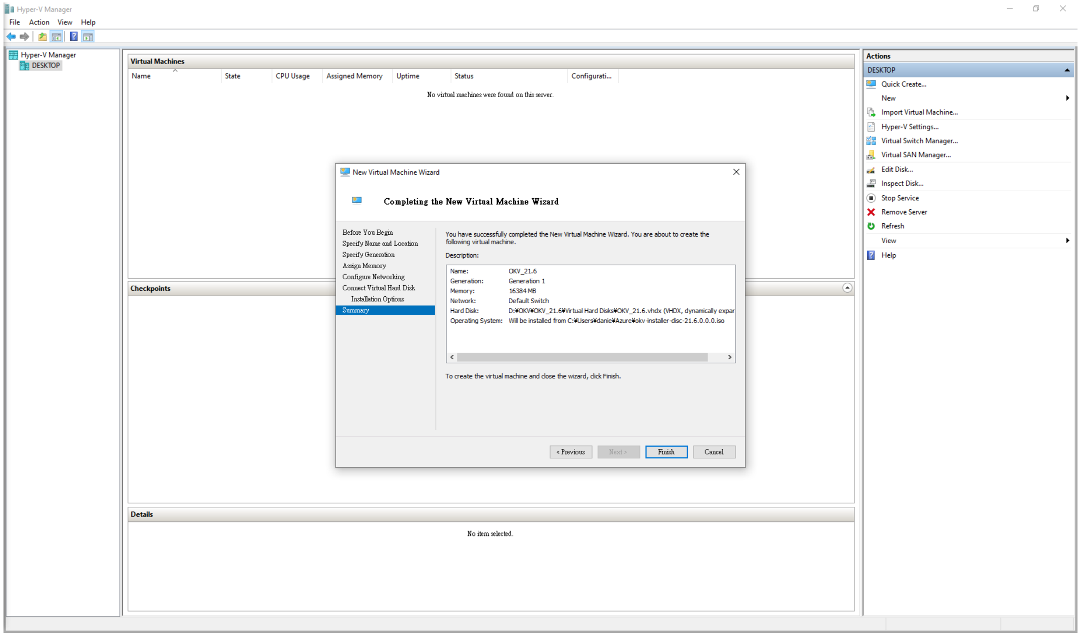
No virtual machine selected.

No item selected.

DESKTOP: 0 virtual machines selected.

2. Select **DESKTOP**. The **New Virtual Machine Wizard** displays.

   Follow the **New Virtual Machine Wizard** to complete the steps to create a new virtual machine.



No virtual machines were found on this server.

Completing the New Virtual Machine Wizard

You have successfully completed the New Virtual Machine Wizard. You are about to create the following virtual machine.

Description:

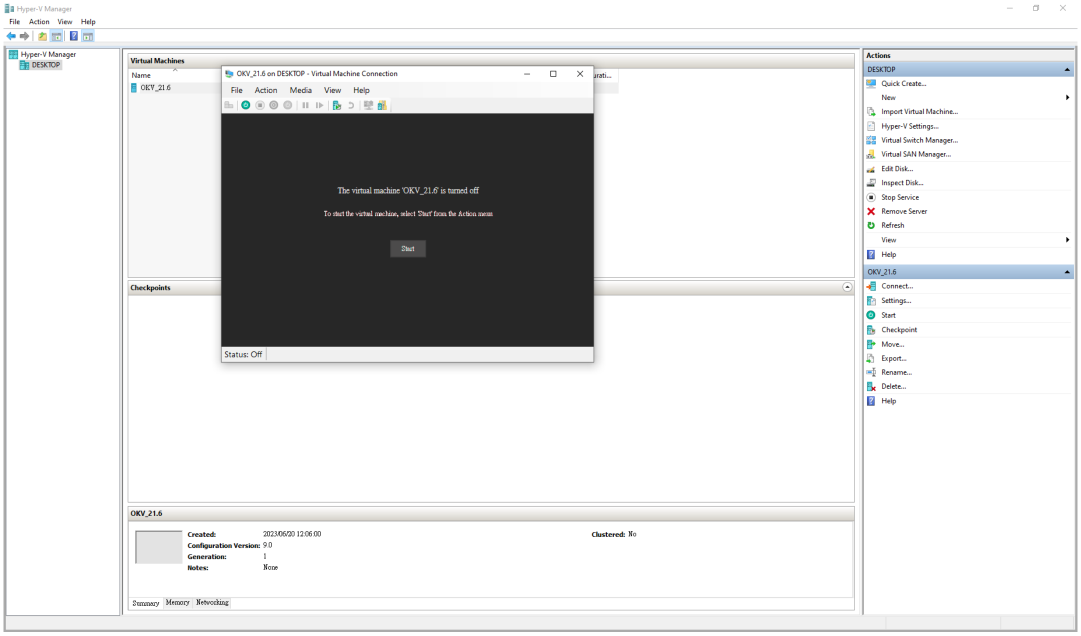
```
Name:              OKV_21.6
Generation:        Generation 1
Memory:            16384 MB
Network:           Default Switch
Hard Disk:         D:¥OKV¥OKV_21.6¥Virtual Hard Disks¥OKV_21.6.vhdx (VHDX, dynamically expar
Operating System:  Will be installed from C:¥Users¥danie¥Azure¥okv-installer-disc-21.6.0.0.0.iso
```

To create the virtual machine and close the wizard, click Finish.

No item selected.

3. Click **Finish**.

   The Oracle Key Vault Virtual Machine desktop window appears.



