

# Oracle® Exadata Database Machine

## Security Guide for Exadata Database Machine



19.2.0  
E93158-03  
April 2019

The Oracle logo, consisting of a solid red square with the word "ORACLE" in white, uppercase, sans-serif font centered within it.

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Oracle Exadata Database Machine Security Guide for Exadata Database Machine, 19.2.0

E93158-03

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# Preface

This guide describes security for Oracle Exadata Database Machine. It includes information about the components, the recommended password policies, and best practices for securing the Oracle Exadata Database Machine environment.

- [Audience](#)
- [Documentation Accessibility](#)
- [Related Documents](#)
- [Conventions](#)

## Audience

This document is intended for database administrators and network administrators responsible for securing Oracle Exadata Database Machine.

## Documentation Accessibility

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## Related Documents

For more information, see the following documents:

- *Oracle Exadata Database Machine System Overview*
- *Oracle Exadata Database Machine Installation and Configuration Guide*
- *Oracle Exadata System Software User's Guide*
- *Oracle Database Security Guide*
- *Sun Datacenter InfiniBand Switch 36 Hardware Security Guide*
- *Oracle ILOM Security Guide For Firmware Releases 3.x and 4.x*
- *Oracle Server X8-2 Security Guide*
- *Oracle Server X7-2 Security Guide*

- [Oracle Server X6-2 Security Guide](#)
- [Oracle Server X5-2 Security Guide](#)
- [Sun Server X4-2 Security Guide](#)
- [Sun Server X3-2 Security Guide](#)

## Conventions

The following text conventions are used in this document:

Convention	Meaning
<b>boldface</b>	Boldface type indicates graphical user interface elements associated with an action, emphasis, or terms defined in text or the glossary.
<i>italic</i>	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.
\$ prompt	The dollar sign (\$) prompt indicates a command run as the <code>oracle</code> user.
# prompt	The pound (#) prompt indicates a command that is run as the <code>root</code> user.

# 1

## Overview of Oracle Exadata Database Machine Security

Oracle Exadata Database Machine is an engineered system that combines the optimized database performance of Oracle Database integrated with Oracle Exadata Storage Servers.

These core components are connected over a redundant InfiniBand fabric that enables low latency, and high throughput network communication. The redundant 10 Gbps Ethernet network (10/25 Gbps on X7 and X8 systems) is used for client access to services running on Oracle Exadata Database Machine. The 1 Gbps Ethernet network is used to manage the Oracle Exadata Database Machine components.

Within this framework, there are basic security principles that should be adhered to for all software and hardware. The following are the principles:

- **Authentication:** Authentication is how a user is identified, typically through confidential information such as user name and password, or shared keys. All components in use authentication to ensure that users are who they say they are. By default, local user names and passwords are used for authentication. Shared key-based authentication is also available.
- **Authorization:** Authorization allows administrators to control what tasks or privileges a user may perform or use. Personnel can only access the tasks and privileges that have been given to them. Oracle Exadata Database Machine system administrators can configure resources with read/write/execute permissions to control user access to commands, disk space, devices, and applications.
- **Accounting and Auditing:** Accounting and auditing maintain a record of a user's activity on the system. Oracle Exadata Database Machine software and hardware features allow administrators to monitor login activity, and maintain hardware inventories.
  - User logons are monitored through system logs. System administrators and service accounts have access to commands that used incorrectly could cause harm and data loss. Access and commands should be carefully monitored through system logs.
  - Hardware assets are tracked through serial numbers. Oracle part numbers are electronically recorded on all cards, modules, and mother boards, and can be used for inventory purposes.

In addition to the basic security principles, Oracle Exadata Database Machine addresses survivability, defense in depth, least privilege, and accountability. Oracle Exadata Database Machine delivers a well-integrated set of security capabilities that help organizations address their most-pressing security requirements and concerns.

- **Survivability of Mission-Critical Workloads**  
Oracle Exadata Database Machine can prevent or minimize the damage caused from accidental and malicious actions taken by internal users or external parties.



- **Defense in Depth to Secure the Operating Environment**  
Oracle Exadata Database Machine employs multiple, independent, and mutually-reinforcing security controls to help organizations create a secure operating environment for their workloads and data.
- **Least Privilege for Services and Users**  
Oracle Exadata Database Machine promotes the principle of least-privilege.
- **Accountability of Events and Actions**  
When an incident occurs, a system must be able to detect and report the incident.

## 1.1 Survivability of Mission-Critical Workloads

Oracle Exadata Database Machine can prevent or minimize the damage caused from accidental and malicious actions taken by internal users or external parties.

As part of the Oracle Maximum Availability Architecture best practices, survivability is increased by the following:

- Ensuring that the components used have been designed, engineered, and tested to work well together in support of secure deployment architectures. Oracle Exadata Database Machine supports secure isolation, access control, cryptographic services, monitoring and auditing, quality of service, and secure management.
- Reducing the default attack surface of its constituent products to help minimize the overall exposure of the machine. Organizations can customize the security settings of Oracle Exadata Database Machine based upon the organization's policies and needs.
- Protecting the machine, including its operational and management interfaces, using a complement of open and vetted protocols, and APIs capable of supporting traditional security goals of strong authentication, access control, confidentiality, integrity, and availability.
- Verifying that software and hardware contain features that keep the service available even when failures occur. These capabilities help in cases where attackers attempt to disable one or more individual components in the system.

## 1.2 Defense in Depth to Secure the Operating Environment

Oracle Exadata Database Machine employs multiple, independent, and mutually-reinforcing security controls to help organizations create a secure operating environment for their workloads and data.

Oracle Exadata Database Machine supports the principle of defense in depth as follows:

- Offering a strong complement of protections to secure information in transit, in use, and at rest. Security controls are available at the server, storage, network, database, and application layers. Each layer's unique security controls can be integrated with the others to enable the creation of strong, layered security architectures.
- Supporting the use of well-defined and open standards, protocols, and interfaces. Oracle Exadata Database Machine can be integrated into an organization's existing security policies, architectures, practices and standards. Integration is

critical as applications and devices do not exist in isolation. The security of IT architectures is only as strong as its weakest component.

- Conducting multiple security scans using industry-leading security analyzers to implement all high-priority security items prior to the release of each new Oracle Exadata System Software release.

## 1.3 Least Privilege for Services and Users

Oracle Exadata Database Machine promotes the principle of least-privilege.

Ensuring that applications, services and users have access to the capabilities that they need to perform their tasks is only one side of the least-privilege principle. It is equally important to ensure that access to unnecessary capabilities, services, and interfaces are limited. Oracle Exadata Database Machine promotes the principle of least-privilege as follows:

- Ensuring that access to individual servers, storage, operating system, databases, and other components can be granted based upon the role of each user and administrator. The use of role-based and multi-factor access control models with fine-grained privileges ensures that access can be limited to only what is needed.
- Constraining applications so that their access to information, underlying resources, network communications, and local or remote service access is restricted based upon need.

Whether caused by an accident or malicious attack, applications can misbehave, and without enforcement of least privilege, those applications may be able to cause harm beyond their intended use.

## 1.4 Accountability of Events and Actions

When an incident occurs, a system must be able to detect and report the incident.

Similarly, when an event cannot be prevented, it is imperative that an organization be able to detect that the event occurred so that proper responses can be taken. Oracle Exadata Database Machine supports the principle of accountability as follows:

- Ensuring each of the components used in Oracle Exadata Database Machine supports activity auditing and monitoring, including the ability to record login and logout events, administrative actions, and other events specific to each component.
- Leveraging features in Oracle Database to support fine-grained, auditing configurations. This allows organizations to tune audit configurations in response to their standards and goals. Administrators can ensure that critical information is captured, while minimizing the amount of unnecessary audit events.

# 2

## Security Features of Oracle Exadata Database Machine

Oracle Exadata Database Machine hardware and software are hardened.

The following steps have been done to harden Oracle Exadata Database Machine:

- Trimmed the list of installed packages so that unnecessary packages are not installed on the servers.
- Turned on only essential services on the Oracle Exadata Storage Servers.
- Enabled firewalls (iptables) on the storage servers.
- Enabled auditing of the operating system user.
- Enforced hardened password policies.

Oracle also provides recommended secure configurations for services such as NTP and SSH. In addition, the Oracle Exadata Database Machine architecture provides the following security capabilities to the core components. These security capabilities are most often applied by organizations seeking to deploy a layered security strategy.

- [Restricting the Binaries Used to Boot the System](#)  
Secure Boot supports a chain of trust that goes down to the kernel module level.
- [Using Isolation Policies](#)  
Oracle Exadata Database Machine supports multiple isolation levels.
- [Controlling Access to Data](#)  
To protect application data, workloads, and the underlying infrastructure on which it runs, Oracle Exadata Database Machine offers comprehensive yet flexible access control capabilities for both users and administrators.
- [Using Cryptographic Services](#)  
Oracle Exadata Database Machine includes network cryptographic services.
- [Monitoring and Auditing of Oracle Exadata Database Machine](#)  
Whether for compliance reporting or incident response, monitoring and auditing are critical functions that organizations must use to gain increased visibility into their IT environment.
- [Monitoring and Auditing Oracle Database Activity](#)  
Oracle Database support of fine-grained auditing allows organizations to establish policies that selectively determine when audit records are generated.
- [Maintaining Quality Service](#)  
There are many ways that applications can be attacked besides breaching a boundary or subverting an access control policy.
- [Using Oracle ILOM for Secure Management](#)  
Collections of security controls and capabilities are necessary to properly secure individual applications and services.

## 2.1 Restricting the Binaries Used to Boot the System

Secure Boot supports a chain of trust that goes down to the kernel module level.

Secure Boot is a method used to restrict which binaries can be executed to boot the system. With Secure Boot, the system UEFI firmware will only allow the execution of boot loaders that carry the cryptographic signature of trusted entities. In other words, anything run in the UEFI firmware must be *signed* with a key that the system recognizes as trustworthy. With each reboot of the server, every executed component is verified. This prevents malware from hiding embedded code in the boot chain.

Loadable kernel modules must be signed with a trusted key or they cannot be loaded into the kernel.

The following trusted keys are stored in UEFI NVRAM variables:

- Database (DB)—Signature database that contains well-known keys. Only binaries that can be verified against the DB are executed by the BIOS.
- Forbidden Database (DBX)—Keys that are blacklisted. Attempting to load an object with a key that matches an entry in the DBX will be denied. This is a list of keys that are bad.
- Machine Owner Key (MOK) - User added keys for kernel modules you want to install.
- Platform Key (PK) - The key installed by the hardware vendor. This key is installed by the vendor and is in the ILOM firmware. This key is not accessible from the host.
- Key Exchange Key (KEK) - The key required to update the signature database.

The user must have physical access to the system console to add keys, modify keys, or enable and disable Secure Boot through the UEFI configuration menu. The default boot loader on most UEFI-enabled servers running Linux is `grub2`. With Secure Boot enabled, an additional `shim` boot loader is needed. When booting in Secure Boot mode, the `shimloader` is called first because it contains a trusted signature. The `shimloader` then loads `grub2`, which then loads the OS kernel, which is also signed.

Secure Boot is available on X7-2 and later database and storage servers.

- [Enabling and Disabling Secure Boot](#)  
Secure Boot is enabled by default in the BIOS.
- [Managing Keys and Certificates Used with Secure Boot](#)  
You can use the `mokutil` command to manage the keys and certificates used with Secure Boot.
- [Checking for Secure Boot Environment](#)  
You can use operating system commands to determine if Secure Boot is enabled.
- [Troubleshooting Secure Boot](#)  
You might encounter the following problems when Secure Boot is enabled.

## 2.1.1 Enabling and Disabling Secure Boot

Secure Boot is enabled by default in the BIOS.

Secure boot is configured in the BIOS and is enabled by default. You can disable secure boot by pressing F12 during the boot process, navigating to the EFI boot menu and disabling the Secure Boot option.

Oracle recommends that you leave the Secure Boot option enabled.

To verify that Secure Boot is enabled, use the following command:

```
# mokutil --sb-state
SecureBoot enabled
```

## 2.1.2 Managing Keys and Certificates Used with Secure Boot

You can use the `mokutil` command to manage the keys and certificates used with Secure Boot.

The certificates are signed by DigiCert and are valid for three years from the date of signing. Even though a certificate may expire, the validation is based on the date on which the grub and kernel were signed and if the certificate was valid at that time.

To renew the certificates, you update the kernel, grub, and ILOM on the secured servers with a new, signed version.

- To query the existing keys, use the command `mokutil`.

```
[root@scaqa03celadm11 ~]# mokutil --list-enrolled
[key 1]
SHA1 Fingerprint: 17:62:e7:3b:f1:6c:d7:89:1f:cd:0c:49:0c:4c:02:0c:
30:41:0c:d0
Certificate:
Data:
  Version: 3 (0x2)
  Serial Number:
    0f:2d:c0:56:d7:4b:e5:54:51:9d:ef:7e:c2:33:2e:d3
  Signature Algorithm: sha256WithRSAEncryption
  Issuer: C=US, O=DigiCert Inc, OU=www.digicert.com, CN=DigiCert EV
Code Signing CA (SHA2)
  Validity
    Not Before: Nov 24 00:00:00 2015 GMT
    Not After : Nov 27 12:00:00 2018 GMT
  Subject: businessCategory=Private Organization/
1.3.6.1.4.1.311.60.2.1.3=US/1.3.6.1.4.1.311.60.2.1.2=Delaware/
serialNumber=4028125/street=500 Oracle Parkway/postalCode=94065, C=US,
ST=California, L=Redwood Shores, O=Oracle Corporation, CN=Oracle
Corporation
  Subject Public Key Info:
    Public Key Algorithm: rsaEncryption
    Public-Key: (2048 bit)
    Modulus:
      00:b3:de:ff:b5:6c:6c:d1:7a:24:c5:44:de:03:e8:
```

```

                29:22:be:0c:3b:06:4a:68:a9:a2:b4:1b:1d:2a:9d:
                ...
                Exponent: 65537 (0x10001)
X509v3 extensions:
    X509v3 Authority Key Identifier:
        keyid:8F:E8:7E:F0:6D:32:6A:00:05:23:C7:70:97:6A:3A:90:FF:
6B:EA:D4

    X509v3 Subject Key Identifier:
        51:69:8E:C3:BE:0F:5E:B8:CB:A8:EC:19:7D:
29:18:79:09:8F:AD:E4
    X509v3 Subject Alternative Name:
        othername: <unsupported>
    X509v3 Key Usage: critical
        Digital Signature
    X509v3 Extended Key Usage:
        Code Signing
    X509v3 CRL Distribution Points:

        Full Name:
            URI:http://crl3.digicert.com/EVCodeSigningSHA2-g1.crl

        Full Name:
            URI:http://crl4.digicert.com/EVCodeSigningSHA2-g1.crl

    X509v3 Certificate Policies:
        Policy: 2.16.840.1.114412.3.2
        CPS: https://www.digicert.com/CPS
        Policy: 2.23.140.1.3

    Authority Information Access:
        OCSP - URI:http://ocsp.digicert.com
        CA Issuers - URI:http://cacerts.digicert.com/
DigiCertEVCodeSigningCA-SHA2.crt

    X509v3 Basic Constraints: critical
        CA:FALSE
    Signature Algorithm: sha256WithRSAEncryption
        6d:42:58:c7:f1:aa:db:e7:5c:7f:d3:47:29:0a:f4:b7:f7:c0:
        0e:55:29:5b:79:60:91:77:4f:f6:ec:b3:a7:9e:e1:5a:e1:79:
        ...

```

- [Adding Keys for Secure Boot Using mokutil](#)  
You can import or add new keys for use with Secure Boot.
- [Removing Keys for Secure Boot Using mokutil](#)  
You can delete or remove keys for use with Secure Boot.

### 2.1.2.1 Adding Keys for Secure Boot Using mokutil

You can import or add new keys for use with Secure Boot.

You can use the command `mokutil --help` to view additional options.

You must run these command as the `root` user.

1. Create a DER-formatted X509 certificate file for the key you want to add.
2. Check to see if the key is already active.

```
# mokutil --test-key new_target_cert.cer
```

3. If the key is not currently active, then import the key certificate.

```
# mokutil --import new_target_cert.cer
```

### 2.1.2.2 Removing Keys for Secure Boot Using mokutil

You can delete or remove keys for use with Secure Boot.

You can use the command `mokutil --help` to view additional options.

You must run these command as the `root` user.

- To delete a key, use the following command:

```
mokutil --delete key_file
```

### 2.1.3 Checking for Secure Boot Environment

You can use operating system commands to determine if Secure Boot is enabled.

1. Log in as the `root` user.
2. Use `dmesg` to see if Secure Boot is enabled.

```
# dmesg | grep "Secure boot";  
[ 0.000000] Secure boot enabled
```

3. Alternatively, use the `od` command to determine if Secure Boot is enabled.

```
$ od -An -t u1 /sys/firmware/efi/vars/SecureBoot-8be4df61-93ca-11d2-  
aa0d-00e098032b8c/data
```

This command returns a value of either 0 (not enabled) or 1 (enabled).

### 2.1.4 Troubleshooting Secure Boot

You might encounter the following problems when Secure Boot is enabled.

The certificates are signed by DigiCert and are valid for three years from the date of signing. Even though a certificate may expire, the validation is based on the date on which the grub & kernel were signed and if the certificate was valid at that time.

**error: file has invalid signature. error: You need to load the kernel first.**  
The grub loader is signed, but the kernel is unsigned.

**Secure boot violation: Invalid signature detected. Check Secure Boot Policy in Setup.**

The grub loader has an invalid signature.

**ERROR: Verification failed: (15) Access Denied. Failed to load image: Access Denied.start\_image() returned Access Denied**

The ISO image being loaded to image the server is not signed.

## 2.2 Using Isolation Policies

Oracle Exadata Database Machine supports multiple isolation levels.

Organizations wanting to consolidate IT infrastructure, implement shared service architectures, and deliver secure multitenant services should isolate services, users, data, communications, and storage. Oracle Exadata Database Machine provides organizations the flexibility to implement the isolation policies and strategies based on their needs. The following are the secure isolation levels of Oracle Exadata Database Machine:

- [Isolating Network Traffic](#)  
Oracle Exadata Database Machine uses multiple networks to segregate network traffic.
- [Isolating Databases](#)  
Use operating system controls and database features to enable database isolation.
- [Isolating Storage](#)  
Oracle Exadata Database Machine storage is isolated from the rest of the architecture through the use of a private InfiniBand network.

### 2.2.1 Isolating Network Traffic

Oracle Exadata Database Machine uses multiple networks to segregate network traffic.

At the physical network level, client access is isolated from device management and inter-device communication. Client and management network traffic are isolated on separate networks. Client access is provided over a redundant 10 Gbps Ethernet network that ensures reliable, high-speed access to services running on the system. Management access is provided over a physically separate 1 Gbps Ethernet network. This provides a separation between operational and management networks.

Organizations may choose to further segregate network traffic over the client access Ethernet network by configuring virtual LANs (VLANs). VLANs segregate network traffic based on their requirements. Oracle recommends the use of encrypted protocols over VLANs to assure the confidentiality and integrity of communications.

Inter-device communication is provided by a redundant InfiniBand network. The InfiniBand network is a high-performance, low-latency backplane for communication between Oracle Exadata Storage Servers and database servers. By default, Oracle Exadata Storage Servers include a configured software firewall. The database servers can also be configured with a software firewall.

 **Note:**

Partitioning the InfiniBand private network does not protect an InfiniBand fabric. Partitioning only offers InfiniBand traffic isolation between machines.



## 2.2.2 Isolating Databases

Use operating system controls and database features to enable database isolation.

Physical separation by dedicating an entire environment to a single application or database is one of the best isolation methods. However, it is expensive. A more cost-effective isolation strategy uses multiple databases within the same operating system image. Multiple database isolation is achieved through a combination of database and operating system-level controls, such as dedicated credentials for users, groups, and resource controls.

All Oracle Database security options are available for Oracle Exadata Database Machine. Organizations wanting finer-grained database isolation can use software such as Oracle Database Vault, Oracle Virtual Private Database, and Oracle Label Security.

Oracle Database Vault includes a mandatory access control model to enforce isolation using logical realms within a single database. Logical realms form a protective boundary around existing application tables by blocking administrative accounts from having ad-hoc access to application data. Oracle Database Vault command rules enable policy-based controls that limit who, when, where, and how the database and application data is accessed. This creates a trusted path to application data. Oracle Database Vault can also be employed to restrict access based upon time, source IP address, and other criteria.

Oracle Virtual Private Database enables the creation of policies that enforce fine-grained access to database tables and views at the row and column levels. Oracle Virtual Private Database provides security portability because the policies are associated with database objects, and are automatically applied no matter how the data is accessed. Oracle Virtual Private Database can be used for fine-grained isolation within the database.

Oracle Label Security is used to classify data, and mediate access to that data based upon its classification. Organizations define classification strategies, such as hierarchical or disjoint, that best support their needs. This capability allows information stored at different classification levels to be isolated at the row level within a single tablespace.

## 2.2.3 Isolating Storage

Oracle Exadata Database Machine storage is isolated from the rest of the architecture through the use of a private InfiniBand network.

The storage managed by Oracle Exadata Storage Servers can be subdivided using Oracle Automatic Storage Management (Oracle ASM) to create individual disk groups. Each disk group can have its own security policies.

## 2.3 Controlling Access to Data

To protect application data, workloads, and the underlying infrastructure on which it runs, Oracle Exadata Database Machine offers comprehensive yet flexible access control capabilities for both users and administrators.

The control capabilities include network access, database access, and storage access.

- [Controlling Network Access](#)  
Beyond simple network-level isolation, fine-grained access control policies can be instituted at the device level.
- [Controlling Database Access](#)  
Separation of duties is critical at every layer of the architecture to reduce the risk of collusive behavior, and prevent inadvertent errors.
- [Controlling Storage Access](#)  
Oracle Exadata System Software supports the access control modes of open security, Oracle ASM-scoped security, and database-scoped security.

## 2.3.1 Controlling Network Access

Beyond simple network-level isolation, fine-grained access control policies can be instituted at the device level.

All components in Oracle Exadata Database Machine include the ability to limit network access to services either using architectural methods, such as network isolation, or using packet filtering and access control lists to limit communication to, from, and between components and services.

## 2.3.2 Controlling Database Access

Separation of duties is critical at every layer of the architecture to reduce the risk of collusive behavior, and prevent inadvertent errors.

For example, use different operating system accounts to ensure role separation for database and storage administrators, including administrators supporting Oracle Automatic Storage Management (Oracle ASM). Within Oracle Database, users can be assigned specific privileges and roles to ensure that users have access to only those data objects that they are authorized to access. Data cannot be shared unless it is explicitly permitted.

In addition to password-based authentication, Oracle Database also supports public key credentials, RADIUS, and Kerberos. Using Oracle Enterprise User Security, the database can be integrated with existing LDAP repositories for authentication and authorization. These capabilities provide higher assurance of the identity of users connecting to the database.

Oracle Database Vault can be used to manage administrative and privileged user access, controlling how, when and where application data can be accessed. Oracle Database Vault protects against misuse of stolen login credentials, application bypass, and unauthorized changes to applications and data, including attempts to make copies of application data. Oracle Database Vault is transparent to most applications, and day-to-day tasks. It supports multi-factor authorization policies, allowing for secure enforcement of policy without disrupting business operations.

Oracle Database Vault can enforce separation of duties to ensure that account management, security administration, resource management, and other functions are granted only to those users authorized to have those privileges.

## 2.3.3 Controlling Storage Access

Oracle Exadata System Software supports the access control modes of open security, Oracle ASM-scoped security, and database-scoped security.

- Open security allows any database to access any of the grid disks.
- Oracle ASM-scoped security allows multiple databases assigned to one or more Oracle ASM clusters to share specific grid disks.

In addition to its overall access control mode, Oracle ASM supports access controls at the disk group and file level to ensure that access to content stored on disk is only available to authorized users.

 **Note:**

- The `/etc/oracle/cell/network-config/cellkey.ora` file needs to be readable only by the software installation owner of Oracle Grid Infrastructure with its specific unique group, such as `asmadmin`.
- Use the `kfod` utility in the Oracle Grid Infrastructure home to troubleshoot or verify which disks are accessible for your cluster.

- Database-scoped security, the most fine-grained level of access control, ensures that only specific databases are able to access specific grid disks.

Database-scoped security works on a container level. This means that grid disks must be made available to the `DB_UNIQUE_NAME` of the container database (CDB) or non-CDB. Because of this, it is not possible to have database-scoped security per pluggable database (PDB).

 **Note:**

You should only set up database-scoped security after configuring and testing Oracle ASM-scoped security.

By default, SSH is enabled on storage servers. If required, you can "lock" the storage servers to block SSH access. You can still perform operations on the storage server using `exaccli`, which runs on compute nodes and communicates using HTTPS and REST APIs to a web service running on the cell. At a high-level, this is accomplished by creating users and roles in CellCLI and then disabling `remoteLogin`.

 **See Also:**

The following topics in *Oracle Exadata System Software User's Guide*:

- Disabling SSH on Storage Servers
- Understanding Data Security for Oracle Exadata Storage Server Software for additional information about the access control modes

## 2.4 Using Cryptographic Services

Oracle Exadata Database Machine includes network cryptographic services.

The requirement to protect and validate information at rest, in transit, and in use often employs cryptographic services. From encryption and decryption to digital fingerprint and certificate validation, cryptography is one of the most-widely deployed security controls in IT organizations.

Whenever possible, Oracle Exadata Database Machine makes use of hardware-based cryptographic engines on processor chips provided by Intel AES-NI and Oracle SPARC. Using hardware for cryptographic operations provides significant performance improvement over performing the operations in software. Both engines provide the ability to perform cryptographic operations in hardware, and both are leveraged by Oracle software on the database and storage servers.

Network cryptographic services protect the confidentiality and integrity of communications by using a cryptographically-secure protocol. For example, Secure Shell (SSH) access provides secure administrative access to systems and Integrated Lights Out Manager (ILOM). SSL/TLS can enable secure communications between applications and other services.

Databases cryptographic services are available from Oracle Advanced Security. Oracle Advanced Security encrypts information in the database using the transparent data encryption (TDE) functionality. TDE supports encryption of application table spaces, and encryption of individual columns within a table. Data stored in temporary table spaces, and redo logs are also encrypted. When the database is backed up, the data remains encrypted on destination media. This protects information at rest no matter where it is physically stored. For organizations concerned about the confidentiality of stored database content, database encryption, either at the table space level or column-level, Oracle Advanced Security should be considered.

In addition, Oracle Advanced Security can encrypt Oracle Net Services and JDBC traffic using either native encryption or SSL to protect information while in transit over a network. Both administrative and application connections can be protected to ensure that data in transit is protected. The SSL implementation supports the standard set of authentication methods including anonymous (Diffie-Hellman), server-only authentication using X.509 certificates, and mutual (client-server) authentication with X.509.

## 2.5 Monitoring and Auditing of Oracle Exadata Database Machine

Whether for compliance reporting or incident response, monitoring and auditing are critical functions that organizations must use to gain increased visibility into their IT environment.

The degree to which monitoring and auditing is employed is often based upon the risk or criticality of the environment. Oracle Exadata Database Machine has been designed to offer comprehensive monitoring and auditing functionality at the server, network, database, and storage layers ensuring that information can be made available to organizations in support of their audit and compliance requirements.

Oracle Exadata System Software release 19.1.0 adds support for Advanced Intrusion Detection Environment (AIDE) to help guard against unauthorized access to the files on your Exadata system. AIDE is a security feature that reports any malicious or unplanned change to the system. AIDE creates a database of files on the system, and then uses that database to ensure file integrity and to detect system intrusions. To

learn more about AIDE see [https://en.wikipedia.org/wiki/Advanced\\_Intrusion\\_Detection\\_Environment](https://en.wikipedia.org/wiki/Advanced_Intrusion_Detection_Environment)

## 2.6 Monitoring and Auditing Oracle Database Activity

Oracle Database support of fine-grained auditing allows organizations to establish policies that selectively determine when audit records are generated.

Establishing policies helps organizations focus on other database activities, and reduce the overhead that is often associated with audit activities.

Oracle Audit Vault centralizes the management of database audit settings and automates the consolidation of audit data into a secure repository. Oracle Audit Vault includes built-in reporting to monitor a wide range of activities including privileged user activity and changes to database structures. The reports generated by Oracle Audit Vault enable visibility into various application and administrative database activities, and provide detailed information to support accountability of actions.

Oracle Audit Vault enables the proactive detection and alerting of activities that may be indicative of unauthorized access attempts or abuse of system privileges. These alerts can include both system and user-defined events and conditions, such as the creation of privileged user accounts or the modification of tables containing sensitive information.

Oracle Database Firewall Remote Monitor can provide real-time database security monitoring. Oracle Database Firewall Remote Monitor queries database connections to detect malicious traffic, such as application bypass, unauthorized activity, SQL injection and other threats. Using an accurate SQL grammar-based approach, Oracle Database Firewall helps organizations quickly identify suspicious database activity.

## 2.7 Maintaining Quality Service

There are many ways that applications can be attacked besides breaching a boundary or subverting an access control policy.

Oracle Exadata Database Machine provides a number of capabilities to help detect and prevent resource exhaustion attacks, denial of service attacks, and accidental or intentional faults that can impact the availability of services and data.

Oracle Exadata System Software includes I/O Resource Management (IORM) to manage interdatabase and intradatabase I/O resources. IORM allows different databases with different performance requirements to share a common Oracle Exadata Storage Server pool. Multiple workloads within the same database can have their own resource policies. This flexible architecture allows organizations to ensure that critical workloads and databases share I/O resources when operating on a consolidated architecture.

Oracle Database includes tools to enable multiple databases to operate under the same operating system. Oracle Database Resource Manager, and instance caging support the ability to dynamically control access to CPU resources using fine-grained methods. Oracle Database Resource Manager can control the degree of parallelism, the number of active sessions, and other shared resources to protect one database from monopolizing resources needed in shared database architectures.

Oracle Database Quality of Service Management (Oracle Database QoS Management) is an automated, policy-based solution that monitors the workload

requests of an entire system. Oracle Database QoS Management correlates accurate run-time performance and resource metrics, analyzes the data to identify bottlenecks, and produces recommended resource adjustments to maintain performance objectives under dynamic load conditions.

## 2.8 Using Oracle ILOM for Secure Management

Collections of security controls and capabilities are necessary to properly secure individual applications and services.

It is equally important to have comprehensive management capabilities to sustain the security of the deployed services and systems. Oracle Exadata Database Machine uses the security management capabilities of ILOM.

ILOM is a service processor embedded in many Oracle Exadata Database Machine components. It is used to perform out-of-band management activities, such as the following:

- Provide secure access to perform secure lights-out management of the database and storage servers. Access includes web-based access protected by SSL, command-line access using Secure Shell, and IPMI v2.0 and SNMPv3 protocols.
- Separate duty requirements using a role-based access control model. Individual users are assigned to specific roles that limit the functions that can be performed.
- Provide an audit record of all logons and configuration changes. Each audit log entry lists the user performing the action, and a timestamp. This allows organizations to detect unauthorized activity or changes, and attribute those actions back to specific users.

# 3

## Planning a Secure Environment

Security practices should be in place before the arrival of Oracle Exadata Database Machine.

After arrival, the security practices should be periodically reviewed and adjusted to stay current with the security requirements of your organization.

- [Considerations for a Secure Environment](#)  
Oracle Exadata Database Machine includes many layered security controls that can be tailored to meet an organization's specific policies and requirements.
- [Understanding the Default Security Settings](#)  
Oracle Exadata System Software is installed with many default security settings.
- [Understanding User Accounts](#)  
There are several users used to manage the components of Oracle Exadata Database Machine
- [Default Password Requirements](#)  
Oracle Exadata Deployment Assistant (OEDA) implements a default password policy on Oracle Exadata Database Machine.
- [Default Security Settings Enacted by OEDA](#)  
Oracle Exadata Deployment Assistant (OEDA) includes a step to increase hardware security on Oracle Exadata Database Machine.

### 3.1 Considerations for a Secure Environment

Oracle Exadata Database Machine includes many layered security controls that can be tailored to meet an organization's specific policies and requirements.

Organizations must evaluate how to best utilize these capabilities and integrate them into their existing IT security architecture. Effective IT security must consider the people, processes, and technology in order to provide solid risk management and governance practices. Practices and policies should be designed and reviewed during the planning, installation, and deployment stages of Oracle Exadata Database Machine.

While many of the features integrated into Oracle Exadata Database Machine are configured by default for secure deployment, organizations have their own security configuration standards. It is important to review Oracle security information before testing any security setting changes to Oracle Exadata Database Machine components. In particular, it is important to identify where existing standards can be improved, and where support issues may limit what changes can be made to a given component.



 **Note:**

To minimize the attack surface, Oracle Exadata Storage Servers do not support customization outside of their management interfaces. No custom users are permitted on the storage servers. The servers have been optimized and hardened for their specific purpose.

- **Identity and Access Management Considerations**  
A unified approach should be used when integrating Oracle Exadata Database Machine components and deployed services with your organization's existing identity and access management architecture.
- **Network Security Considerations**  
Before Oracle Exadata Database Machine arrives at your location, network security considerations should be discussed.

### 3.1.1 Identity and Access Management Considerations

A unified approach should be used when integrating Oracle Exadata Database Machine components and deployed services with your organization's existing identity and access management architecture.

Oracle Database supports many open and standard protocols that allow it to be integrated with existing identity and access management deployments. To ensure application availability, unified identity and access management systems must be available, or the availability of Oracle Exadata Database Machine may be compromised.

Before Oracle Exadata Database Machine arrives, the following security considerations should be discussed. These considerations are based on Oracle best practices for Oracle Exadata Database Machine.

- The ability to directly log in to common operating system accounts such as `root`, `grid` and `oracle` should be disabled. Individual user accounts should be created for each administrator. After logging in with their individual account, the administrator can use `sudo` to run privileged commands, when required.
- The use of host-based intrusion detection and prevention systems for increased visibility within Oracle Exadata Database Machine. By using the fine-grained auditing capabilities of Oracle Database, host-based systems have a greater likelihood of detecting inappropriate actions and unauthorized activity.
- The use of centralized audit and log repositories to aggregate the security-relevant information for improved correlation, analysis, and reporting. Oracle Exadata Storage Servers support this through the `CELL` attribute `syslogConf`. The database servers support centralized logging using the typical system configuration methods.
- The use of encryption features such as transparent data encryption (TDE), Oracle Recovery Manager (RMAN) encryption for backups.

The security of the data and system is diminished by user access and password security. Oracle recommends the following guidelines to maximize your user security:

- Create separate software owner accounts for Oracle Grid Infrastructure and Oracle Database software installations. These accounts should be used when



deploying Oracle Exadata Database Machine. A separate software owner for Oracle Grid Infrastructure and Oracle Database software installations is required for implementing DB-scoped security.

- Implement a user password policy that enforces password complexity beyond the minimum requirements.
- Implement password aging and account locking. Starting with Oracle Exadata System Software release 19.1.0 you can use `DBSERVER` and `CELL` attributes to configure the following account security features:
  - A user's password expires after a specified number of days. The default user password expiration time is 0. 0 means passwords will not expire.
  - A user gets a warning message when logging in for a specified number of days before their password expires. The default user account password expiration warning time is 7 days.
  - The user is prompted to change their password when logging within a specified number of days after their password expires. If the `remotePwdChangeAllowed` attribute on the server indicates that a service request is not required to change the password, then the user can change the password immediately. Otherwise, the user must connect the server administrator to have their password changed.
  - A user account is locked a specified number of days after the password expires. The default user account lock time is 7 days. After the account is locked, the user must contact the server administrator to have the account unlocked.

## 3.1.2 Network Security Considerations

Before Oracle Exadata Database Machine arrives at your location, network security considerations should be discussed.

The following considerations are based on Oracle best practices for Oracle Exadata Database Machine.

- The use of intrusion prevention systems on database servers to monitor network traffic flowing to and from Oracle Exadata Database Machine. Such systems enable the identification of suspicious communications, potential attack patterns, and unauthorized access attempts.
- The use of application and network-layer firewalls to protect information flowing to and from Oracle Exadata Database Machine. Filtering network ports provides the first line of defense in preventing unauthorized access to systems and services.

Network-level segmentation using Ethernet virtual local area networks (VLANs) and host-based firewalls enforce inbound and outbound network policy at the host level. Using segmentation allows fine-grained control of communications between components of Oracle Exadata Database Machine. Oracle Exadata Storage Servers include a configured software firewall by default. The database servers can be configured with a software firewall.

- The use of encryption features such as Oracle Advanced Security to encrypt traffic to Oracle Data Guard standby databases.

The security of the data and system is diminished by weak network security. Oracle recommends the following guidelines to maximize your Ethernet network security:

- Configure administrative and operational services to use encryption protocols and key lengths that align with current policies. Cryptographic services provided by Oracle Exadata Database Machine benefit from hardware acceleration, which improves security without impacting performance.
- Manage and separate switches in Oracle Exadata Database Machine from data traffic on the network. This separation is also referred to as "out-of-band."
- Separate sensitive clusters from the rest of the network by using virtual local area networks (VLANs). This decreases the likelihood that users can gain access to information on these clients and servers.
- Use a static VLAN configuration.
- Disable unused switch ports, and assign an unused VLAN number.
- Assign a unique native VLAN number to trunk ports.
- Limit the VLANs that can be transported over a trunk to only those that are strictly required.
- Disable VLAN Trunking Protocol (VTP), if possible. If it is not possible, then set the management domain, password and pruning for VTP. In addition, set VTP to transparent mode.
- Disable unnecessary network services, such as TCP small servers or HTTP. Enable only necessary network services, and configure these services securely.
- Network switches offer different levels of port security features. Use these port security features if they are available:
- Lock the Media Access Control (MAC) address of one or more connected devices to a physical port on a switch. If a switch port is locked to a particular MAC address, then super users cannot create back doors into the network with rogue access points.
- Disable a specified MAC address from connecting to a switch.
- Use each switch port's direct connections so the switch can set security based on its current connections.

### Network Diagrams

Figure 3-1 shows the default network for Oracle Exadata Database Machine X7-2 and X8-2. Each Oracle Exadata Database Machine requires a minimum of two Ethernet networks and one InfiniBand network.

**Figure 3-1 Network for Oracle Exadata Database Machine X7-2 and X8-2 with Bonded Client Access**

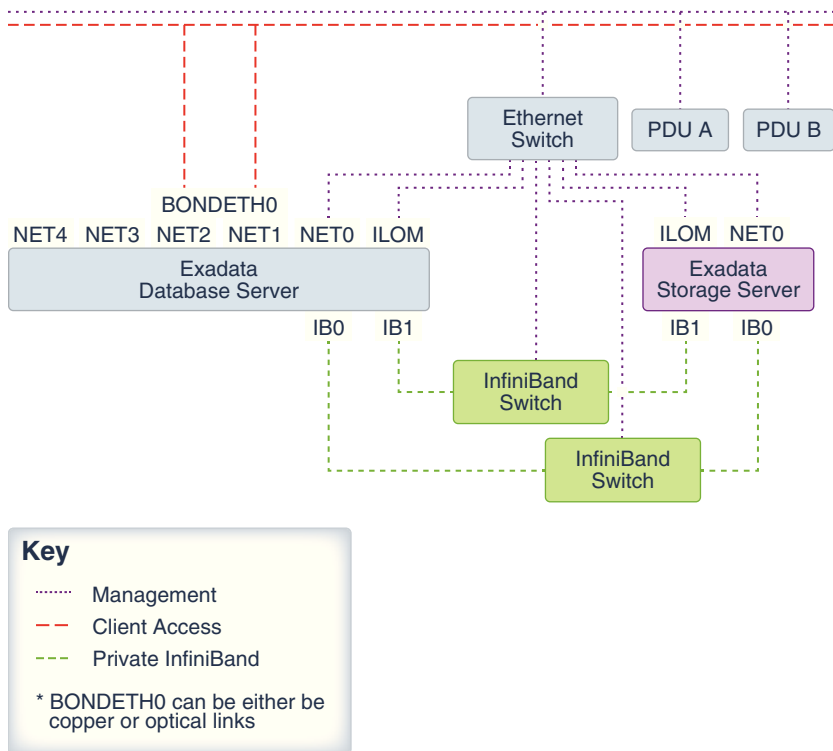


Figure 3-2 shows the default network for Oracle Exadata Database Machine X6-2, X5-2, X4-2, X3-2, and X2-2. Each Oracle Exadata Database Machine requires a minimum of two Ethernet networks and one InfiniBand network.

**Figure 3-2 Network for Oracle Exadata Database Machine X6-2, X5-2, X4-2, X3-2, and X2-2 with Bonded Client Access**

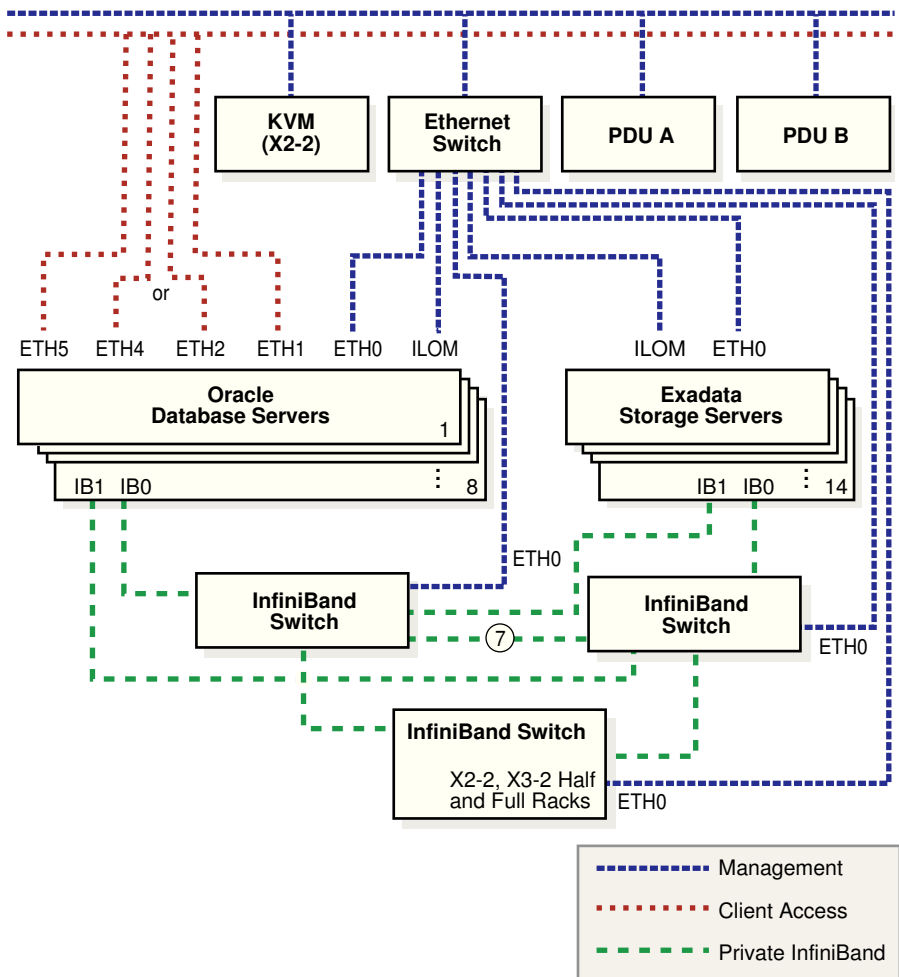


Figure 3-3 shows the default network for Oracle Exadata Database Machine X6-8, X5-8, and X4-8 Full Rack. Each Oracle Exadata Database Machine requires a minimum of two Ethernet networks and one InfiniBand network.