The virtual machine 'OKV_21.6' is turned off

To start the virtual machine, select 'Start' from the Action menu

OKV_21.6

| | | | |
|---|---|---|---|
| **Created:** | 2023/06/20 12:06:00 | **Clustered:** | No |
| **Configuration Version:** | 9.0 | | |
| **Generation:** | 1 | | |
| **Notes:** | None | | |

4. Go to **Actions** window pane.
5. Select **Start** to start the virtual machine.
6. Select the required options from the displayed window. See, Installing Oracle Key Vault to complete the Oracle Key Vault installation and post-installation.

**Note:**

For an Oracle Key Vault server on a Hyper-V, dual nic (in the Oracle Key Vault network configuration) is not supported.

**Related Topics**

- Installing Oracle Key Vault
  You must download the Oracle Key Vault application software, and then you can perform the installation.

# B

# Tablespace Encryption for Oracle Key Vault

## B.1 Tablespace Encryption for Oracle Key Vault Upgraded from 12.2.0.3.0 or Before

You can refer to this topic for the tablespace encryption for Oracle Key Vault upgraded from 12.2.0.3.0 or before.

The fresh installations of Oracle Key Vault 12.2.0.4.0 and higher encrypt the tablespaces using AES256 encryption.

If you have an installation of Oracle Key Vault that is upgraded from a fresh installation of Oracle Key Vault version prior to 12.2.0.4.0, the Oracle Key Vault tablespace continues to use AES128 encryption and the auditing tablespace remains unencrypted.

Use the following steps to encrypt the tablespaces of an Oracle Key Vault that is upgraded from a fresh installation of Oracle Key Vault version prior to 12.2.0.4.0 using AES256.

> **Note:**
>
> For the multi-master cluster deployment, you need to run below steps on every node. For the primary-standby deployment, you need to run the steps on the primary node only. The standby conversion takes place automatically.

1. Perform a full backup of Oracle Key Vault to a remote destination. Ensure that the backup is successful.
2. Log in to the Oracle Key Vault server through SSH as user `support`, then switch user `su` to `root`.

   ```
   ssh support@okv_server_IP_address
   su - root
   ```

3. Switch user to oracle user.

   ```
   su - oracle
   ```

4. Use sqlplus to connect to the Database as the `SYSDBA` user.

   ```
   sqlplus / as SYSDBA
   ```

5. Run the query to verify that the tablespace `KEYVAULT_SPACE` is encrypted using AES128 and the tablespace `KEYVAULT_AUDIT_TBS` is not encrypted.

   ```
   SQL> select a.name, b.encryptionalg, b.status
        from v$tablespace a, v$encrypted_tablespaces b
   where a.ts# = b.ts#;

   NAME                           ENCRYPT STATUS
   ------------------------------ ------- ----------
   AVSPACE                        AES256  NORMAL
   KEYVAULT_SPACE                 AES128  NORMAL
   ```

6. Ensure that the auxiliary space (tablespace SYSAUX) is at least the same size as the largest data file of this tablespace.
   This size requirement is because Oracle Database performs the conversion one file at a time. For example, if the largest data file of the tablespace is 32 GB, then ensure that you have 32 GB of auxiliary space.

   To find the space a data file uses, run the below query.

   ```
   select a.name, a.bytes, a.blocks, a.block_size, a.create_bytes, b.name
   from v$datafile a, v$tablespace b where a.TS# = b.TS#
   SQL> /

   NAME
   ---------------------------------------------------------------------------
   -----
        BYTES     BLOCKS BLOCK_SIZE CREATE_BYTES NAME
   ---------- ---------- ---------- ------------
   ------------------------------
   /var/lib/oracle/oradata/dbfwdb/system01.dbf
   1614807040     197120       8192            0 SYSTEM

   /var/lib/oracle/oradata/dbfwdb/keyvault_tbs
     33554432       4096       8192     33554432 KEYVAULT_SPACE

   /var/lib/oracle/oradata/dbfwdb/sysaux01.dbf
   2715811840     331520       8192            0 SYSAUX

   /var/lib/oracle/oradata/dbfwdb/undotbs01.dbf
   2202009600     268800       8192            0 UNDOTBS1

   /var/lib/oracle/oradata/DBFWDB/datafile/o1_mf_avspace_1n88t6vp_.dbf
    209715200      25600       8192    104857600 AVSPACE

   /var/lib/oracle/oradata/dbfwdb/users01.dbf
      5242880        640       8192            0 USERS

   /var/lib/oracle/oradata/dbfwdb/keyvault_audit_tbs
     33554432       4096       8192     33554432 KEYVAULT_AUDIT_TBS
   ```

   Ensure that the size of tablespace SYSAUX is larger than size of tablespaces `KEYVAULT_SPACE` and `KEYVAULT_AUDIT_TBS`.

   .

7. Re-encrypt online tablespace `KEYVAULT_SPACE` using AES256.

   ```
   SQL> ALTER TABLESPACE KEYVAULT_SPACE ENCRYPTION ONLINE USING 'AES256'
   REKEY;
   Tablespace altered.
   ```

8. Encrypt online tablespace `KEYVAULT_AUDIT_TBS` using AES256.

   ```
   SQL> ALTER TABLESPACE KEYVAULT_AUDIT_TBS ENCRYPTION ONLINE USING 'AES256'
   ENCRYPT;
   Tablespace altered.
   ```

9. Verify that Oracle Key Vault tablespaces are now encrypted using AES256.

   ```
   SQL> select a.name, b.encryptionalg, b.status
        from v$tablespace a, v$encrypted_tablespaces b
        where a.ts# = b.ts#;
   NAME                           ENCRYPT STATUS
   ------------------------------ ------- ----------
   AVSPACE                        AES256  NORMAL
   KEYVAULT_SPACE                 AES256
   NORMAL
   KEYVAULT_AUDIT_TBS             AES256  NORMAL
   ```

# Index