**Figure 3-3 Network for Oracle Exadata Database Machine X6-8, X5-8, and X4-8 Full Rack with Bonded Client Access**

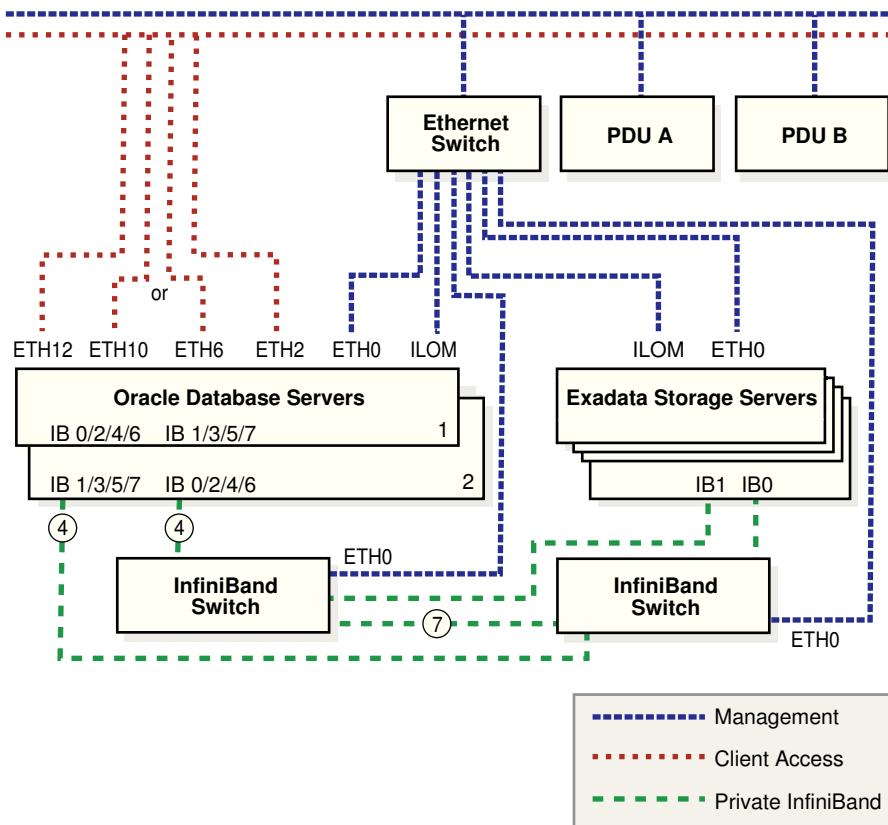
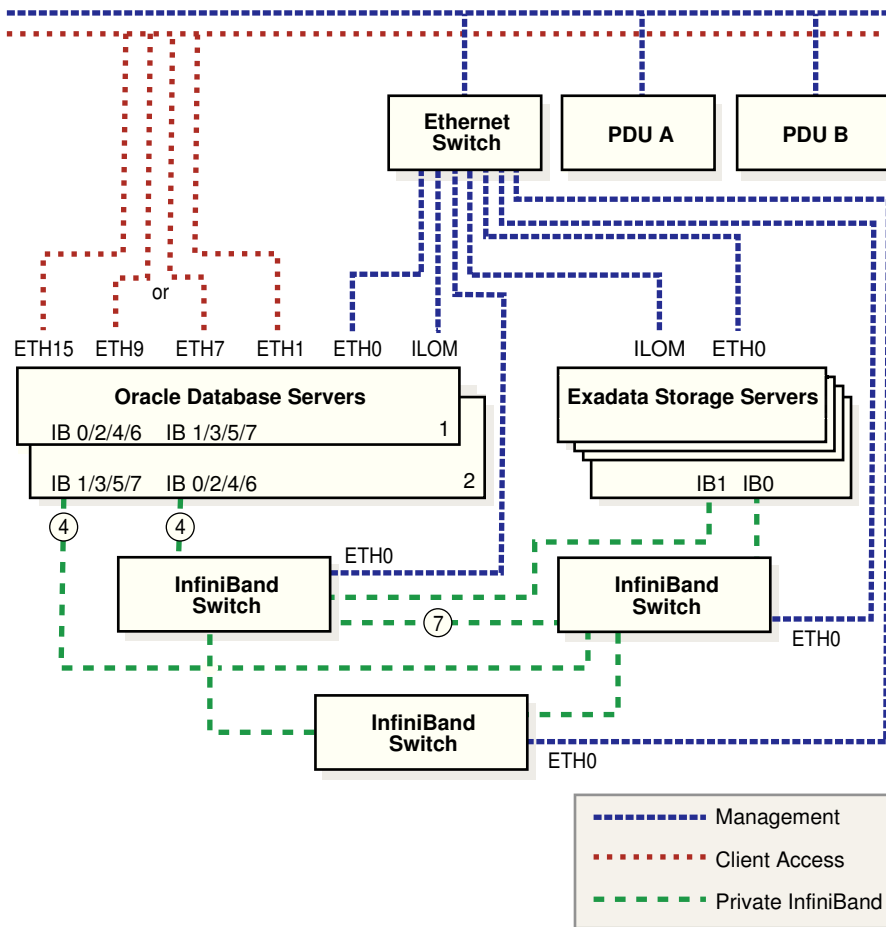


Figure 3-4 shows the default network for Oracle Exadata Database Machine X3-8 Full Rack, and Oracle Exadata Database Machine X2-8 Full Rack. Each Oracle Exadata Database Machine requires a minimum of two Ethernet networks and one InfiniBand network.

**Figure 3-4 Network Diagram for Oracle Exadata Database Machine X3-8 Full Rack, and Oracle Exadata Database Machine X2-8 Full Rack with Bonded Client Access**



### Related Topics

- Understanding the Network Requirements for Oracle Exadata Database Machine
- Using Network VLAN Tagging with Oracle Exadata Database Machine

## 3.2 Understanding the Default Security Settings

Oracle Exadata System Software is installed with many default security settings.

Whenever possible and practical, secure default settings should be chosen and configured. The following default settings are used in Oracle Exadata Database Machine:

- A minimal software installation to reduce attack surface.
- Oracle Database secure settings developed and implemented using Oracle best practices.
- A password policy that enforces a minimum password complexity.
- Failed log in attempts cause a lockout after a set number of failed attempts.

- All default system accounts in the operating system are locked and prohibited from logging in.
- Limited ability to use the `su` command.
- Password-protected boot loader installation.
- All unnecessary system services are disabled, including the Internet service daemon (`inetd/xinetd`).
- Software firewall configured on the storage cells.
- Restrictive file permissions on key security-related configuration files and executable files.
- SSH listen ports restricted to management and private networks.
- SSH limited to v2 protocol.
- Disabled insecure SSH authentication mechanisms.
- Configured specific cryptographic ciphers.
- Unnecessary protocols and modules are disabled from the operating system kernel.

## 3.3 Understanding User Accounts

There are several users used to manage the components of Oracle Exadata Database Machine

In addition to the `root` user, Oracle Exadata Storage Servers have two users, `celladmin` and `cellmonitor`. The `celladmin` user is used to run all services on the cell. The `cellmonitor` user is used for monitoring purposes. The `cellmonitor` user cannot run services on the cell. Other Oracle Exadata Database Machine components have users for the management of the component.

 **Note:**

After Oracle Exadata Database Machine has been deployed, the installation process disables all root SSH keys and expires all user passwords as a security measure for your system. If you do not want the SSH keys disabled or the passwords expired, advise the installation engineer before the deployment.

Starting with Oracle Exadata System Software release 19.1.0, two new users are created, to improve security of specific actions. The `celloff1` user runs query offload processes on the storage servers as a non-`root` user. The `exawatch` user is responsible for collecting and archiving system statistics on both the database servers and the storage servers.

The following table lists the default users and passwords for the Oracle Exadata Database Machine components. All default passwords should be changed after installation of Oracle Exadata Database Machine. Refer to My Oracle Support note 1291766.1 for information about changing the default user accounts passwords.

**Table 3-1 Default Users and Passwords**

User Name and password	User type	Component
root/welcome1	Operating system user	Oracle Exadata Database Servers Oracle Exadata Storage Servers InfiniBand switches Database server ILOMs Oracle Exadata Storage Server ILOMs InfiniBand ILOMs
oracle/ Welcome\$	Operating system user	Oracle Exadata Database Servers
grid/Welcome\$ (this user exists only if role separation is chosen during deployment)	Operating system user	Oracle Exadata Database Servers
celladmin/ welcome	Operating system user	Oracle Exadata Storage Servers
CELLDIAG/ Welcome12345 The password of the CELLDIAG user is reset to a random password during the "Apply Security Fixes" step of Oracle Exadata Deployment Assistant (OEDA).	Oracle Exadata System Software user	Oracle Exadata Storage Servers
cellmonitor/ welcome	Operating system user	Oracle Exadata Storage Servers
cellofl (release 18.2 and later) - no logon privileges	Operating system user	Oracle Exadata Storage Servers
dbmadmin/ welcome	Operating system user	Oracle Exadata Database Servers
dbmmonitor/ welcome	Operating system user	Oracle Exadata Database Servers
exawatch (release 18.2 and later) - no logon privileges	Operating system user	Oracle Exadata Database Servers Oracle Exadata Storage Servers
SYS/Welcome\$	Oracle Database user	Oracle Exadata Database Servers



**Table 3-1 (Cont.) Default Users and Passwords**

User Name and password	User type	Component
SYSTEM/ Welcome\$	Oracle Database user	Oracle Exadata Database Servers
grub boot loader password: sos1Exadata	Operating system user	Oracle Exadata Database Servers Oracle Exadata Storage Servers
nm2user/ changeme	Firmware user	InfiniBand switches
ilom-admin/ ilom-admin	ILOM user	InfiniBand switches
ilom- operator/ ilom-operator	ILOM user	InfiniBand switches
admin/ welcome1  You should secure the enable mode <i>password</i> and <i>secret</i> values for the admin user.	Firmware user	Ethernet switches
admin/ welcome1  The password for the admin user is adm1n if you reset the PDU to factory default settings.	Firmware user	Power distribution units (PDUs) Keyboard, video, mouse (KVM)

**Table 3-1 (Cont.) Default Users and Passwords**

User Name and password	User type	Component
<p>MSUser</p> <p>Management Server (MS) uses this account to manage ILOM and reset it if it detects a hang.</p> <p>The MSUser password is not persisted anywhere. Each time MS starts up, it deletes the previous MSUser account and re-creates the account with a randomly generated password.</p> <p>Do not modify this account. This account is to be used by MS only.</p>	ILOM user	<p>Database server ILOMs</p> <p>Oracle Exadata Storage Server ILOMs</p>

**Related Topics**

- CREATE DIAGPACK
- [How to change OS user password for Cell Node, Database Node, ILOM, KVM, Infiniband Switch, GigaBit Ethernet Switch and PDU on Exadata Database Machine \(My Oracle Support Doc ID 1291766.1\)](#)

## 3.4 Default Password Requirements

Oracle Exadata Deployment Assistant (OEDA) implements a default password policy on Oracle Exadata Database Machine.

The last step of OEDA, "Secure Oracle Exadata Database Machine", implements the following password requirements:

- Dictionary words are not valid or accepted.
- Character classes for passwords are uppercase letters, lowercase letters, digits, and special characters.
- Passwords must contain characters from all four character classes. Passwords using only one, two, or three character classes are not allowed.
- The minimum length of a password is eight characters.
- Pass-phrases are allowed. A pass-phrase should contain at least three words, be 16 to 40 characters in length, and contain different character classes.

- A new password cannot be similar to old passwords. There must be at least eight characters in the new password that were not present in the old password.
- A maximum of three consecutive characters of the same value can be used in a password.
- A maximum of four consecutive characters of the same character class can be used in a password. For example, `abcde1#6B` cannot be used as a password because it uses five consecutive lower case letters.

## 3.5 Default Security Settings Enacted by OEDA

Oracle Exadata Deployment Assistant (OEDA) includes a step to increase hardware security on Oracle Exadata Database Machine.

The last step of OEDA, "Secure Oracle Exadata Database Machine", implements the following security policies:

- For all newly created operating system users on the database servers and storage servers, the following password-aging values are set:
  - The maximum number of days for a password is 90 days. Starting with Oracle Exadata System Software release 19.1.0, this value has been reduced to 60 days.
  - The minimum amount of time between password changes is 24 hours.
  - The number of days of alerts before a password change is seven days.
  - All non-root users must change their password at their next log in.
- An operating system user account is temporarily locked for 10 minutes after one failed log in attempt.
- An operating system user account is locked after five failed attempts.
- A log in session will terminate after 14400 seconds of no input.
- An SSH session will terminate after 7200 seconds of inactivity.
- For the `root` user, SSH equivalency is removed for all database servers and Oracle Exadata Storage Servers.
- The following permissions are set by OEDA:
  - The Automatic Diagnostic Repository (ADR) base directory, `$ADR_BASE`, has SUID (Set owner User ID) on the `diag` directory and its sub-directories.
  - The `celladmin` user group has read and write permissions on the `$ADR_BASE`.

# 4

## Keeping Oracle Exadata Database Machine Secure

This chapter describes policies and procedures to keep Oracle Exadata Database Machine secure.

- [Securing the Hardware](#)  
After installation of Oracle Exadata Database Machine, the hardware should be secured.
- [Securing the Software](#)  
Frequently, hardware security is implemented through software measures.
- [Configuring Data Security for Exadata Storage Servers](#)  
Data security for Oracle Exadata Storage Servers is implemented by controlling which Oracle Automatic Storage Management (Oracle ASM) clusters and Oracle Database clients can access specific grid disks on storage cells.
- [Maintaining a Secure Environment](#)  
After security measures are implemented, they must be maintained to keep the system secure.

### 4.1 Securing the Hardware

After installation of Oracle Exadata Database Machine, the hardware should be secured.

Hardware can be secured by restricting access to the hardware and recording the serial numbers. Oracle recommends the following practices to restrict access:

- Install Oracle Exadata Database Machine and related equipment in a locked, restricted-access room.
- Lock the rack door unless service is required on components within the rack.
- Restrict access to hot-pluggable or hot-swappable devices because the components can be easily removed by design. See
- Store spare field-replaceable units (FRUs) or customer-replaceable units (CRUs) in a locked cabinet. Restrict access to the locked cabinet to authorized personnel.
- Limit SSH listener ports to the management and private networks.
- Use SSH protocol 2 (SSH-2) and FIPS 140-2 approved ciphers.
- Limit SSH allowed authentication mechanisms. Inherently insecure methods are disabled.
- Mark all significant items of computer hardware, such as FRUs.
- Keep hardware activation keys and licenses in a secure location that is easily accessible to the system managers in the case of a system emergency.

- Record the serial numbers of the components in Oracle Exadata Database Machine, and keep a record in a secure place. All components in Oracle Exadata Database Machine have a serial number.

#### Related Topics

- [How To Obtain The Serial Number Associated With The System Board, Motherboard, Disk Controller, Disks, Infiniband HCA And More Contained In A Cell Or Compute Box \(Exadata-Sun V2 or X2 / 11.2\)? \(My Oracle Support Doc ID 949614.1\)](#)
- [How to Determine the Serial Number of a Datacenter InfiniBand Switch 36 or QDR InfiniBand Gateway InfiniBand Switch \(My Oracle Support Doc ID 1299791.1\)](#)

## 4.2 Securing the Software

Frequently, hardware security is implemented through software measures.

Implement the following guidelines to protect hardware and software:

- Change all default passwords when the system is installed at the site. Oracle Exadata Database Machine uses default passwords for initial installation and deployment that are widely known. A default password could allow unauthorized access to the equipment. Devices such as the network switches have multiple user accounts. Be sure to change all account passwords on the components in the rack.
- Limit use of the `root` super user account. Create and use Integrated Lights Out Manager (ILOM) user accounts for individual users to ensure a positive identification in audit trails, and less maintenance when administrators leave the team or company.
- Ensure Oracle Exadata Database Machine is deployed with separate software owner accounts for Oracle Grid Infrastructure and Oracle Database software installations.

#### Note:

Separate software owner accounts for Oracle Grid Infrastructure and Oracle Database software installations are required for enabling DB-scoped security.

- Disable unnecessary protocols and modules in the operating system.
- Restrict physical access to USB ports, network ports, and system consoles. Servers and network switches have ports and console connections, which provide direct access to the system.
- Restrict the capability to restart the system over the network.
- Refer to the documentation to enable available security features.

Oracle Exadata Database Machine can leverage all the security features available with Oracle Database releases installed on legacy platforms. Oracle Database security products and features include the following:

- Oracle Advanced Security
- Oracle Audit Vault

- Data Masking
- Oracle Database Firewall
- Oracle Database Vault
- Oracle Label Security
- Oracle Secure Backup
- Oracle Total Recall

Using the Oracle privileged user and multi-factor access control, data classification, transparent data encryption, auditing, monitoring, and data masking, customers can deploy reliable data security solutions that do not require any changes to existing applications.

#### Related Topics

- [Understanding User Accounts](#)  
There are several users used to manage the components of Oracle Exadata Database Machine
- *Oracle Database Security Guide*

## 4.3 Configuring Data Security for Exadata Storage Servers

Data security for Oracle Exadata Storage Servers is implemented by controlling which Oracle Automatic Storage Management (Oracle ASM) clusters and Oracle Database clients can access specific grid disks on storage cells.

By default, all Oracle Database and Oracle ASM instances have access to all grid disks on the storage servers. The storage for each database is provided by Oracle ASM. You can have multiple clustered or unclustered databases running in your Oracle Exadata Database Machine. You can also have more than one Oracle ASM cluster. An Oracle ASM cluster is a collection of interconnected nodes, each with an Oracle ASM instance, operating as a unified cluster. An Oracle ASM cluster presents a shared pool of storage to one or more Oracle Database instances that are also operating on the nodes.

- [About Exadata Storage Server Security Modes](#)  
Oracle Exadata System Software security allows open security, ASM-scoped security, or DB-scoped security.
- [Best Practices for ASM-Scoped Security and DB-Scoped Security](#)  
While setting up security, it is imperative that the configuration is the same across all the storage servers.
- [About Security Keys](#)  
Oracle Exadata System Software uses keys to identify clients and determine access rights to the grid disks.
- [Setting Up ASM-Scoped Security on Oracle Exadata Storage Servers](#)  
Configuring ASM-scoped security requires actions to be performed on both the database servers and storage servers.
- [Setting Up DB-Scoped Security on Oracle Exadata Database Machine](#)  
When configuring DB-scoped security, you perform actions on both the database and storage servers.
- [Changing Security Keys for ASM-Scoped Security or DB-Scoped Security](#)  
You can change the keys used with ASM-scoped security or DB-scoped security.

- [Enabling Cell-to-Cell Operations](#)  
If you have configured ASM-scoped security or DB-scoped security for your Oracle Exadata Database Machine, then you must configure access control to ensure direct cell-to-cell operations are not restricted.
- [Removing ASM-Scoped Security or DB-Scoped Security](#)  
If you want to revert to an open security model, you must remove DB-scoped security for grid disks before removing ASM-scoped security.

### 4.3.1 About Exadata Storage Server Security Modes

Oracle Exadata System Software security allows open security, ASM-scoped security, or DB-scoped security.

#### **Open Security**

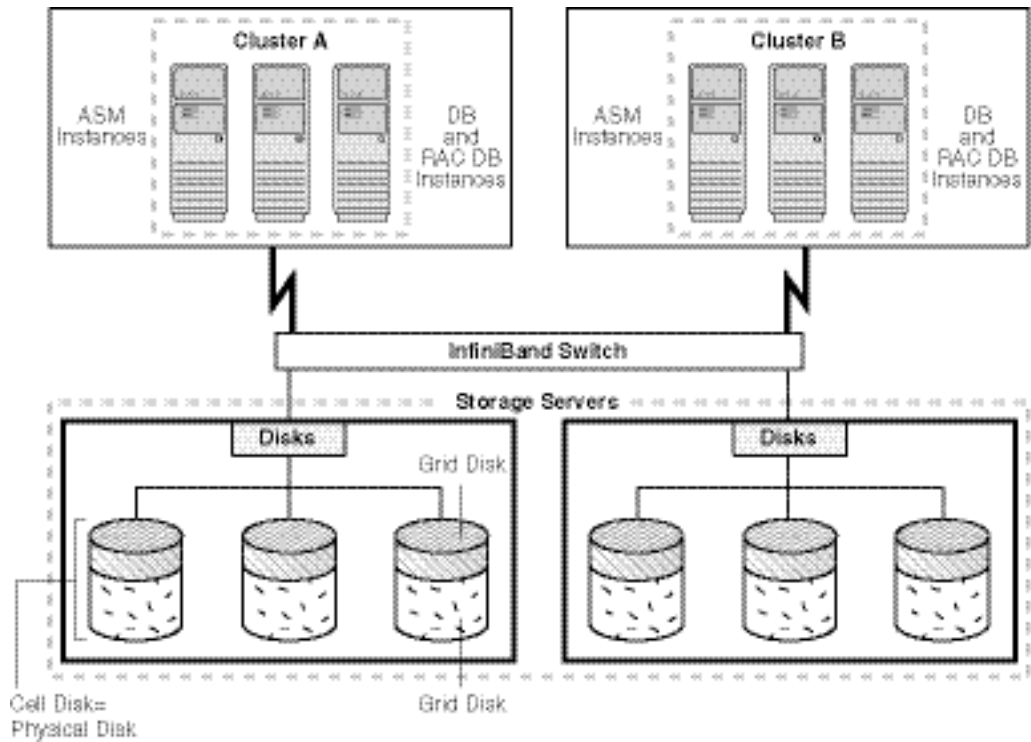
The default security mode is open security, where any database client has access to all the grid disks. Open security mode is useful for test or development databases where there are no security requirements. This is the default security mode after creating a new storage cell.

#### **ASM-Scoped Security**

Using ASM-scoped security you can restrict access to only the grid disks used by the Oracle ASM disk groups associated with a Oracle ASM cluster. All Oracle Database instances associated with that Oracle ASM cluster have access to the disk groups and underlying grid disks. Grid disks used in disk groups belonging to a different Oracle ASM cluster are not be accessible to these instances.

Use ASM-scoped security when you want all databases and Oracle ASM instances in a cluster to have access to the grid disks that comprise the Oracle ASM disk groups used by the cluster. This includes the case when there is only one database in an Oracle ASM cluster.

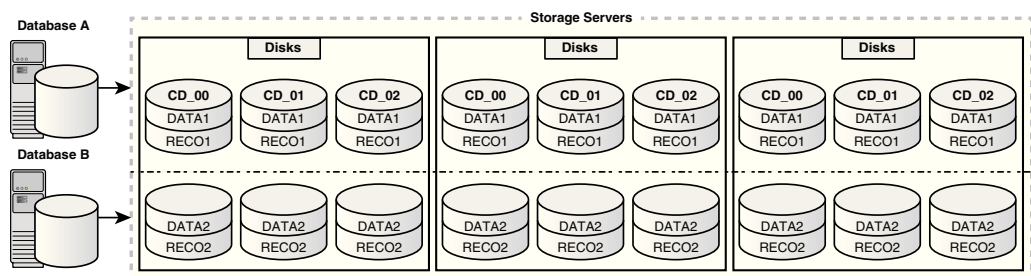
Figure 4-1 ASM-Scoped Security



### DB-Scoped Security

Using DB-scoped security, you can restrict access for an Oracle Database instance to a specific set of grid disks. The database instance must have access to all the grid disks used by the Oracle ASM disk groups for the database. The grid disks used by these Oracle ASM disk groups cannot be used by any other Oracle ASM disk group.

DB-scoped security mode is appropriate when multiple databases are accessing the grid disks. DB-scoped security allows you to limit database access to only the grid disks that are used by the Oracle ASM disk groups associated with the database.



## 4.3.2 Best Practices for ASM-Scoped Security and DB-Scoped Security

While setting up security, it is imperative that the configuration is the same across all the storage servers.

To have consistent Oracle Exadata System Software security, ensure the following:



- Configure the same cell-side grid disk security for all grid disks that belong to the same Oracle ASM disk group to avoid confusion and errors.
- Ensure that all Oracle Real Application Clusters (Oracle RAC) servers in an Oracle ASM cluster have the same content, ownership, and security for the Oracle ASM `cellkey.ora` file.
- Ensure that all Oracle RAC servers in a database cluster have the same content, ownership, and security for the database `cellkey.ora` file.
- If DB-scoped security is implemented, then ensure it is implemented for all databases accessing the grid disks. Do not mix ASM-scoped security and DB-scoped security for any grid disks.
- Use the `dcli` utility to make configuration changes to ensure consistency and eliminate potential user errors.

#### Related Topics

- Using the `dcli` Utility

### 4.3.3 About Security Keys

Oracle Exadata System Software uses keys to identify clients and determine access rights to the grid disks.

To determine which clients have access to a grid disk, a key is generated using CellCLI and stored in a read-only file that is accessible only by the clients. The CellCLI `CREATE KEY` command generates a random hexadecimal string for use as a security key. This key is stored in a `cellkey.ora` file on the client side, and assigned to the targets on the storage servers using the `ASSIGN KEY` command.



#### Note:

The client name or Oracle ASM cluster name not case-sensitive. For example, `ASM1` and `asm1` are treated as the same value.

The `CREATE KEY` command can be run on any cell. You should only run this command when you need to create a new unique key. If you are configuring ASM-scoped security, then only a single security key is needed for each Oracle ASM cluster. If you are configuring DB-scoped security, then one key is needed for each Oracle ASM cluster and an additional security key is needed for each database client.

For ASM-scoped security, the `cellkey.ora` file is only accessible by the Oracle ASM cluster. For DB-scoped security multiple security keys are used. One key is assigned to the Oracle ASM cluster, and one key is assigned to each database client. These security keys are stored in separate `cellkey.ora` files, and each file is accessible only by the client.

The `cellkey.ora` file contains entries that configure security among Oracle ASM, database clients and cells. The `key` and `asm` values in the `cellkey.ora` files on the Oracle ASM and database host computers must match the values assigned to the clients on the cells.

The `cellkey.ora` file contains the following fields:

- `key` — This field is required.

- For ASM-scoped security, this key must match the value of the key assigned to the Oracle ASM cluster with the `CellCLI ASSIGN KEY` command.
- For DB-scoped security, this key must match the value of the key assigned to the database client with the `CellCLI ASSIGN KEY` command.
- `asm` — This field is required.

This field contains a unique identifier for each Oracle ASM cluster. This value must be unique among all the clusters that access the storage servers in the storage grid. This value is used in the `ASSIGN KEY` command run on each cell, and the `ALTER GRIDDISK` and `CREATE GRIDDISK` commands used to configure grid disks to allow access from only a specific Oracle ASM cluster.

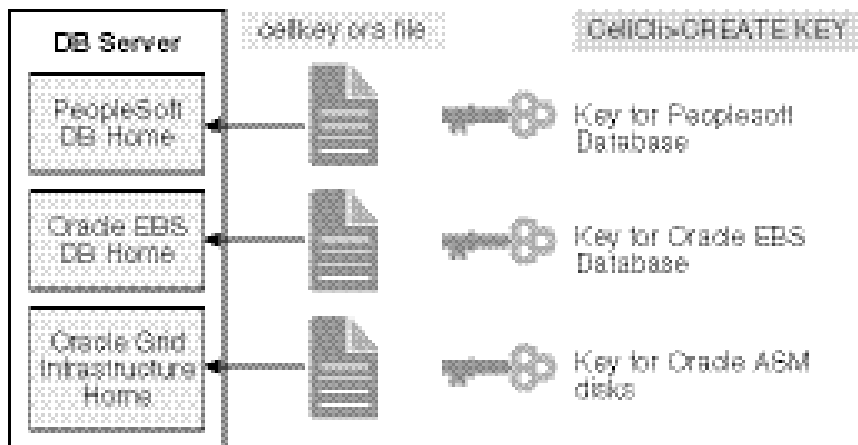
**Note:**  
The `asm` field is used when configuring both ASM-scoped security and DB-scoped security.

Access to the `cellkey.ora` file is controlled by operating system privileges.

- For Oracle ASM clients, the file is stored in the `/etc/oracle/cell/network-config` directory, and is readable by the Oracle Grid Infrastructure software owner.
- For DB-scoped security, there is a `cellkey.ora` for Oracle ASM, readable only by the Oracle Grid Infrastructure software owner, and additional `cellkey.ora` files for each database client. For the database clients, the file is stored in the `pfile` directory of the Oracle home directory for each database. The `cellkey.ora` file for a database is readable only by the operating system user that owns the Oracle Database software installation.

**Note:**  
The Oracle Grid Infrastructure and Oracle Database software must be owned by different operating system users to implement DB-scoped security.

Figure 4-2 Security Keys and cellkey.ora Files



On the storage servers, you use the `ASSIGN KEY` command to store the security keys in an access control list (ACL) for the cells. You use the `ALTER GRIDDISK` command to set the access rights for individual grid disks with the `AvailableTo` attribute. In order to access a grid disk, the security key of the cell ACL must match the security key of the client and the unique name of the client must be included in the `AvailableTo` attribute of the grid disk.

The identifying names used for the Oracle ASM and database must be unique. However, in some environments, there is more than one database with the same value for the `DB_UNIQUE_ID`. Each database uses a different Oracle ASM cluster for storage. Starting with Oracle Exadata System Software release 12.2.1.1.0, you can define ASM-scoped security based on Oracle ASM clusters. You use the `ASMCLUSTER` keyword with the `ASSIGN KEY` command. When you use the `ASMCLUSTER` keyword, the database name is qualified by the Oracle ASM unique identifier, creating a unique ID for each database, even if they have the same `DB_UNIQUE_ID`. Within each Oracle ASM cluster, the database names still have to be unique.

If you configure ASM-scoped security or DB-scoped security, then you also need to configure security keys to enable cell-to-cell operations. You create a key for each storage server, or cell, and assign that key as a local key for the cell using the `ASSIGN KEY FOR LOCAL CELL` command. You then assign the keys for the other cells that perform cell-to-cell operations with the current cell using the `ASSIGN KEY FOR REMOTE CELL` command.

#### Example 4-1 Creating a Security Key for Exadata Storage Security

Use the following command on any storage server to generate a unique security key. This key will be used to configure ASM-scoped security or DB-scoped security.

```
CellCLI> CREATE KEY
        66e12adb996805358bf82258587f5050
```

#### Example 4-2 cellkey.ora File Entries

This example shows the entries for the `cellkey.ora` file.

```
key=66e12adb996805358bf82258587f5050
asm=cluster1
```

#### Related Topics

- [CREATE KEY](#)
- [ASSIGN KEY](#)

## 4.3.4 Setting Up ASM-Scoped Security on Oracle Exadata Storage Servers

Configuring ASM-scoped security requires actions to be performed on both the database servers and storage servers.

The steps here are for configuring ASM-scoped security for a single Oracle ASM cluster and the databases that are clients of that Oracle ASM cluster. The examples in these steps assume that the Oracle ASM software owner is the user `grid`.

1. Shut down the Oracle Database and Oracle ASM instances.
2. On one of the storage servers, use the CellCLI `CREATE KEY` command to generate a random hexadecimal string. The command can be run on any storage server.

```
CellCLI> CREATE KEY

66e12adb996805358bf82258587f5050
```

3. Copy the key to the `cellkey.ora` file on one of the database servers.
  - a. Create a `cellkey.ora` in the home directory of the software owner, for example, `/home/grid/cellkey.ora`.
  - b. Using the format shown below, where `cluster1` is an alias for the Oracle ASM cluster, add the key to the `cellkey.ora` file.

The alias must be unique among all the clusters that access the storage servers. The Oracle Clusterware cluster name can be used if the clusters have unique names.

```
key=66e12adb996805358bf82258587f5050
asm=cluster1
```

4. Use the `ASSIGN KEY` command to assign the security key to the Oracle ASM cluster client on all the storage servers that you want the Oracle ASM cluster to access, for example:

```
CellCLI> ASSIGN KEY FOR ASMCLUSTER
'cluster1'='66e12adb996805358bf82258587f5050'
```

The above command must be repeated on all storage servers that you want the Oracle ASM cluster to access, or you can use a `dcli` command, as shown here:

```
dcli -g cell_group -l celladmin "cellcli -e \"ASSIGN KEY FOR ASMCLUSTER
'cluster1'=
'66e12adb996805358bf82258587f5050'\""
```

5. Configure security on the grid disks on all the storage servers that you want the Oracle ASM cluster to access.

You can configure the security key either when creating grid disks, or with the `ALTER GRIDDISK` command.

- To create new grid disks with security configured, use a command similar to the following where `cluster1` is the unique name for the Oracle ASM client:

```
CellCLI> CREATE GRIDDISK ALL PREFIX=sales, size=75G, -
          availableTo='cluster1'
```

- To change security on existing grid disks, use a command similar to the following **on every storage server**. In the following example, `cluster1` is the

unique name for the Oracle ASM client. The grid disks specified in this command must include all the grid disks used by the Oracle ASM disk groups.

```
CellCLI> ALTER GRIDDISK sales_CD_01_cell01,  
sales_CD_02_cell01,          -  
          sales_CD_03_cell01, sales_CD_04_cell01,  
sales_CD_05_cell01,          -  
  
sales_CD_06_cell01          -  
          availableTo='cluster1'
```

In the preceding commands, the alias used, for example, `cluster1`, is a unique and consistent value on all the storage servers and among all the clusters. When you specify a value for `availableTo`, then only the clients configured with the same alias in the `cellkey.ora` file have access to the grid disks. If there is no value for the `availableTo` attribute, then any client has access to those grid disks.

6. Verify the key assignment on the storage servers.

```
CellCLI> LIST KEY
```

```
CellCLI> LIST GRIDDISK ATTRIBUTES name,availableTo
```

7. Copy the `cellkey.ora` file created in Step 3 to the `/etc/oracle/cell/network-config` directory on each database server.

In the following command, `db_group` is a file that contains the names of the database servers that are clients of the Oracle ASM cluster.

```
dcli -g db_group -l grid -f /home/grid/cellkey.ora -d /etc/oracle/cell/  
network-config/cellkey.ora
```

8. On each database server, configure the permissions for the `cellkey.ora`.
  - If you use role-separated management for all Oracle software, then set the permissions on the file to be read-only by the owner and the group. Change the group ownership for the file to the `oinstall` group that contains the installation users for both Oracle Grid Infrastructure (`grid`) and Oracle Database (`oracle`).

You can use `dcli` to configure the file on multiple servers with a single command.

```
dcli -g db_group -l root chown grid:oinstall /etc/oracle/cell/  
network-config/cellkey.ora
```

```
dcli -g db_group -l grid chmod 600 /etc/oracle/cell/network-config/  
cellkey.ora
```

- If you use a single installation user for all Oracle software, then set the permissions on the file to be read-only by the software owner (for example, oracle).

```
chown oracle:oinstall /etc/oracle/cell/network-config/cellkey.ora
chmod 600 /etc/oracle/cell/network-config/cellkey.ora
```

9. On the database servers, restart Oracle Clusterware, the Oracle ASM instances, and the Oracle Database instances.

The commands to stop and start Oracle Clusterware are:

```
# crsctl stop crs
# crsctl start crs
```

Then restart the Oracle ASM and Oracle Database instances if they are not started automatically.

10. Remove the temporary `cellkey.ora` file created in Step 3.

#### Related Topics

- CREATE KEY
- ASSIGN KEY
- LIST KEY
- ALTER GRIDDISK
- CREATE GRIDDISK
- Using the dcli Utility

## 4.3.5 Setting Up DB-Scoped Security on Oracle Exadata Database Machine

When configuring DB-scoped security, you perform actions on both the database and storage servers.

These steps are for configuring DB-scoped security for a single Oracle ASM cluster and the databases that are clients of that Oracle ASM cluster. The examples in these steps assume that the Oracle ASM software owner is the user `grid` and each Oracle Database home is owned by a different operating system user.

To configure DB-scoped security, the following conditions must exist:

- The combination of the Oracle Database client unique name and the Oracle ASM Cluster used by the database client must be unique in your environment.
- The Oracle Grid Infrastructure software installation and each Oracle Database software installation must be owned by different operating system users.
- Each database client must have distinct Oracle ASM disk groups. The grid disks used by Oracle ASM disk groups can only be assigned to one Oracle ASM disk group.

1. Get the `DB_UNIQUE_NAME` for each database. Names are case-sensitive.

```
SQL> SELECT db_unique_name FROM V$DATABASE;
```

2. Shut down the databases and Oracle ASM instances for the Oracle ASM cluster.
3. On one of the storage servers, use the `CellCLI CREATE KEY` command to generate a key for Oracle ASM and a key for each Oracle Database client.

The command can be run on any storage server.

```
CellCLI> CREATE KEY  
66e12adb996805358bf82258587f5050
```

```
CellCLI> CREATE KEY  
f3f21c625ff41ef479a1bb033e0839e5
```

```
CellCLI> CREATE KEY  
cf03b74de32a67a6c1ec87b9da72bd47
```

4. Copy the key for Oracle ASM to the `cellkey.ora` file on one of the database servers.
  - a. Create a `cellkey.ora` in the home directory of the Oracle Grid Infrastructure software owner, for example, `/home/grid/cellkey.ora`.
  - b. Using the format shown below, where `asm1` is an alias for the Oracle ASM cluster, add the key to the `cellkey.ora` file.

The alias must be unique among all the clusters that access the storage servers. The Oracle Clusterware cluster name can be used if the clusters have unique names.

```
key=66e12adb996805358bf82258587f5050  
asm=asm1
```

5. Copy the key for each Oracle Database client to a `cellkey.ora` file in the user directory of the Oracle home software owner on one of the database servers.
  - a. Create a `cellkey.ora` in the home directory of each Oracle Database software owner, for example, `/home/db1user/cellkey.ora` and `/home/db2user/cellkey.ora`.
  - b. Add the security key for each database client to the `cellkey.ora` file.

Using the format shown here, where `asm1` is an alias for the Oracle ASM cluster used by the database client. In this example, each database client uses the same Oracle ASM cluster.

```
$ cat /home/db1user/cellkey.ora  
key=f3f21c625ff41ef479a1bb033e0839e5  
asm=asm1  
$ cat /home/db2user/cellkey.ora  
key=cf03b74de32a67a6c1ec87b9da72bd47  
asm=asm1
```

 **Note:**

The `asm` field is used for both ASM-scoped security and DB-scoped security.

6. Use the `ASSIGN KEY` command to assign the security key for the Oracle ASM client on all the storage servers that you want the Oracle ASM cluster to access, for example:

```
CellCLI> ASSIGN KEY FOR 'asm1'='66e12adb996805358bf82258587f5050'
```

The above command must be repeated on all storage servers, or you can use a `dcli` command, as shown here:

```
dcli -g cell_group -l root "cellcli -e \"ASSIGN KEY FOR 'asm1'='66e12adb996805358bf82258587f5050'\""
```

7. Use the `ASSIGN KEY` command to assign the security key for each Oracle Database client on all the storage servers that contain grid disks used by the Oracle ASM disk groups of that database, for example:

```
CellCLI> ASSIGN KEY FOR 'db1'='f3f21c625ff41ef479a1bb033e0839e5'
```

```
CellCLI> ASSIGN KEY FOR 'db2'='cf03b74de32a67a6c1ec87b9da72bd47'
```

The above command must be repeated on all storage servers, or you can use a `dcli` command, as shown here, where `cell_group_db1` contains a list of the storage servers used by the first database and `cell_group_db2` contains the list of storage servers used by the second database:

```
dcli -g cell_group_db1 -l root "cellcli -e \"ASSIGN KEY FOR 'db1'='f3f21c625ff41ef479a1bb033e0839e5'\""
```

```
dcli -g cell_group_db2 -l root "cellcli -e \"ASSIGN KEY FOR 'db2'='cf03b74de32a67a6c1ec87b9da72bd47'\""
```

8. Configure security on the grid disks on all the storage servers that you want the database clients to access.

You can configure the security key either when creating grid disks, or with the `ALTER GRIDDISK` command.

- To create new grid disks with security configured, use a command similar to the following where `asm1` is the unique name for the Oracle ASM client, and `db1` and `db2` are the unique names for the database clients:

```
CellCLI> CREATE GRIDDISK data1_CD_00_cell01,data1_CD_01_cell01, -  
data1_CD_02_cell01 size=75G, availableTo='asm1,db1'
```

```
CellCLI> CREATE GRIDDISK reco1_CD_00_cell01,reco1_CD_01_cell01, -  
reco1_CD_02_cell01 size=75G, availableTo='asm1,db1'
```

```
CellCLI> CREATE GRIDDISK data2_CD_00_cell01,data2_CD_01_cell01, -
```



```
data2_CD_02_cell01 size=75G, availableTo='asm1,db2'
```

```
CellCLI> CREATE GRIDDISK reco2_CD_00_cell01,reco2_CD_01_cell01, -
reco2_CD_02_cell01 size=75G, availableTo='asm1,db2'
```

- To change security on existing grid disks, use a command similar to the following **on every storage server**. In the following example, `asm1` is the unique name for the Oracle ASM client, and `db1` and `db2` are the unique names for the database clients. The grid disks specified in this command must include all the grid disks used by the Oracle ASM disk groups for each database client.

```
CellCLI> ALTER GRIDDISK data1_CD_00_cell01, data1_CD_01_cell01, -
data1_CD_02_cell01, reco1_CD_00_cell01, reco1_CD_01_cell01, -
reco1_CD_02_cell01, -
availableTo='asm1,db1'
```

```
CellCLI> ALTER GRIDDISK data2_CD_00_cell01, data2_CD_01_cell02, -
data2_CD_02_cell01, reco2_CD_00_cell01, reco2_CD_01_cell01, -
reco2_CD_02_cell01, -
availableTo='asm1,db2'
```

When you specify a value for `availableTo`, then only the clients configured with the same key assigned to that alias in their `cellkey.ora` file have access to the grid disks. If there is no value for the `availableTo` attribute, then any client has access to those grid disks.

9. Verify the key assignment on the storage servers.

```
CellCLI> LIST KEY
asm1      66e12adb996805358bf82258587f5050
db1      f3f21c625ff41ef479a1bb033e0839e5
db2      cf03b74de32a67a6c1ec87b9da72bd47
```

```
CellCLI> LIST GRIDDISK ATTRIBUTES name,availableTo WHERE availableTo='''
DATA1_CD_00_cell01      asm1,db1
DATA1_CD_01_cell01      asm1,db1
DATA1_CD_02_cell01      asm1,db1
DATA2_CD_00_cell01      asm1,db2
DATA2_CD_01_cell01      asm1,db2
DATA2_CD_02_cell01      asm1,db2
...
```

10. Copy the `cellkey.ora` file created in step 4 to the `/etc/oracle/cell/network-config` directory on each database server.

In the following command, `dbs_group` is a file that contains the names of the database servers that are clients of the Oracle ASM cluster.

```
dcli -g dbs_group -l grid -f /home/grid/cellkey.ora -d /etc/oracle/cell/
network-config/cellkey.ora
```

11. On each database server, set the permissions for the `cellkey.ora` file for Oracle ASM to be read-only by the file owner and the group.

You can use `dcli` to configure the file permissions multiple servers with a single command. In the following example, `db_s_group` is a file that contains a list of all the database servers that are clients of the Oracle ASM cluster.

```
dcli -g db_s_group -l grid chmod 640 /etc/oracle/cell/network-config/cellkey.ora
```

12. Copy each `cellkey.ora` file created in step 5 to its `$ORACLE_HOME/admin/db_unique_name/pfile` directory on each database server.

In the following command, `db1_group` is a file that contains the names of the database servers that host the database instances for the `db1` database, and `dbuser1` is the operating system user that owns the `$ORACLE_HOME/admin/db1` directory.

```
dcli -g db1_group -l dbuser1 -f /home/dbuser1/cellkey.ora  
-d $ORACLE_HOME/admin/db1/pfile/cellkey.ora
```

In this example, `db2_group` is a file that contains the names of the database servers that host the database instances for the database with the unique database name of `db2`, and `dbuser2` is the operating system user that owns the `$ORACLE_HOME/admin/db2` directory.

```
dcli -g db2_group -l dbuser2 -f /home/dbuser2/cellkey.ora  
-d $ORACLE_HOME/admin/db2/pfile/cellkey.ora
```

13. On each database server, set the permissions the permissions for the `cellkey.ora` file in each Oracle database home to be accessible by only the file owner.

You can use `dcli` to configure the file permissions multiple servers with a single command. In the following example, `db1_group` is a file that contains the names of the database servers that host the database instances for the database with the unique database name of `db1`, and `dbuser1` is the operating system user that owns the `$ORACLE_HOME/admin/db1` directory.

```
dcli -g db1_group -l dbuser1 chmod 600 $ORACLE_HOME/admin/db1/pfile/cellkey.ora
```

In this example, `db2_group` is a file that contains the names of the database servers that host the database instances for the database with the unique database name of `db2`, and `dbuser2` is the operating system user that owns the `$ORACLE_HOME/admin/db2` directory.

```
dcli -g db2_group -l dbuser2 chmod 600 $ORACLE_HOME/admin/db2/pfile/cellkey.ora
```

14. On the database servers, restart Oracle Clusterware, the Oracle ASM instances, and the Oracle Database instances.

The commands to stop and start Oracle Clusterware are:

```
# crsctl stop crs  
# crsctl start crs
```

Then restart the Oracle ASM and Oracle Database instances if they are not started automatically by Oracle Clusterware.

15. Remove the temporary `cellkey.ora` files created in step 4 and step 5.

#### Related Topics

- [CREATE KEY](#)
- [ASSIGN KEY](#)
- [LIST KEY](#)
- [ALTER GRIDDISK](#)
- [CREATE GRIDDISK](#)
- [Using the dcli Utility](#)

## 4.3.6 Changing Security Keys for ASM-Scoped Security or DB-Scoped Security

You can change the keys used with ASM-scoped security or DB-scoped security.

- [Upgrading ASM-Scoped Security Key for ASMCLUSTER](#)  
Starting with Oracle Exadata System Software release 12.2.1.1.0, you can define ASM-scoped security based on Oracle ASM clusters.
- [Changing the Assigned Key Value for ASM-Scoped Security](#)  
You can change the key value used for an Oracle ASM client configured to use ASM-scoped security.
- [Changing the Assigned Key Value for DB-Scoped Security](#)  
You can change the key value used by an Oracle Database client configured to use DB-scoped security.

### 4.3.6.1 Upgrading ASM-Scoped Security Key for ASMCLUSTER

Starting with Oracle Exadata System Software release 12.2.1.1.0, you can define ASM-scoped security based on Oracle ASM clusters.

The identifying names used for the Oracle ASM and database instances must be unique. However, in some environments, there is more than one database with the same value for the `DB_UNIQUE_ID`. If each database uses a different Oracle ASM cluster for storage, then you can use the `ASMCLUSTER` keyword when assigning the security key to specify that access should be limited to the specified Oracle ASM cluster.

When you use the `ASMCLUSTER` keyword, the database name is qualified by the Oracle ASM unique identifier, creating a unique ID for each database, even if they have the same `DB_UNIQUE_ID`. Within each Oracle ASM cluster, the database names still have to be unique.

 **Note:**

Do not use the `ASMCLUSTER` keyword when assigning keys if you are using DB-scoped security. Only use the `ASMCLUSTER` keyword for ASM-scoped security.

If you have ASM-scoped security configured, but want to change the keys to be `ASMCLUSTER` keys, perform the following steps:

1. Obtain the key value that you want to upgrade to an `ASMCLUSTER` key.

```
$ dcli -c dm01cel01,dm01cel02,dm01cel03 cellcli -e list key
dm01cel01:      asm1    118af47c57ab8da650ab67d5587fe728
dm01cel02:      asm1    118af47c57ab8da650ab67d5587fe728
dm01cel03:      asm1    118af47c57ab8da650ab67d5587fe728
```

2. Re-issue the `ASSIGN KEY` command using the same key value but adding the `ASMCLUSTER` keyword.

```
$ dcli -c dm01cel01,dm01cel02,dm01cel03 "cellcli -e assign key for
ASMCLUSTER
\'asm1\'=\'118af47c57ab8da650ab67d5587fe728\'"
```

The name and key are removed from the ASM-scoped security list, and added as an Oracle ASM cluster client. Grid disks with this Oracle ASM client in their ACL can remain online for this operation.

3. Verify the keys have been upgraded to `ASMCLUSTER` keys.

```
$ dcli -c dm01cel01,dm01cel02,dm01cel03 cellcli -e list key
dm01cel01:      asm1    118af47c57ab8da650ab67d5587fe728      ASMCLUSTER
dm01cel02:      asm1    118af47c57ab8da650ab67d5587fe728      ASMCLUSTER
dm01cel03:      asm1    118af47c57ab8da650ab67d5587fe728      ASMCLUSTER
```

### 4.3.6.2 Changing the Assigned Key Value for ASM-Scoped Security

You can change the key value used for an Oracle ASM client configured to use ASM-scoped security.

1. Shut down the Oracle Database and Oracle ASM instances for which you are changing the security configuration.
2. Use the CellCLI `CREATE KEY` command to generate a random hexadecimal string. The command can be run on any cell.

```
CellCLI> CREATE KEY
```

```
f3d15c0c5e854345bcb3c2b678b1de45
```

3. Update the `cellkey.ora` file.

- a. On one of the database servers, copy the `/etc/oracle/cell/network-config/cellkey.ora` file to the grid owner home directory, for example, `/home/grid/cellkey.ora`,
- b. Update the file to use the new key for the Oracle ASM client.

```
key=f3d15c0c5e854345bcb3c2b678b1de45
asm=asm1
```

4. Copy the `cellkey.ora` file to `/etc/oracle/cell/network-config` on each database server, overwriting the existing file.

In the following command, `dbs_group` is a file that contains the names of the database servers that are clients of the Oracle ASM cluster, and `grid` is the software owner for the Oracle ASM installation.

```
dcli -g dbs_group -l grid -f /home/grid/cellkey.ora -d /etc/oracle/cell/network-config/cellkey.ora
```

5. Make sure the permissions for the `cellkey.ora` in `/etc/oracle/cell/network-config` are configured so that only the Oracle Grid Infrastructure software owner has access to the file.

Make sure the owner of the file is the Oracle Grid Infrastructure software owner. If the current file permissions are not `rw-----` (600), then modify the permissions, as shown in the following command:

```
dcli -g dbs_group -l grid chmod 600 /etc/oracle/cell/network-config/cellkey.ora
```

6. Use the `ASSIGN KEY` command to update the security key assigned to the Oracle ASM cluster client on all the cells that contains grid disks used by the Oracle ASM cluster.

Use the same identifier and key value for the Oracle ASM client that is used in the `cellkey.ora` file on the database servers.

```
dcli -g cell_group -l root "cellcli -e \"ASSIGN KEY FOR
'asm1'='f3d15c0c5e8543
45bcb3c2b678b1de45'
```

Starting with Oracle Exadata System Software release 12.2.1.1.0, add the `ASMCLUSTER` keyword to the `ASSIGN KEY` command if the security is based only on Oracle ASM clusters. Specify the Oracle ASM cluster name for the unique name for the key. For example:

```
CellCLI> ASSIGN KEY FOR ASMCLUSTER '+asm1' -
='f3d15c0c5e854345bcb3c2b678b1de45
```

 **Note:**

If you are using DB-scoped security, do not add the `ASMCLUSTER` keyword to the `ASSIGN KEY` command.

7. On the database servers, restart Oracle Clusterware, the Oracle ASM instances, and the Oracle Database instances.

The commands to stop and start Oracle Clusterware are:

```
# crsctl stop crs
# crsctl start crs
```

Then restart the Oracle ASM and Oracle Database instances if they are not started automatically by Oracle Clusterware.

8. Remove the temporary `cellkey.ora` files created in step 3.

#### Related Topics

- [Upgrading ASM-Scoped Security Key for ASMCLUSTER](#)  
Starting with Oracle Exadata System Software release 12.2.1.1.0, you can define ASM-scoped security based on Oracle ASM clusters.

### 4.3.6.3 Changing the Assigned Key Value for DB-Scoped Security

You can change the key value used by an Oracle Database client configured to use DB-scoped security.

1. Shut down the Oracle Database instances for which you are changing the security configuration.
2. Use the CellCLI `CREATE KEY` command to generate a random hexadecimal string. This command can be run on any cell.

```
CellCLI> CREATE KEY

fa292e11b31b210c4b7a24c5f1bb4d32
```

3. Update the `cellkey.ora` file for the database client.
  - a. On one of the database servers, copy the `$ORACLE_HOME/admin/db_unique_name/pfile/cellkey.ora` file to the user directory for the Oracle software owner, for example, `/home/oradba1/cellkey.ora`.
  - b. Update the file to use the new key for the database client.

```
key=fa292e11b31b210c4b7a24c5f1bb4d32
asm=asm1
```

4. Copy the `cellkey.ora` file to `$ORACLE_HOME/admin/db_unique_name/pfile` on each database server, overwriting the existing file.

In the following command, `dba1_group` is a file that contains the names of the database servers that host instances of the database client, and `oradba1` is the software owner for the Oracle Database installation.

```
dcli -g dba1_group -l oradba1 -f /home/oradba1/cellkey.ora -
d $ORACLE_HOME/admin/
db_unique_name/pfile/cellkey.ora
```

5. Make sure the permissions for the `cellkey.ora` in `$ORACLE_HOME/admin/db_unique_name/pfile` are configured so that only the Oracle Database software owner has access to the file.

Make sure the owner of the file is the Oracle Database software owner. If the current file permissions are not `rw-----` (600), then modify the permissions, as shown in the following command:

```
dcli -g dba1_group -l oradba1 chmod 600 $ORACLE_HOME/admin/  
db_unique_name/  
pfile/cellkey.ora
```

6. Use the `ASSIGN KEY` command to update the security key assigned to the Oracle Database client on all the cells that contains grid disks used by the database.

Use the `DB_UNIQUE_NAME` for the database and the new key value for the database client.

```
dcli -g cell_group -l celladmin "cellcli -e \"ASSIGN KEY FOR  
'db_unique_name'=  
'fa292e11b31b210c4b7a24c5f1bb4d32'\"
```

7. On the database servers, restart the Oracle Database instances.
8. Remove the temporary `cellkey.ora` file created in step 3.

#### Related Topics

- [Setting Up DB-Scoped Security on Oracle Exadata Database Machine](#)  
When configuring DB-scoped security, you perform actions on both the database and storage servers.
- [About Security Keys](#)  
Oracle Exadata System Software uses keys to identify clients and determine access rights to the grid disks.

## 4.3.7 Enabling Cell-to-Cell Operations

If you have configured ASM-scoped security or DB-scoped security for your Oracle Exadata Database Machine, then you must configure access control to ensure direct cell-to-cell operations are not restricted.

To ensure cells have access to other cells when they need to communicate directly with one another, for example for offload operations, you need to set up **cell keys** for each cell.

- [Configuring Simple Cell Access](#)  
You can use a single key for both inbound and outbound cell-to-cell traffic.
- [Configuring LOCAL and REMOTE Cell Keys](#)  
You can configure each cell to have a unique key and to accept multiple remote cell keys for granting access.
- [Changing Between Simple Cell Keys and LOCAL and REMOTE Keys](#)  
You must remove the existing cell keys before assigning any new keys with a different format. This protects you from inadvertently breaking your configuration by having different remote and local keys on the storage servers.

### 4.3.7.1 Configuring Simple Cell Access

You can use a single key for both inbound and outbound cell-to-cell traffic.

To ensure cells have access to other cells when they need to communicate directly with one another, for offload operations for example, you can create a single key. Assign that key to all cells using the simple version of the `ASSIGN KEY` command.

It is not necessary to use the `ALTER GRIDDISK` command to update the `availableTo` attribute for the cell key. The cells use the existing access control policy by making sure the originating client is identified at the remote target cell.

Perform these steps only if you have already configured ASM-Scoped Security or DB-Scoped Security.

1. Generate a random hexadecimal string.

This command can be run on any cell.

```
CellCLI> CREATE KEY  
fa292e11b31b210c4b7a24c5f1bb4d32
```

2. Assign the key to each cell.

```
CellCLI> ASSIGN KEY FOR CELL 'fa292e11b31b210c4b7a24c5f1bb4d32'
```

To update all cells with a single command, use `dcli`.

```
dcli -g mycells -l celladmin "cellcli -e assign key for cell  
'fa292e11b31b210c4b7a24c5f1bb4d32\''
```

### 4.3.7.2 Configuring LOCAL and REMOTE Cell Keys

You can configure each cell to have a unique key and to accept multiple remote cell keys for granting access.

To ensure cells have access to other cells when they need to communicate directly with one another, for offload operations for example, you create cell keys. You can create a single key used by all cells, or you can assign a unique key to individual cells using the `LOCAL` and `REMOTE` keywords.

You might want to use multiple cell keys temporarily during rekeying, or if you want to limit access to specific cells. In this case, you need to specify `LOCAL` or `REMOTE` in the `ASSIGN KEY` command.

Perform these steps only if you have already configured ASM-Scoped Security or DB-Scoped Security.

1. Generate a random hexadecimal string for each cell.

These commands can be run on any cell.

```
Cellcli> CREATE KEY  
fa292e11b31b210c4b7a24c5f1bb4d3
```

```
Cellcli> CREATE KEY
```



```
b67d5587fe728118af47c57ab8da650a
```

```
Cellcli> CREATE KEY
118af47c57ab8da650ab67d5587fe728
```

2. On each cell, set the key for the local cell.

Specify a unique identifier for each cell, for example, cell101, cell102, and so on.

```
[celladmin@dm01cel01 ~]$ cellcli -e assign key for local cell -
'cell101'='fa292e11b31b210c4b7a24c5f1bb4d3'
[celladmin@dm01cel02 ~]$ cellcli -e assign key for local cell -
'cell102'='b67d5587fe728118af47c57ab8da650a'
[celladmin@dm01cel03 ~]$ cellcli -e assign key for local cell -
'cell103'='118af47c57ab8da650ab67d5587fe728'
```

3. Set the cell keys that the local cell will accept.

For each cell that you want to grant access to the local cell, use the `ASSIGN KEY FOR REMOTE CELL` command and specify the local key of that cell. You can specify any name for the remote keys.

```
[celladmin@dm01cel01 ~]$ cellcli -e assign key for remote cell -
'rcell102'='b67d5587fe728118af47c57ab8da650a', -
'rcell103'='118af47c57ab8da650ab67d5587fe728'
```

```
[celladmin@dm01cel02 ~]$ cellcli -e assign key for remote cell -
'rcell101'='fa292e11b31b210c4b7a24c5f1bb4d3', -
'rcell103'='118af47c57ab8da650ab67d5587fe728'
```

```
[celladmin@dm01cel03 ~]$ cellcli -e assign key for remote cell -
'rcell101'='fa292e11b31b210c4b7a24c5f1bb4d3', -
'rcell102'='b67d5587fe728118af47c57ab8da650a'
```

4. Verify that the keys are set on each storage server.

```
CellCLI> LIST KEY
db1          c25a62472a160e28bf15a29c162f1d74
asm1         118af47c57ab8da650ab67d5587fe728    ASMCLUSTER
cell101      fa292e11b31b210c4b7a24c5f1bb4d32    LOCAL-CELL
rcell102     b67d5587fe728118af47c57ab8da650a    REMOTE-CELL
rcell103     118af47c57ab8da650ab67d5587fe728    REMOTE-CELL
```

### 4.3.7.3 Changing Between Simple Cell Keys and LOCAL and REMOTE Keys

You must remove the existing cell keys before assigning any new keys with a different format. This protects you from inadvertently breaking your configuration by having different remote and local keys on the storage servers.

If you attempt to assign a LOCAL or REMOTE key to an existing cell key (that is, you have run the simple ASSIGN KEY FOR CELL command, and you want to switch to the explicit LOCAL or REMOTE keys), you will get the following error:

```
CELL-02911: Remove existing CELL key before assigning LOCAL CELL key
```

Similarly, if you attempt run ASSIGN KEY FOR CELL when local or remote cell keys already exist, you will get the following error:

```
CELL-02912: Remove all existing LOCAL and REMOTE CELL keys before assigning a CELL key.
```

Use LIST KEY FOR CELL to show all LOCAL and REMOTE CELL keys, then use ASSIGN KEY to assign an empty value to each.

You must remove all existing LOCAL and REMOTE cell keys before assigning a simple cell key.

1. View the configured keys on each storage server.
  - a. For simple cell keys, you would see results similar to the following:

```
CellCLI> LIST KEY
      db1          c25a62472a160e28bf15a29c162f1d74
      asm1         b4095e91d67bbf68d2e2fbc50530f      ASMCLUSTER
      cellkey      fa292e11b31b210c4b7a24c5f1bb4d32    CELL
```

- b. For local and remote cell keys, you would see results similar to the following:

```
CellCLI> LIST KEY
      db1          c25a62472a160e28bf15a29c162f1d74
      asm1         b4095e91d67bbf68d2e2fbc50530f      ASMCLUSTER
      cell101      fa292e11b31b210c4b7a24c5f1bb4d32    LOCAL-CELL
      rcell102     b67d5587fe728118af47c57ab8da650a    REMOTE-CELL
      rcell103     118af47c57ab8da650ab67d5587fe728    REMOTE-CELL
```

2. Remove the existing cell keys.
  - a. For simple cell keys, use a command similar to the following:

```
dcli -g mycells -l celladmin "cellcli -e assign key for cell
'cell101'=''"
```

- b. For local and remote cell keys:

Remove the local key on each cell.

```
[celladmin@dm01cel01 ~]$ cellcli -e assign key for local cell  
'cell01'=''  
[celladmin@dm01cel02 ~]$ cellcli -e assign key for local cell  
'cell02'=''  
[celladmin@dm01cel03 ~]$ cellcli -e assign key for local cell  
'cell03'=''
```

Run the following commands from any server to remove the remote keys on each cell:

```
dcli -g mycells -l celladmin "cellcli -e assign key for remote cell  
'rcell01'=''  
dcli -g mycells -l celladmin "cellcli -e assign key for remote cell  
'rcell02'=''  
dcli -g mycells -l celladmin "cellcli -e assign key for remote cell  
'rcell03'=''"
```

3. Recreate the keys in the desired format.
  - a. To change simple cell keys to local and remote keys, follow the steps in [Configuring LOCAL and REMOTE Cell Keys](#)
  - b. To change local and remote cell keys to a simple cell key, follow the steps in [Configuring Simple Cell Access](#).

## 4.3.8 Removing ASM-Scoped Security or DB-Scoped Security

If you want to revert to an open security model, you must remove DB-scoped security for grid disks before removing ASM-scoped security.

Before making updates to the security on cells, you must shut down the Oracle Database and Oracle ASM instances. After all of the changes to security configuration are complete, start the Oracle Database and Oracle ASM instances.

- [Removing DB-Scoped Security](#)
- [Removing ASM-Scoped Security](#)  
After you have removed DB-scoped security, you can remove ASM-scoped security if you want open security for the grid disks on the storage servers.

### 4.3.8.1 Removing DB-Scoped Security

To remove DB-scoped security on grid disks, perform the following procedure:

1. Shut down the Oracle Database and Oracle ASM instances.
2. Remove any database clients named in the `availableTo` attribute of the grid disks for which you want to remove DB-scoped security. [Example 4-3](#) provides examples of how to do this.

 **Note:**

If you removing DB-scoped security for a database client for only some of the grid disks, but not all, do not complete any further steps.

3. If a database client is not configured for security with any other grid disks, then you can remove the key assigned to the database client on the storage servers. Use the CellCLI `ASSIGN KEY` command.

In the following command, *db\_client* is the name of the database client. To the right of the equal sign are two single quote characters with no space between them.

```
CellCLI> ASSIGN KEY FOR 'db_client'=''
```

Repeat this step on each storage server (cell) for which the database client no longer needs DB-scoped security.

4. On each database server, remove the `cellkey.ora` file located in the `$ORACLE_HOME/admin/db_unique_name/pfile/` directory for the database client.
5. Verify the key assignment has been updated on the storage servers.

```
CellCLI> LIST KEY
asm1      66e12adb996805358bf82258587f5050
db2       cf03b74de32a67a6c1ec87b9da72bd47
```

```
CellCLI> LIST GRIDDISK ATTRIBUTES name,availableTo WHERE availableTo!=''
DATA1_CD_00_cell101      asm1
DATA1_CD_01_cell101      asm1
DATA1_CD_02_cell101      asm1
DATA2_CD_00_cell101      asm1,db2
DATA2_CD_01_cell101      asm1,db2
DATA2_CD_02_cell101      asm1,db2
...
```

6. Restart the Oracle Database and Oracle ASM instances.

**Example 4-3 Removing Database Clients from Grid Disks**

The following command removes all database clients from a group of grid disks:

```
CellCLI> ALTER GRIDDISK DATA1_CD_00_cell101,
DATA1_CD_01_cell101,          -
DATA1_CD_02_cell101, RECO1_CD_00_cell101,
RECO1_CD_01_cell101,          -
RECO1_CD_02_cell101          -
availableTo='asm1'
```

If there are multiple database clients configured for DB-scoped security, for example db1, db2, and db3, and you only want to remove security for one client (db1), you can use a command similar to the following for a group of grid disks:

```
CellCLI> ALTER GRIDDISK sales_CD_04_cell01,
sales_CD_05_cell01,          -
          sales_CD_06_cell01, sales_CD_07_cell01,
sales_CD_08_cell01,          -
sales_CD_09_cell01,          -
          availableTo='+asm,db2,db3'
```

The following example removes all database clients from all grid disks:

```
ALTER GRIDDISK ALL availableTo='+asm'
```

#### Note:

If you want open security for the grid disks and storage servers, then you must remove ASM-scoped security after removing DB-scoped security.

#### Related Topics

- [Removing ASM-Scoped Security](#)  
After you have removed DB-scoped security, you can remove ASM-scoped security if you want open security for the grid disks on the storage servers.

### 4.3.8.2 Removing ASM-Scoped Security

After you have removed DB-scoped security, you can remove ASM-scoped security if you want open security for the grid disks on the storage servers.

1. Shut down the Oracle Database and Oracle ASM instances.
2. Use the `LIST KEY` command to view the unique alias used for the Oracle ASM client.

Run this command on any storage server where ASM-scoped security is configured for the Oracle ASM client.

```
CellCLI> LIST KEY
asm1      66e12adb996805358bf82258587f5050
db2       cf03b74de32a67a6c1ec87b9da72bd47
```

3. Remove the Oracle ASM client named in the `availableTo` attribute of the grid disks for which you want to remove ASM-scoped security.  
Use the alias from step 2. [Example 4-4](#) provides examples of how to do this.
4. If the Oracle ASM client is not configured for security with any other grid disks, then you can remove the key assigned to the Oracle ASM client on the storage servers. Use the `CellCLI ASSIGN KEY` command.
  - a. Determine if the Oracle ASM client in step 2 shows the `ASMCLUSTER` designation to the right of the key value.

- b.** Use the `ASMCLUSTER` keyword in the `ASSIGN KEY` command only if the Oracle ASM client is listed as an `ASMCLUSTER`.

In the following command, `asm_cluster` is the alias from step 2. To the right of the equal sign are two single quote characters with no space between them.

```
CellCLI> ASSIGN KEY FOR [ASMCLUSTER] 'asm_cluster'=''
```

Run this command on all storage servers on which the key was assigned to the Oracle ASM client. You can alternatively use a command similar to the following:

```
dcli -g cell_group -l celladmin "cellcli -e \"ASSIGN KEY FOR  
[asmcluster]  
'asm_cluster'=''\\""
```

- 5.** Update or delete the `cellkey.ora` file.

View the `cellkey.ora` file located in the `/etc/oracle/cell/network-config/` directory on each database server.

If the Oracle ASM client for which you are removing ASM-scoped security is the only client listed in the file, then remove the `cellkey.ora` file on all servers with the same file contents.

If there is more than one Oracle ASM client listed in the `cellkey.ora` file, then perform the following steps:

- a.** Remove the entry for the Oracle ASM client for which you are removing ASM-scoped security.
  - b.** For all servers that list the Oracle ASM client in the `cellkey.ora` file, copy this file to those servers, or update the file on those servers.
- 6.** Verify the key assignment has been updated on the storage servers.

```
CellCLI> LIST KEY
```

```
CellCLI> LIST GRIDDISK ATTRIBUTES name,availableTo WHERE availableTo='''
```

- 7.** Restart the Oracle Database and Oracle ASM instances.

#### **Example 4-4 Removing the Oracle ASM Client from Grid Disks**

The following command removes the Oracle ASM client from all grid disks on a cell:

```
CellCLI> ALTER GRIDDISK ALL availableTo=''
```

The following command removes the Oracle ASM client from all grid disks on a group of cells:

```
dcli -g cell_group -l celladmin "cellcli -e \"ALTER GRIDDISK ALL  
availableTo=''\\""
```

The following command removes the Oracle ASM client from a group of grid disks on a cell:

```
CellCLI> ALTER GRIDDISK sales_CD_01_cell01, sales_CD_02_cell01, -  
sales_CD_03_cell01, sales_CD_04_cell01, sales_CD_05_cell01, -  
sales_CD_06_cell01  
availableTo=' '
```

#### Related Topics

- ALTER GRIDDISK
- ASSIGN KEY

## 4.4 Maintaining a Secure Environment

After security measures are implemented, they must be maintained to keep the system secure.

Software, hardware and user access need to be updated and reviewed periodically. For example, organizations should review the users and administrators with access to Oracle Exadata Database Machine, and its deployed services to verify if the levels of access and privilege are appropriate. Without review, the level of access granted to individuals may increase unintentionally due to role changes or changes to default settings. It is recommended that access rights for operational and administrative tasks be reviewed to ensure that each user's level of access is aligned to their roles and responsibilities.

Organizations are encouraged to utilize tools to detect unauthorized changes, configuration drift, and prepare for security updates. Oracle Enterprise Manager provides an integrated solution for managing operational issues for hardware, deployed applications, and services.

- [Maintaining Network Security](#)  
After the networks are configured based on the security guidelines, regular review and maintenance is needed.
- [Guarding Against Unauthorized Operating System Access](#)  
AIDE is a utility that creates a database of files on the system, and then uses that database to ensure file integrity and to detect system intrusions.
- [Updating Software and Firmware](#)  
Effective and proactive software management is a critical part of system security.
- [Ensuring Data Security Outside of Oracle Exadata Database Machine](#)  
It is important to protect data stored outside of Oracle Exadata Database Machine, on backups or removed hard drives.

#### Related Topics

- [Responses to common Exadata security scan findings\(My Oracle Support Doc ID 1405320.1\)](#)
- [Oracle Exadata Database Machine Maintenance Guide](#)

## 4.4.1 Maintaining Network Security

After the networks are configured based on the security guidelines, regular review and maintenance is needed.

The management network switch configuration file should be managed offline, and access to the configuration file should be limited to authorized administrators. The configuration file should contain descriptive comments for each setting. Consider keeping a static copy of the configuration file in a source code control system. Periodic reviews of the client access network are required to ensure that secure host and Integrated Lights Out Manager (ILOM) settings remain intact and in effect. In addition, periodic reviews of the settings ensure that they remain intact and in effect.

Follow these guidelines to ensure the security of local and remote access to the system:

- Create a login banner to state that unauthorized access is prohibited.
- Use access control lists to apply restrictions where appropriate.
- Set time-outs for extended sessions and set privilege levels.
- Use authentication, authorization, and accounting (AAA) features for local and remote access to a switch.
- Use the port mirroring capability of the switch for intrusion detection system (IDS) access.
- Implement port security to limit access based upon a MAC address. Disable auto-trunking on all ports for any switch connected to Oracle Exadata Database Machine.
- Limit remote configuration to specific IP addresses using SSH.
- Require users to use strong passwords by setting minimum password complexity rules and password expiration policies.
- Enable logging and send logs to a dedicated secure log host.
- Configure logging to include accurate time information, using NTP and timestamps.
- Review logs for possible incidents and archive them in accordance with the organization's security policy.

Standard 140 of FIPS (Federal Information Processing Standards) relates to security and cryptography. FIPS 140 is a collection of standards published by NIST (National Institute of Standards and Technology), an agency of the United States federal government. FIPS 140 protects data during transit as well as at rest. It specifies security standards for cryptographic components within a computing environment. FIPS 140 is useful for organizations that need to document that their computing environment meets a published level of security. Many government agencies and financial institutions use FIPS 140 qualified systems.

Configuring FIPS 140 at the Oracle Database level enables the use of FIPS 140 cryptographic modules in the Secure Sockets Layer (SSL), transparent data encryption (TDE), DBMS\_CRYPTO PL/SQL package, and Exadata Smart Scan. This protects data while processing Smart Scan offload operations.



**Related Topics**

- [Oracle Database Security Guide](#)
- [Oracle Database Advanced Security Guide](#)
- [Oracle Exadata Database Machine System Overview](#)

## 4.4.2 Guarding Against Unauthorized Operating System Access

AIDE is a utility that creates a database of files on the system, and then uses that database to ensure file integrity and to detect system intrusions.

- [About Advanced Intrusion Detection Environment \(AIDE\)](#)  
AIDE helps to track down which file has been affected in case the system was compromised.
- [Managing AIDE Components](#)  
You can use the `exadataAIDE` utility to manage AIDE.
- [Adding Custom AIDE Rules](#)  
You can instruct AIDE to not check for changes in specific directories during AIDE the metadata initialize step and also during the daily `cron` check.
- [Managing AIDE Alerts when Updating Exadata Software](#)  
Software and hardware updates and installs tend to change the size and nature of operating system files. Therefore, you should re-generate the AIDE database after making changes.

### 4.4.2.1 About Advanced Intrusion Detection Environment (AIDE)

AIDE helps to track down which file has been affected in case the system was compromised.

AIDE runs a daily cron job that monitors the system for changes to files in specific directories. It takes a snapshot of all files in the system defined by rules specified in its configuration file. AIDE compares the current file with the snapshot of files taken previously. If any content changes in the snapshot file, AIDE automatically raises CRITICAL software alerts. AIDE uses the default alerting destination email and sends the alert email to the configured SMTP email address. The results of the daily AIDE scan are written to `/var/log/aide/aide.log`.

The file snapshot database created by AIDE is stored at `/var/lib/aide/aide.db.gz`. You can backup this file daily if you want to audit what happened on a given system on daily basis.

### 4.4.2.2 Managing AIDE Components

You can use the `exadataAIDE` utility to manage AIDE.

AIDE comes pre-configured with Exadata System Software release 19.1; you do not have to perform any setup tasks to use this feature.

**exadataAIDE Syntax**

The utility is located at `/opt/oracle.SupportTools/exadataAIDE`.

```
exadataAIDE [-s|-status] [-e|enable] [-d|disable] [-u|-update] [-h|help]
```

Description of syntax options:

- `-s[tatus]` : Print the current status of the AIDE daily cron job
- `-e[nable]` : Enable the AIDE daily cron job
- `-d[isable]` : Disable the AIDE daily cron job
- `-u[pdate]` : Update the AIDE database metadata and run the daily scan
- `-h[elp]` : Print the command syntax and help information
- Get the current status of the `aide` cron job.

```
exadataAIDE -status
```

- Disable the daily AIDE scan.

```
exadataAIDE -disable
```

- Enable the daily AIDE scan.

```
exadataAIDE -enable
```

- Update the AIDE database after making changes to the system.

```
exadataAIDE -update
```

### 4.4.2.3 Adding Custom AIDE Rules

You can instruct AIDE to not check for changes in specific directories during AIDE the metadata initialize step and also during the daily `cron` check.

1. Log in to the server or virtual machine as the `root` user.
2. Edit the file `/etc/aide.conf`.

Add the directories you want AIDE to skip during its scan. Prefix the directory path with an exclamation point.

```
# Ignore /opt/myapp directory content
!/opt/myapp
```

3. Update the AIDE database metadata.

```
# /opt/oracle.SupportTools/exadataAIDE -u
```

AIDE will not raise any alerts for `/opt/myapp` directory content changes going forward.

### 4.4.2.4 Managing AIDE Alerts when Updating Exadata Software

Software and hardware updates and installs tend to change the size and nature of operating system files. Therefore, you should re-generate the AIDE database after making changes.

Use the following steps to reduce false alarms when updating software:

 **Note:**

Oracle Exadata Deployment Assistant (OEDA) has intelligence built-in to avoid false alerts when installing or updating software.

1. Disable AIDE monitoring.

```
exadataAIDE -disable
```

2. Update the software on your system.

3. Re-enable AIDE monitoring.

```
exadataAIDE -enable
```

4. Update the AIDE database with the recent file changes.

```
exadataAIDE -update
```

### 4.4.3 Updating Software and Firmware

Effective and proactive software management is a critical part of system security.

Security enhancements are introduced through new releases and software updates. Oracle recommends installing the latest release of the software, and all necessary security updates on the equipment. The application of Oracle recommended and security updates is a best practice for the establishment of baseline security.

Oracle Exadata Storage Server operating system and kernel updates are delivered with Oracle Exadata System Software updates. Oracle Exadata Database Machine database servers are updated using `yum` facilities. Power distribution unit (PDU) firmware updates are handled separately from the software and other firmware updates. Ensure that the PDU is running the latest approved firmware for Oracle Exadata Database Machine. As PDU firmware updates are not issued frequently, it is usually sufficient to check the PDU firmware release when upgrading Oracle Exadata System Software.

 **Note:**

Devices such as network switches that contain firmware may require patches and firmware updates.

#### Related Topics

- *Oracle Exadata Database Machine Maintenance Guide*

## 4.4.4 Ensuring Data Security Outside of Oracle Exadata Database Machine

It is important to protect data stored outside of Oracle Exadata Database Machine, on backups or removed hard drives.

Data located outside of Oracle Exadata Database Machine can be secured by backing up important data. The data should then be stored in an off-site, secure location. Retain the backups according to organizational policies and requirements.

When disposing of an old hard drive, physically destroy the drive or completely erase all the data on the drive. Deleting the files or reformatting the drive removes only the address tables on the drive. The information can still be recovered from a drive after deleting files or reformatting the drive. The Oracle Exadata Database Machine disk retention support option allows the retention of all replaced hard drives and flash drives, instead of returning them to Oracle.

The CellCLI command `DROP CELLDISK` includes an option to securely erase data by overwriting the data. If Oracle Exadata Storage Server drives contain sensitive data that needs to be erased for redeployment or another purpose, then the secure erase feature should be used on the storage cell. The `ERASE` option ensures that all data is overwritten with random data, and erased up to seven times. This ensures that the data cannot be recovered, and that the data is permanently erased.

Starting with Oracle Exadata System Software release 19.1.0, if you use `DROP CELLDISK` and select to erase disks using 1pass, 3pass, or 7pass method, Oracle Exadata System Software uses the better and faster Secure Eraser if supported by the underlying hardware.

# 5

## Securely Erasing Oracle Exadata Database Machine

If you are repurposing or removing an Oracle Exadata Database Machine from your environment, it is critical to securely erase all the information on the servers.

Starting with Oracle Exadata System Software release 19.1.0, Secure Eraser is automatically started during re-imaging if the hardware supports Secure Eraser. This significantly simplifies the re-imaging procedure while maintaining performance. Now, when re-purposing a rack, you only have to image the rack and the secure data erasure is taken care of transparently as part of the process.

- [Overview of Secure Eraser](#)  
Oracle Exadata System Software release 12.2.1.1.0 or later provides a secure erasure solution, called Secure Eraser, for every component within Oracle Exadata Database Machine.
- [Securely Erasing Database Servers and Storage Servers](#)
- [Automatic Secure Eraser through PXE Boot](#)  
In this procedure, you configure Secure Eraser to run automatically when you reboot the nodes.
- [Interactive Secure Eraser through PXE Boot](#)  
On Exadata systems prior to Oracle Exadata Database Machine X7-2, you can use Preboot Execution Environment (PXE) Boot when performing a Secure Eraser.
- [Interactive Secure Eraser through Network Boot](#)  
Starting with Oracle Exadata Database Machine X7-2, you can use EFI Network Boot when using Secure Eraser.
- [Interactive Secure Eraser through External USB](#)  
You can securely erase a node using an external USB drive.
- [Secure Eraser Syntax](#)  
Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.
- [Resetting InfiniBand Switches, Ethernet Switch, and Power Distribution Units to Factory Default](#)
- [Actions After Using Secure Eraser](#)  
After performing a secure erase, the system is ready for return or re-imaging.

### 5.1 Overview of Secure Eraser

Oracle Exadata System Software release 12.2.1.1.0 or later provides a secure erasure solution, called Secure Eraser, for every component within Oracle Exadata Database Machine.

Oracle Exadata Database Machine consists of the following components:

- Oracle Exadata Database Servers
- Oracle Exadata Storage Servers
- InfiniBand switches
- Ethernet switches
- Power distribution units

Secure Eraser is a comprehensive solution that covers all Oracle Exadata Database Machines V2 or higher, including both 2-socket and 8-socket servers. The solution securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to factory default.

To achieve the best possible performance, secure erasure is performed in parallel at every layer on an Oracle Exadata Database Machine. All Oracle Exadata Database Servers and Oracle Exadata Storage Servers are securely erased in parallel. Within a server, all device types (such as hard drives, flash devices, and internal USBs) are securely erased in parallel. For each device type, all devices are further securely erased in parallel. This means that the total time to securely erase an entire rack is the same regardless of whether it's a quarter, half, or full rack, and that the total time should be approximately the time it takes to erase whichever component takes the longest time.

Secure Eraser automatically detects the hardware capability of a storage device and picks the best erasure method supported by the device. Crypto erase is used whenever possible to provide better security and faster speed. The crypto erasure method used by Secure Eraser is fully compliant with the NIST SP-800-88r1 standard.

Secure Eraser comes with flexible options. You can choose to initiate a secure erasure either through PXE or through an external USB. The entire process can be completely automated without any user intervention. Or, you can choose to do it interactively and choose to erase specific types of storage devices.

Secure Eraser periodically generates a progress report every 10 seconds so that you can easily monitor the progress.

When the secure erasure is completed, a certificate is generated for each server with a list of devices that have been securely erased. The following figure shows a sample certificate from Secure Eraser.

Figure 5-1 Sample Certificate from Secure Eraser

**ORACLE**  
EXADATA

---

**Data Erasure Certificate**

**Start Time:** 2016-07-06 21:27:05  
**End Time:** 2016-07-06 21:28:11  
**Chassis Numer:** 1523NM705C

This is to certify that the components identified below have been securely erased in accordance with the applicable guidelines of NIST SP-800-88r1 standard.

ID	Type	Model	Serial	Size	Erasure Level	Status
1	Flash	Flash Accelerator F80 PCIe Card	FL00A96H	200.00GB	Crypto Erase	Succeeded
2	Flash	Flash Accelerator F80 PCIe Card	FL00A84Y	200.00GB	Crypto Erase	Succeeded
3	Flash	Flash Accelerator F80 PCIe Card	FL00A7D4	200.00GB	Crypto Erase	Succeeded
4	Flash	Flash Accelerator F80 PCIe Card	FL00A6WG	200.00GB	Crypto Erase	Succeeded
5	Flash	Flash Accelerator F80 PCIe Card	FL008KSE	200.00GB	Crypto Erase	Succeeded
6	Flash	Flash Accelerator F80 PCIe Card	FL008KS3	200.00GB	Crypto Erase	Succeeded
7	Flash	Flash Accelerator F80 PCIe Card	FL008KL7	200.00GB	Crypto Erase	Succeeded
8	Flash	Flash Accelerator F80 PCIe Card	FL008KQR	200.00GB	Crypto Erase	Succeeded
9	Flash	Flash Accelerator F80 PCIe Card	FL00A812	200.00GB	Crypto Erase	Succeeded
10	Flash	Flash Accelerator F80 PCIe Card	FL00A79G	200.00GB	Crypto Erase	Succeeded
11	Flash	Flash Accelerator F80 PCIe Card	FL00A80C	200.00GB	Crypto Erase	Succeeded
12	Flash	Flash Accelerator F80 PCIe Card	FL00A79F	200.00GB	Crypto Erase	Succeeded
13	Flash	Flash Accelerator F80 PCIe Card	FL00A5WD	200.00GB	Crypto Erase	Succeeded
14	Flash	Flash Accelerator F80 PCIe Card	FL00A5XS	200.00GB	Crypto Erase	Succeeded
15	Flash	Flash Accelerator F80 PCIe Card	FL00A7N1	200.00GB	Crypto Erase	Succeeded
16	Flash	Flash Accelerator F80 PCIe Card	FL00A62G	200.00GB	Crypto Erase	Succeeded
17	Disk	H7240AS60SUN4.0T	1352E5XHWX	3.99TB	3-Pass Erase	Succeeded
18	Disk	H7240AS60SUN4.0T	1352E60SYX	3.99TB	3-Pass Erase	Succeeded
19	Disk	H7240AS60SUN4.0T	1352E60U4X	4.00TB	3-Pass Erase	Succeeded
20	Disk	H7240AS60SUN4.0T	1352E5UPAX	3.99TB	3-Pass Erase	Succeeded
21	Disk	H7240AS60SUN4.0T	1352E5XK3X	3.99TB	3-Pass Erase	Succeeded
22	Disk	H7240AS60SUN4.0T	1352E62M7X	3.99TB	3-Pass Erase	Succeeded
23	Disk	H7240AS60SUN4.0T	1352E5PSPX	3.99TB	3-Pass Erase	Succeeded
24	Disk	H7240AS60SUN4.0T	1352E60TJX	3.99TB	3-Pass Erase	Succeeded
25	Disk	H7240AS60SUN4.0T	1352E5LYDX	3.99TB	3-Pass Erase	Succeeded
26	Disk	H7240AS60SUN4.0T	1352E602WX	3.99TB	3-Pass Erase	Succeeded
27	Disk	H7240AS60SUN4.0T	1352E5LY9X	3.99TB	3-Pass Erase	Succeeded
28	Disk	H7240AS60SUN4.0T	1352E5VX4X	3.99TB	3-Pass Erase	Succeeded
29	USB	SSM	1900638EA8BFB749	8.01GB	3-Pass Erase	Succeeded
30	ILOM		1516NM703E		Factory Reset	Succeeded

**ERASURE PERFORMED BY:**  
**Name** Jane Doe  
**Signature** \_\_\_\_\_ **Date** \_\_\_\_\_

**ERASURE WITNESSED BY:**  
**Name** John Smith  
**Signature** \_\_\_\_\_ **Date** \_\_\_\_\_



## 5.2 Securely Erasing Database Servers and Storage Servers

Oracle Exadata System Software 12.2.1.1.0 or later comes with a utility called Secure Eraser which securely erases data on hard drives, flash devices, and internal USBs, and resets ILOM to factory default.

In earlier versions of Exadata, you can securely erase user data through CellCLI commands such as `DROP CELL ERASE`, `DROP CELLDISK ERASE`, or `DROP GRIDDISK ERASE`. These `DROP` commands only cover user data on hard drives and flash devices. Secure Eraser, on the other hand, sanitizes all content, not only user data but also operating system, Oracle Exadata System Software, and user configurations. In addition, it covers a wider range of hardware components including hard drives, flash devices, internal USBs, and ILOMs.

### **Caution:**

The server will become unbootable after the system devices are securely erased, and ILOM will no longer be remotely accessible after being reset to factory default. ILOM will remain accessible through serial console.

The Secure Eraser utility works on both database servers and storage servers and covers all Oracle Exadata Database Machines V2 or higher.

Based on hardware capabilities, different secure erasure methods are applied. In general, Secure Eraser has two types of erasure methods: 3-pass erase and crypto erase. The 3-pass erase method overwrites all addressable locations with a character, its complement, then a random character, and finally verifies the results. The crypto erase method erases all user data present on instant secure erase (ISE) devices by deleting the encryption keys with which the user data was previously encrypted.

Refer to the table "Estimated Erasure Times for Disks by Erasure Method" in the topic `DROP CELL` for a summary of the secure erasure methods used and their approximate time. Note that the time for 3-pass erase varies from drives to drives based on their size and speed. It is approximately equal to the time required to overwrite the entire device three times and read it one more time. Hard drives, flash devices, and internal USBs are securely erased in parallel: the time required to erase one device is the same as that required for erasing multiple devices of the same kind.

## 5.3 Automatic Secure Eraser through PXE Boot

In this procedure, you configure Secure Eraser to run automatically when you reboot the nodes.

### **Note:**

Starting with Oracle Exadata System Software release 19.1.0, the Secure Eraser package (`secureeraser_label.zip`) contains ISO images instead of NFS images.



Use one of the following procedures, depending on your system:

- [Automatic Secure Eraser through PXE Boot for X7 and Later Systems](#)  
In this procedure, you configure Secure Eraser to run automatically when you reboot Oracle Exadata Database Machine X7-2 and later nodes.
- [Automatic Secure Eraser through PXE Boot for X6 and Earlier Systems](#)  
In this procedure, you configure Secure Eraser to run automatically when you reboot the nodes.

#### Related Topics

- [Secure Eraser Syntax](#)  
Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.
- [Securely Erasing Oracle Exadata Database Machine Servers \(My Oracle Support Doc ID 2180963.1\)](#)

## 5.3.1 Automatic Secure Eraser through PXE Boot for X7 and Later Systems

In this procedure, you configure Secure Eraser to run automatically when you reboot Oracle Exadata Database Machine X7-2 and later nodes.

#### Note:

Starting with Oracle Exadata System Software release 19.1.0, the Secure Eraser package (`secureeraser_label.zip`) contains ISO images instead of NFS images.

Before you begin:

- Review My Oracle Support note 2180963.1 for the latest Secure Eraser information and to download the Secure Eraser package.
  - Make sure you have access to a Preboot Execution Environment (PXE) server where the nodes to be erased can boot from.
  - Make sure you have access to a NFS server that is accessible from all the nodes to be erased.
  - Make sure you have access to one of the nodes to be erased.
1. Copy the PXE image files `initrd (initrd-<version>)` and `kernel (vmlinux-<version>)` from the Secure Eraser package to the `/tftpboot` directory on the PXE server.
  2. Create a file containing the names of the database servers and storage servers you want to erase.

To generate this file, you can run the following command from one of the nodes to be erased, and verify the nodes in the files are the ones to be erased.

```
# ibhosts | awk '/S [0-9\\.\\,]*/ || /C [0-9\\.\\,]*/ {print $6}' |  
sed "s/\\/\\/g" > nodes_to_be_erased
```

If you only want to erase one server, enter the name of the server into the `nodes_to_be_erased` file, for example `Exa01celadm04`.

3. Copy the `dcli` utility from the Secure Eraser package and the `nodes_to_be_erased` file generated in step 2 to the PXE server.
4. Create a PXE configuration template called `pxe_cfg.template` to contain the following lines:

 **Note:**

In the following example, the following parameters must be updated to match your environment:

- `kernel` (the `vmlinuz` file)
- `initrd` (the `initrd*.img` file)
- `logpath`

- For Oracle Exadata System Software 18c (18.1.0):

```
set default 0
set timeout=10
menuentry 'ExadataLinux' {
    echo "Loading efi/vmlinuz"
    linuxefi efi/vmlinuz-nfs-18.1.0.0-170915.1 dhcp pxe boot-
from=uefi
quiet loglevel=0 secureeraser bootarea=diagnostics
console=ttyS0,115200n8
logpath=10.133.42.221:/export/
exadata_secure_eraser_certificate_dir
    echo "Loading efi/initrd.img"
    initrdefi efi/initrd-nfs-18.1.0.0-170915.1.img
    echo "Booting installation kernel"
}
```

- For Oracle Exadata System Software release 19.1.0 or later:

```
set default 0
set timeout=10
menuentry 'ExadataLinux' {
    echo "Loading efi/vmlinuz"
    linuxefi efi/vmlinuz-iso-19.1.2.0-190111 dhcp pxe boot-from=uefi
quiet loglevel=0 secureeraser bootarea=diagnostics
console=ttyS0,115200n8
logpath=10.133.42.221:/export/
exadata_secure_eraser_certificate_dir
    echo "Loading efi/initrd.img"
    initrdefi efi/initrd-iso-19.1.2.0-190111.img
    echo "Booting installation kernel"
}
```

- The first line (`default`) identifies a menu entry that should be selected by default, after the timeout value specified by the second line.
- The third line (`menuentry`) represents the Linux kernel that will be used in the Secure Eraser environment.
- The fifth line (`linuxefi`) indicates the kernel is on an UEFI-based system. The `linuxefi` statement must be on a single line in the configuration file.
  - The `dhcp` option specifies to use DHCP to discover the `eth0` interface.
  - The `pxe` option suppresses search for the image on virtual CD and USB devices.
  - The `boot-from=uefi` option indicates the system is booting from UEFI.
  - The `quiet` option disables excessive kernel log messages.
  - The `loglevel=0` option suppresses non-critical kernel messages.
  - The `secureeraser` option indicates PXE boot will automatically trigger the Secure Eraser utility to sanitize all media including hard drives, flash devices, internal USBs, and ILOM on the node.
  - The `bootarea` option indicates that the boot mode is diagnostic and not imaging install or rescue.
  - The `console` options indicate standard output and standard error messages are printed to both ILOM web console and serial console.
  - The `logpath` option specifies the NFS share directory where Secure Eraser will save the certificate.
- The seventh line (`initrdefi`) specifies the `initrd` file to load. In this case it is the `initrd` file copied over in step 1.

By default, the examples shown above cause Secure Eraser to erase all components. You can use `secureeraser-options` to specify command-line options for Secure Eraser to change the default behavior and securely erase certain components only. For example, to erase hard drives and USBs only during the PXE boot, the template would look like this for grub2 / Secure Boot on Oracle Exadata Database Machine X7 and later systems:

**Note:**

In the following example, the following parameters must be updated to match your environment:

- `kernel` (the `vmlinuz` file)
- `initrd` (the `initrd*img` file)
- `logpath`

- For Oracle Exadata System Software 18c (18.1.0):

```
set default 0
set timeout=10
menuentry 'ExadataLinux' {
    echo "Loading efi/vmlinuz"
```

```

    linuxefi efi/vmlinux-nfs-18.1.0.0-170915.1 stit dhcp pxe boot-
from=
uefi quiet loglevel=0 secureeraser secureeraser-options="--hdd --
usb"
bootarea=diagnostics console=ttyS0,115200n8 logpath=10.133.42
.221:/export/exadata_secure_eraser_certificate_dir
    echo "Loading efi/initrd.img"
    initrdefi efi/initrd-nfs-18.1.0.0-170915.1.img
    echo "Booting installation kernel"
}

```

- For Oracle Exadata System Software release 19.1.0 or later:

```

set default 0
set timeout=10
menuentry 'ExadataLinux' {
    echo "Loading efi/vmlinuz"
    linuxefi efi/vmlinux-iso-19.1.2.0.0-190111 stit dhcp pxe boot-
from=
uefi quiet loglevel=0 secureeraser secureeraser-options="--hdd --
usb"
bootarea=diagnostics console=ttyS0,115200n8 logpath=10.133.42
.221:/export/exadata_secure_eraser_certificate_dir
    echo "Loading efi/initrd.img"
    initrdefi efi/initrd-iso-19.1.2.0.0-190111.img
    echo "Booting installation kernel"
}

```

5. On the PXE server, use the template file to generate a PXE configuration file in the `/tftpboot/pxelinux.cfg/` directory for each of the nodes to be erased.

The PXE configuration file name is the dash-separated MAC address of the node with the prefix `01-`.

If the nodes to be erased are accessible, use the following steps to automatically generate a PXE configuration file for each node based on the template.

- a. Set up SSH equivalence with the nodes to be erased from the PXE server. The command will prompt for the `root` password of each node.

```
pxe_server# dcli -g nodes_to_be_erased -k -l root
```

- b. Create PXE configuration files, one for each node to be erased based on the configuration template.

```

pxe_server# dcli -g nodes_to_be_erased -l root "ip addr show eth0"
|
awk '/link\/ether/ {print "01:"$3}' | sed "s:/-/" |
xargs -I {} cp pxe_cfg.template {}

```

If the nodes are not accessible, use the following step to generate a PXE configuration file for each node to be erased:

- a. Manually collect the MAC address of the eth0 interface from each node and write them into a text file called `mac_addresses`. Write one MAC address per line. For example:

```
00:10:e0:62:c4:fa
00:10:e0:62:c2:8a
00:10:e0:62:b8:7c
00:10:e0:62:b8:3a
00:10:e0:62:c6:bc
```

- b. Use the following command to create a list of PXE configuration files, one for each node to be erased based on the configuration template.

```
pxe_server# cat mac_addresses | sed "s:/-/g;s/^/01-/g" |
xargs -I {} cp pxe_cfg.template {}
```

In both cases, you should get a list of PXE configuration files, one for each node to be erased. For example, if the MAC addresses of the nodes in a quarter rack are 00:10:e0:62:c4:fa, 00:10:e0:62:c2:8a, 00:10:e0:62:b8:7c, 00:10:e0:62:b8:3a, and 00:10:e0:62:c6:bc, you should get the following files:

```
01-00-10-e0-62-c4-fa
01-00-10-e0-62-c2-8a
01-00-10-e0-62-b8-7c
01-00-10-e0-62-b8-3a
01-00-10-e0-62-c6-bc
```

The files have the same content as the configuration template.

Check your specific PXE server requirements. Your PXE server may need slightly different names or settings.

6. Configure the nodes to boot from PXE and reboot the nodes.

If the nodes to be erased are accessible, run the following commands:

```
pxe_server# dcli -g nodes_to_be_erased -l root "ipmitool chassis
bootdev pxe"

pxe_server# dcli -g nodes_to_be_erased -l root "reboot"
```

If the nodes to be erased are not remotely accessible but the ILOMs are, use the following steps

- a. Create a file called `iloms_to_be_reset` containing the names of ILOMs. For example:

```
db1-ilom
db2-ilom
cell1-ilom
cell2-ilom
cell3-ilom
```

- b. Configure the nodes to boot from PXE through ILOMs. The command will prompt for ILOM root password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H
{} -U root chassis bootdev pxe
```

- c. Reboot the nodes from ILOMs. The command will prompt for ILOM root password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H
{} -U root chassis power cycle
```

If neither host nor ILOM is remotely accessible, log into ILOM using a serial console and run the following commands

```
ILOM> set /HOST/boot_device=pxe
```

```
ILOM> reset /SYS
```

7. The Secure Eraser utility will be automatically called to sanitize all storage media including hard drives, flash devices, and internal USBs, and to reset ILOM to factory default for all nodes in parallel.

Secure Eraser creates a file called `secureeraser_node_chassis_number_date_time.certificate` in the specified `logpath` location. `node_chassis_number` is the ID attribute of the storage server or database server in CellCLI or DBMCLI.

The file contains a progress report that is updated every 10 seconds. The progress report is also output to the console on each node. The following is an example of the progress report:

ID	Type	Model	Serial Number	Size
1	Flash	Flash Accelerator F80 PCIe Card	FL00A96H	200.00GB
Being Erased (6%)				
2	Flash	Flash Accelerator F80 PCIe Card	FL00A84Y	200.00GB
Being Erased (5%)				
3	Flash	Flash Accelerator F80 PCIe Card	FL00A7D4	200.00GB
Being Erased (5%)				
4	Flash	Flash Accelerator F80 PCIe Card	FL00A6WG	200.00GB
Being Erased (6%)				
5	Flash	Flash Accelerator F80 PCIe Card	FL008KSE	200.00GB
Being Erased (5%)				
6	Flash	Flash Accelerator F80 PCIe Card	FL008KS3	200.00GB
Being Erased (5%)				
7	Flash	Flash Accelerator F80 PCIe Card	FL008KL7	200.00GB
Being Erased (5%)				
8	Flash	Flash Accelerator F80 PCIe Card	FL008KQR	200.00GB
Being Erased (6%)				
9	Flash	Flash Accelerator F80 PCIe Card	FL00A812	200.00GB
Being Erased (5%)				
10	Flash	Flash Accelerator F80 PCIe Card	FL00A79G	200.00GB

```

Being Erased (5%)
11 Flash Flash Accelerator F80 PCIe Card FL00A80C      200.00GB
Being Erased (6%)
12 Flash Flash Accelerator F80 PCIe Card FL00A79F      200.00GB
Being Erased (6%)
13 Flash Flash Accelerator F80 PCIe Card FL00A5WD      200.00GB
Being Erased (5%)
14 Flash Flash Accelerator F80 PCIe Card FL00A5XS      200.00GB
Being Erased (5%)
15 Flash Flash Accelerator F80 PCIe Card FL00A7N1      200.00GB
Being Erased (5%)
16 Flash Flash Accelerator F80 PCIe Card FL00A62G      200.00GB
Being Erased (5%)
17 Disk  H7240AS60SUN4.0T                1352E5XHWX      4.00TB
Being Erased (1%)
18 Disk  H7240AS60SUN4.0T                1352E60SYX      4.00TB
Being Erased (1%)
19 Disk  H7240AS60SUN4.0T                1352E60U4X      4.00TB
Being Erased (1%)
20 Disk  H7240AS60SUN4.0T                1352E5UPAX      4.00TB
Being Erased (1%)
21 Disk  H7240AS60SUN4.0T                1352E5XK3X      4.00TB
Being Erased (1%)
22 Disk  H7240AS60SUN4.0T                1352E62M7X      4.00TB
Being Erased (1%)
23 Disk  H7240AS60SUN4.0T                1352E5PSPX      4.00TB
Being Erased (1%)
24 Disk  H7240AS60SUN4.0T                1352E60TJX      4.00TB
Being Erased (1%)
25 Disk  H7240AS60SUN4.0T                1352E5LYDX      4.00TB
Being Erased (1%)
26 Disk  H7240AS60SUN4.0T                1352E602WX      4.00TB
Being Erased (1%)
27 Disk  H7240AS60SUN4.0T                1352E5LY9X      4.00TB
Being Erased (1%)
28 Disk  H7240AS60SUN4.0T                1352E5VX4X      4.00TB
Being Erased (1%)
29 USB   SSM                              1900638EA8BFB749 8.00GB
Being Erased (5%)
30 ILOM
1403NM50CA                                To Be Reset

```

As the sample progress report shows, Secure Eraser erases all storage devices in parallel. After the storage devices are securely erased, Secure Eraser will reset the ILOM to the factory default. This is to ensure that in the case that secure erasure fails on some storage device, the web console is still accessible for remote debugging, and ILOM is still accessible to control the host.

Once secure erasure is complete, a certificate called `secureeraser_node_chassis_number_date_time.certificate.pdf` is generated at the NFS share location specified by the `logpath` option in step 4. If secure erasure is successful, the nodes will be shut down automatically. If Secure Eraser does not succeed on some components, then the node will be left in diagnostic

shell for further debugging. Assuming all previous steps are successful, and you have resolved the issue, you can go back to step 6 and rerun Secure Eraser.

### Related Topics

- [Secure Eraser Syntax](#)  
Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.
- [Securely Erasing Oracle Exadata Database Machine Servers \(My Oracle Support Doc ID 2180963.1\)](#)

## 5.3.2 Automatic Secure Eraser through PXE Boot for X6 and Earlier Systems

In this procedure, you configure Secure Eraser to run automatically when you reboot the nodes.



### Note:

Starting with Oracle Exadata System Software release 19.1.0, the Secure Eraser package (`secureeraser_label.zip`) contains ISO images instead of NFS images.

Before you begin:

- Review My Oracle Support note 2180963.1 for the latest Secure Eraser information and to download the Secure Eraser package.
- Make sure you have access to a Preboot Execution Environment (PXE) server where the nodes to be erased can boot from.
- Make sure you have access to a NFS server that is accessible from all the nodes to be erased.
- Make sure you have access to one of the nodes to be erased.

1. Copy the PXE image files `initrd (initrd-<version>)` and `kernel (vmlinux-<version>)` from the Secure Eraser package to the `/tftpboot` directory on the PXE server.
2. Create a file containing the names of the database servers and storage servers you want to erase.

To generate this file, you can run the following command from one of the nodes to be erased, and verify the nodes in the files are the ones to be erased.

```
# ibhosts | awk '/S [0-9\\.\\,]*/ || /C [0-9\\.\\,]*/' {print $6}' |  
sed "s/\\/\\/g" > nodes_to_be_erased
```

If you only want to erase one server, enter the name of the server into the `nodes_to_be_erased` file, for example `Exa01celadm04`.

3. Copy the `dcli` utility from the Secure Eraser package and the `nodes_to_be_erased` file generated in step 2 to the PXE server.



4. Create a PXE configuration template called `pxe_cfg.template` to contain the following lines:

- For releases earlier than Oracle Exadata System Software release 19.1.0:

```
default linux
label linux
kernel vmlinux-nfs-12.2.1.1.0-161015-cell
append initrd=initrd-nfs-12.2.1.1.0-161015-cell.img dhcp pxe quiet
loglevel=
0 secureeraser bootarea=diagnostics console=tty1
console=ttyS0,115200n8 logp
ath=10.133.42.221:/export/exadata_secure_eraser_certificate_dir
```

- For Oracle Exadata System Software release 19.1.0 or later:

```
default linux
label linux
kernel vmlinux-iso-19.1.2.0.0-190111-cell
append initrd=initrd-iso-19.1.2.0.0-190111-cell.img dhcp pxe quiet
loglevel=
0 secureeraser bootarea=diagnostics console=tty1
console=ttyS0,115200n8 logp
ath=10.133.42.221:/export/exadata_secure_eraser_certificate_dir
```

- The first line (`default`) indicates that the default label to use is called `linux`.
- The second line (`label`) defines the `linux` label.
- The third line (`kernel`) identifies the kernel file to load. In this case it is the file copied over in step 1.
- The fourth line (`append`) adds more options to the kernel command line. The `append` statement must be on a single line in the configuration file.
  - The `initrd` option specifies the `initrd` file to load. In this case it is the `initrd` file copied over in step 1.
  - The `dhcp` option specifies to use DHCP to discover the `eth0` interface.
  - The `pxe` option suppresses search for the image on virtual CD and USB devices.
  - The `quiet` option disables excessive kernel log messages.
  - The `loglevel=0` option suppresses non-critical kernel messages.
  - The `secureeraser` option indicates PXE boot will automatically trigger the Secure Eraser utility to sanitize all media including hard drives, flash devices, internal USBs, and ILOM on the node.
  - The `bootarea` option indicates that the boot mode is diagnostic and not imaging install or rescue.
  - The `console` options indicate standard output and standard error messages are printed to both ILOM web console and serial console.
  - The `logpath` option specifies the NFS share directory where Secure Eraser will save the certificate.

By default, the examples shown above cause Secure Eraser to erase all components. You can use `secureeraser-options` to specify command-line options for Secure Eraser to change the default behavior and securely erase certain components only. For example, to erase hard drives and USBs only during the PXE boot, the template would look like this:

- For releases earlier than Oracle Exadata System Software release 19.1.0:

```
default linux
label linux
kernel vmlinux-nfs-12.2.1.1.0-161015-cell
append initrd=initrd-nfs-12.2.1.1.0-161015-cell.img dhcp pxe quiet
loglevel=0
secureeraser secureeraser-options="--hdd --usb"
bootarea=diagnostics
console=tty1 console=ttyS0,115200n8 logpath=10.133.42.221:/export/
exadata_
secure_eraser_certificate_dir
```

- For Oracle Exadata System Software release 19.1.0 or later:

```
default linux
label linux
kernel vmlinux-iso-19.1.2.0.0-190111-cell
append initrd=initrd-iso-19.1.2.0.0-190111-cell.img dhcp pxe quiet
loglevel=0
secureeraser secureeraser-options="--hdd --usb"
bootarea=diagnostics
console=tty1 console=ttyS0,115200n8 logpath=10.133.42.221:/export/
exadata_
secure_eraser_certificate_dir
```

5. On the PXE server, use the template file to generate a PXE configuration file in the `/tftpboot/pxelinux.cfg/` directory for each of the nodes to be erased.

The PXE configuration file name is the dash-separated MAC address of the node with the prefix `01-`.

If the nodes to be erased are accessible, use the following steps to automatically generate a PXE configuration file for each node based on the template.

- a. Set up SSH equivalence with the nodes to be erased from the PXE server. The command will prompt for the `root` password of each node.

```
pxe_server# dcli -g nodes_to_be_erased -k -l root
```

- b. Create PXE configuration files, one for each node to be erased based on the configuration template.

```
pxe_server# dcli -g nodes_to_be_erased -l root "ip addr show eth0"
|
awk '/link\/ether/ {print "01:"$3}' | sed "s:/-/g" |
xargs -I {} cp pxe_cfg.template {}
```

If the nodes are not accessible, use the following step to generate a PXE configuration file for each node to be erased:

- a. Manually collect the MAC address of the eth0 interface from each node and write them into a text file called `mac_addresses`. Write one MAC address per line. For example:

```
00:10:e0:62:c4:fa
00:10:e0:62:c2:8a
00:10:e0:62:b8:7c
00:10:e0:62:b8:3a
00:10:e0:62:c6:bc
```

- b. Use the following command to create a list of PXE configuration files, one for each node to be erased based on the configuration template.

```
pxe_server# cat mac_addresses | sed "s:/-/g;s/^/01-/g" |
xargs -I {} cp pxe_cfg.template {}
```

In both cases, you should get a list of PXE configuration files, one for each node to be erased. For example, if the MAC addresses of the nodes in a quarter rack are 00:10:e0:62:c4:fa, 00:10:e0:62:c2:8a, 00:10:e0:62:b8:7c, 00:10:e0:62:b8:3a, and 00:10:e0:62:c6:bc, you should get the following files:

```
01-00-10-e0-62-c4-fa
01-00-10-e0-62-c2-8a
01-00-10-e0-62-b8-7c
01-00-10-e0-62-b8-3a
01-00-10-e0-62-c6-bc
```

The files have the same content as the configuration template.

Check your specific PXE server requirements. Your PXE server may need slightly different names or settings.

6. Configure the nodes to boot from PXE and reboot the nodes.

If the nodes to be erased are accessible, run the following commands:

```
pxe_server# dcli -g nodes_to_be_erased -l root "ipmitool chassis
bootdev pxe"

pxe_server# dcli -g nodes_to_be_erased -l root "reboot"
```

If the nodes to be erased are not remotely accessible but the ILOMs are, use the following steps

- a. Create a file called `iloms_to_be_reset` containing the names of ILOMs. For example:

```
db1-ilom
db2-ilom
cell1-ilom
cell2-ilom
cell3-ilom
```

- b. Configure the nodes to boot from PXE through ILOMs. The command will prompt for ILOM root password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H
{} -U root chassis bootdev pxe
```

- c. Reboot the nodes from ILOMs. The command will prompt for ILOM root password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H
{} -U root chassis power cycle
```

If neither host nor ILOM is remotely accessible, log into ILOM using a serial console and run the following commands

```
ILOM> set /HOST/boot_device=pxe
```

```
ILOM> reset /SYS
```

7. The Secure Eraser utility will be automatically called to sanitize all storage media including hard drives, flash devices, and internal USBs, and to reset ILOM to factory default for all nodes in parallel.

Secure Eraser creates a file called `secureeraser_node_chassis_number_date_time.certificate` in the specified `logpath` location. `node_chassis_number` is the ID attribute of the storage server or database server in CellCLI or DBMCLI.

The file contains a progress report that is updated every 10 seconds. The progress report is also output to the console on each node. The following is an example of the progress report:

ID	Type	Model	Serial Number	Size
1	Flash	Flash Accelerator F80 PCIe Card	FL00A96H	200.00GB
Being Erased (6%)				
2	Flash	Flash Accelerator F80 PCIe Card	FL00A84Y	200.00GB
Being Erased (5%)				
3	Flash	Flash Accelerator F80 PCIe Card	FL00A7D4	200.00GB
Being Erased (5%)				
4	Flash	Flash Accelerator F80 PCIe Card	FL00A6WG	200.00GB
Being Erased (6%)				
5	Flash	Flash Accelerator F80 PCIe Card	FL008KSE	200.00GB
Being Erased (5%)				
6	Flash	Flash Accelerator F80 PCIe Card	FL008KS3	200.00GB
Being Erased (5%)				
7	Flash	Flash Accelerator F80 PCIe Card	FL008KL7	200.00GB
Being Erased (5%)				
8	Flash	Flash Accelerator F80 PCIe Card	FL008KQR	200.00GB
Being Erased (6%)				
9	Flash	Flash Accelerator F80 PCIe Card	FL00A812	200.00GB
Being Erased (5%)				
10	Flash	Flash Accelerator F80 PCIe Card	FL00A79G	200.00GB

```

Being Erased (5%)
11 Flash Flash Accelerator F80 PCIe Card FL00A80C      200.00GB
Being Erased (6%)
12 Flash Flash Accelerator F80 PCIe Card FL00A79F      200.00GB
Being Erased (6%)
13 Flash Flash Accelerator F80 PCIe Card FL00A5WD      200.00GB
Being Erased (5%)
14 Flash Flash Accelerator F80 PCIe Card FL00A5XS      200.00GB
Being Erased (5%)
15 Flash Flash Accelerator F80 PCIe Card FL00A7N1      200.00GB
Being Erased (5%)
16 Flash Flash Accelerator F80 PCIe Card FL00A62G      200.00GB
Being Erased (5%)
17 Disk  H7240AS60SUN4.0T                1352E5XHWX      4.00TB
Being Erased (1%)
18 Disk  H7240AS60SUN4.0T                1352E60SYX      4.00TB
Being Erased (1%)
19 Disk  H7240AS60SUN4.0T                1352E60U4X      4.00TB
Being Erased (1%)
20 Disk  H7240AS60SUN4.0T                1352E5UPAX      4.00TB
Being Erased (1%)
21 Disk  H7240AS60SUN4.0T                1352E5XK3X      4.00TB
Being Erased (1%)
22 Disk  H7240AS60SUN4.0T                1352E62M7X      4.00TB
Being Erased (1%)
23 Disk  H7240AS60SUN4.0T                1352E5PSPX      4.00TB
Being Erased (1%)
24 Disk  H7240AS60SUN4.0T                1352E60TJX      4.00TB
Being Erased (1%)
25 Disk  H7240AS60SUN4.0T                1352E5LYDX      4.00TB
Being Erased (1%)
26 Disk  H7240AS60SUN4.0T                1352E602WX      4.00TB
Being Erased (1%)
27 Disk  H7240AS60SUN4.0T                1352E5LY9X      4.00TB
Being Erased (1%)
28 Disk  H7240AS60SUN4.0T                1352E5VX4X      4.00TB
Being Erased (1%)
29 USB   SSM                              1900638EA8BFB749 8.00GB
Being Erased (5%)
30 ILOM
1403NM50CA                                To Be Reset

```

As the sample progress report shows, Secure Eraser erases all storage devices in parallel. After the storage devices are securely erased, Secure Eraser will reset the ILOM to the factory default. This is to ensure that in the case that secure erasure fails on some storage device, the web console is still accessible for remote debugging, and ILOM is still accessible to control the host.

Once secure erasure is complete, a certificate called `secureeraser_node_chassis_number_date_time.certificate.pdf` is generated at the NFS share location specified by the `logpath` option in step 4. If secure erasure is successful, the nodes will be shut down automatically. If Secure Eraser does not succeed on some components, then the node will be left in diagnostic

shell for further debugging. Assuming all previous steps are successful, and you have resolved the issue, you can go back to step 6 and rerun Secure Eraser.

### Related Topics

- [Secure Eraser Syntax](#)  
Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.
- [Securely Erasing Oracle Exadata Database Machine Servers \(My Oracle Support Doc ID 2180963.1\)](#)

## 5.4 Interactive Secure Eraser through PXE Boot

On Exadata systems prior to Oracle Exadata Database Machine X7-2, you can use Preboot Execution Environment (PXE) Boot when performing a Secure Eraser.



### Note:

Starting with Oracle Exadata System Software release 19.1.0, the Secure Eraser package (`secureeraser_label.zip`) contains ISO images instead of NFS images.

Before you begin:

- Review My Oracle Support note 2180963.1 for the latest information and to download the Secure Eraser package
  - Make sure you have access to a PXE server where the nodes to be erased can boot from.
  - Make sure you have access to a NFS server that is accessible from all the nodes to be erased.
  - Make sure you have access to one of the nodes to be erased.
1. Copy the cell PXE image files `initrd` (`initrd-version`) and `kernel` (`vmlinux-version`) from the Secure Eraser package to the `/tftpboot` directory on the PXE server. For Oracle Exadata Database Machine X7 and later systems, the directory is `/tftpboot/efi` for `grub2` and `Secure Boot`.
  2. Create a file containing the names of the database servers and storage servers to be erased.

To generate this file, you can run the following command from one of the nodes to be erased, and verify the nodes in the files are the ones to be erased.

```
# ibhosts | awk '/S [0-9\\.\\,]*/ || /C [0-9\\.\\,]*/ {print $6}' | sed  
"s/\\/\\/g"  
> nodes_to_be_erased
```

If you only want to erase one server, enter the name of the server into the `nodes_to_be_erased` file, for example `Exa01celadm04`.

3. Copy the `dcli` utility from the Secure Eraser package along with the file generated in step 2 to the PXE server.

4. Create a PXE configuration template called `pxe_cfg.template` to contain the following lines:

- For all models prior to Oracle Exadata Database Machine X7-2 — grub:
  - For releases earlier than Oracle Exadata System Software release 19.1.0:

```
default linux
label linux
kernel vmlinux-nfs-12.2.1.1.0-161015-cell
append initrd=initrd-nfs-12.2.1.1.0-161015-cell.img dhcp pxe
quiet loglevel=
0 secureeraser bootarea=diagnostics console=tty1
console=ttyS0,115200n8 logp
ath=10.133.42.221:/export/exadata_secure_eraser_certificate_dir
```

- For Oracle Exadata System Software release 19.1.0 or later:

```
default linux
label linux
kernel vmlinux-iso-19.1.2.0.0-190111-cell
append initrd=initrd-iso-19.1.2.0.0-190111-cell.img dhcp pxe
quiet loglevel=
0 secureeraser bootarea=diagnostics console=tty1
console=ttyS0,115200n8 logp
ath=10.133.42.221:/export/exadata_secure_eraser_certificate_dir
```

For a description of each component of the above task, refer to the appropriate topic in [Automatic Secure Eraser through PXE Boot](#) for your system.

- For Oracle Exadata Database Machine X7-2 and newer models —grub2 / Secure Boot:

 **Note:**

In the following example, the following parameters must be updated to match your environment:

- kernel (the `vmlinux` file)
- initrd (the `initrd*.img` file)
- `logpath`

- For Oracle Exadata System Software 18c (18.1.0):

```
set default 0
set timeout=10
menuentry 'ExadataLinux' {
  echo "Loading efi/vmlinuz"
  linuxefi efi/vmlinux-nfs-18.1.0.0.0-170915.1 stit dhcp pxe
  boot-from=uefi
  quiet loglevel=0 bootarea=diagnostics console=ttyS0,115200n8
  logpath=10.133.42.221:/export/
```

```

exadata_secure_eraser_certificate_dir
  echo "Loading efi/initrd.img"
  initrdefi efi/initrd-nfs-18.1.0.0-170915.1.img
  echo "Booting installation kernel"
}

```

- For Oracle Exadata System Software release 19.1.0 or later:

```

set default 0
set timeout=10
menuentry 'ExadataLinux' {
  echo "Loading efi/vmlinuz"
  linuxefi efi/vmlinux-iso-19.1.2.0.0-190111 stit dhcp pxe boot-
from=uefi
quiet loglevel=0 bootarea=diagnostics console=ttyS0,115200n8
logpath=10.133.42.221:/export/
exadata_secure_eraser_certificate_dir
  echo "Loading efi/initrd.img"
  initrdefi efi/initrd-iso-19.1.2.0.0-190111.img
  echo "Booting installation kernel"
}

```

For a description of each component of the task in this step, see [Automatic Secure Eraser through PXE Boot](#).

This configuration file differs from the one in [Automatic Secure Eraser through PXE Boot](#) in that the `secureeraser` option is left out to indicate that the Secure Eraser process should not be triggered automatically. The rest of the file is the same.

5. On the PXE server, use the template file to generate a PXE configuration file. For all systems up to Oracle Exadata Database Machine X6-2, save the file in the `/tftpboot/pxelinux.cfg/` directory for each of the nodes to be erased. For Oracle Exadata Database Machine X7-2 and newer systems, save the file in the `/tftpboot/efi/pxelinux.cfg/` directory for each of the nodes to be erased.

The PXE configuration file name is the dash-separated MAC address of the node with the prefix `01-`.

If the nodes to be erased are accessible, perform the following steps to automatically generate a PXE configuration file for each node based on the template:

- a. Set up SSH equivalence with the nodes to be erased from the PXE server. The command will prompt for the `root` password of each node.

```
pxe_server# dcli -g nodes_to_be_erased -k -l root
```

- b. Create a list of PXE configuration files, one for each node to be erased based on the configuration template.

```

pxe_server# dcli -g nodes_to_be_erased -l root "ip addr show eth0"
|
awk '/link\/ether/ {print "01:"$3}' | sed "s:/-/" | xargs -I {}
cp pxe_cfg.template {}

```



If the nodes are not accessible, perform the following steps to generate a PXE configuration file for each node.

- a. Manually collect the MAC address of the eth0 interface from each node and write them into a text file called `mac_addresses`. Write one MAC address per line. For example:

```
00:10:e0:62:c4:fa
00:10:e0:62:c2:8a
00:10:e0:62:b8:7c
00:10:e0:62:b8:3a
00:10:e0:62:c6:bc
```

- b. Use the following command to create a list of PXE configuration file, one for each node to be erased based on the configuration template.

```
pxe_server# cat mac_addresses | sed "s:/-/g;s/^/01-/g" | xargs -I
{} cp
pxe_cfg.template {}
```

In both cases, you should have a list of PXE configuration files, one for each node to be erased. For example, if the MAC addresses of the nodes in a quarter rack are 00:10:e0:62:c4:fa, 00:10:e0:62:c2:8a, 00:10:e0:62:b8:7c, 00:10:e0:62:b8:3a, and 00:10:e0:62:c6:bc, then you should get the following files:

```
01-00-10-e0-62-c4-fa
01-00-10-e0-62-c2-8a
01-00-10-e0-62-b8-7c
01-00-10-e0-62-b8-3a
01-00-10-e0-62-c6-bc
```

The files have the same content as the configuration template.

Check your specific PXE server requirements. Your PXE server may need slightly different names or settings.

6. Configure the nodes to boot from PXE and reboot the nodes.

If the nodes to be erased are accessible, run the following commands:

```
pxe_server# dcli -g nodes_to_be_erased -l root "ipmitool chassis
bootdev pxe"
```

```
pxe_server# dcli -g nodes_to_be_erased -l root "reboot"
```

If the nodes are not accessible, then perform the following steps:

- a. Create a file called `iloms_to_be_reset` containing the names of ILOMs. For example:

```
db1-ilom
db2-ilom
cell1-ilom
cell2-ilom
cell3-ilom
```

- b. Configure the nodes to boot from PXE through ILOMs. The command will prompt for ILOM root password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H {}
-U root chassis bootdev pxe
```

- c. Reboot the nodes from ILOMs. The command will prompt for ILOM root password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H {}
-U root chassis power cycle
```

7. If you get the following prompt on the remote or serial console, enter `e` at the prompt to enter the diagnostic shell:

```
Choose from following by typing letter in '()':
(e)nter interactive diagnostics shell. Must use credentials from Oracle
support to login (reboot or power cycle to exit the shell),
Select:e
```

8. Log in to the system as the `root` user.

You will be prompted for the password for the root user of diagnostic shell. The password can be retrieved from Oracle Support Services.

```
localhost login: root
Password: *****
-sh-3.1#
```

9. Run the Secure Eraser utility to sanitize all devices or one type of device.

```
-sh-3.1# /usr/sbin/secureeraser --erase --all --
output=REMOTE_NFS_LOCATION
```

*REMOTE\_NFS\_LOCATION* is the remote NFS location in the format of *IP:FILE\_PATH*. The Secure Eraser utility will automatically mount the remote NFS location and save the certificate there.

For example, to erase all devices including hard drives, flash devices, internal USBs, and ILOM, and save the certificate at this NFS location:

```
10.133.42.221:/export/exadata_secure_eraser_certificate_dir:
```

```
-sh-3.1# /usr/sbin/secureeraser --erase --all --output=10.133.42.221:/
export
/exadata_secure_eraser_certificate_dir
```

To erase just the hard drives:

```
-sh-3.1# /usr/sbin/secureeraser --erase --hdd --output=10.133.42.221:/
export
/exadata_secure_eraser_certificate_dir
```

Note that it is important to point the output option to an NFS location so that the certificate can be saved properly.

You will be prompted with a list of devices to be erased and to confirm that you want to proceed with Secure Eraser.

A progress report, as shown in step 7 of [Automatic Secure Eraser through PXE Boot for X7 and Later Systems](#), will be printed to the console every 10 seconds.

In interactive mode, the server will be left on after the specified devices are securely erased. You can power off the node from the diagnostic shell.

The web console will no longer be accessible if ILOM is reset. You can power off the server from the serial console or with the power button.

### Related Topics

- [Secure Eraser Syntax](#)  
Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.
- [Securely Erasing Oracle Exadata Database Machine Servers \(My Oracle Support Doc ID 2180963.1\)](#)

## 5.5 Interactive Secure Eraser through Network Boot

Starting with Oracle Exadata Database Machine X7-2, you can use EFI Network Boot when using Secure Eraser.

### Note:

Starting with Oracle Exadata System Software release 19.1.0, the Secure Eraser package (`secureeraser_label.zip`) contains ISO images instead of NFS images.

Before you begin:

- Review My Oracle Support Doc ID 2180963.1 for the latest information
  - Make sure you have access to a NFS server that is accessible from all the nodes to be erased.
  - Make sure you have access to one of the nodes to be erased.
1. Copy the cell `initrd` file (`initrd-version`) and kernel file (`vmlinux-version`) from the Secure Eraser package to the `/tftpboot/efi` on the network boot server.  
The location does not have to be `/tftpboot/efi/`. The location is determined by the TFTP Server configuration.
  2. Create a file containing the names of the database servers and storage servers to be erased.

To generate this file, you can run the following command from one of the nodes to be erased, and verify the nodes in the files are the ones to be erased.

```
# ibhosts | awk '/S [0-9\.\/,]* / || /C [0-9\.\/,]* / {print $6}' | sed
"s/\\/"/g"
> nodes_to_be_erased
```

If you only want to erase one server, enter the name of the server into the `nodes_to_be_erased` file, for example `Exa01celadm04`.

3. Copy the `dcli` utility from the Secure Eraser package along with the file generated in step 2 to the network boot server.
4. Create a configuration template called `pxe_cfg.template` to contain the following lines for `grub2` and Secure Boot on Oracle Exadata Database Machine X7-2 and newer systems:

 **Note:**

In the following example, the following parameters must be updated to match your environment:

- kernel (the `vmlinuz` file)
- initrd (the `initrd*.img` file)
- `logpath`

- For releases earlier than Oracle Exadata System Software release 19.1.0:

```
set default 0
set timeout=10
menuentry 'ExadataLinux' {
    echo "Loading efi/vmlinuz"
    linuxefi efi/vmlinuz-nfs-18.1.0.0-170915.1 stit dhcp pxe boot-
from=uefi quiet
    loglevel=0 bootarea=diagnostics console=ttyS0,115200n8
    logpath=10.133.42.221:/export/
    exadata_secure_eraser_certificate_dir
    echo "Loading efi/initrd.img"
    initrdefi efi/initrd-nfs-18.1.0.0-170915.1.img
    echo "Booting installation kernel"
}
```

- For Oracle Exadata System Software release 19.1.0 or later:

```
set default 0
set timeout=10
menuentry 'ExadataLinux' {
    echo "Loading efi/vmlinuz"
    linuxefi efi/vmlinuz-nfs-19.1.2.0-190111 stit dhcp pxe boot-
from=uefi quiet
    loglevel=0 bootarea=diagnostics console=ttyS0,115200n8
    logpath=10.133.42.221:/export/
```

```

exadata_secure_eraser_certificate_dir
echo "Loading efi/initrd.img"
initrdefi efi/initrd-nfs-19.1.2.0.0-190111.img
echo "Booting installation kernel"
}

```

- The first line (`default`) identifies a menu entry that should be selected by default, after the timeout value specified by the second line.
  - The third line (`menuentry`) represents the Linux kernel that will be used in the Secure Eraser environment.
  - The fifth line (`linuxefi`) indicates the kernel is on an UEFI-based system. The `linuxefi` statement must be on a single line in the configuration file.
    - The `stit` option specifies INSTALL imaging mode, plus BARE METAL conditions, plus ERASING ADD DATA PARTITIONS
    - The `dhcp` option specifies to use DHCP to discover the `eth0` interface.
    - The `pxe` option suppresses search for the image on virtual CD and USB devices.
    - The `boot-from=uefi` option indicates the system is booting from UEFI.
    - The `quiet` option disables excessive kernel log messages.
    - The `loglevel=0` option suppresses non-critical kernel messages.
    - The `secureeraser` option indicates the network boot will automatically trigger the Secure Eraser utility to sanitize all media including hard drives, flash devices, internal USBs, and ILOM on the node.
    - The `bootarea` option indicates that the boot mode is diagnostic and not imaging install or rescue.
    - The `console` options indicate standard output and standard error messages are printed to both the ILOM web console and the serial console.
    - The `logpath` option specifies the NFS share directory where Secure Eraser will save the certificate.
  - The seventh line (`initrdefi`) specifies the `initrd` file to load. In this case it is the `initrd` file copied over in step 1.
5. On the network boot server, use the template file to generate a network boot configuration file in the `/tftpbboot/efi/pxelinux.cfg/` directory (Oracle Exadata Database Machine X7-2 and newer) for each of the nodes to be erased.

The network boot configuration file name is the dash-separated MAC address of the node with the prefix `01-`.

If the nodes to be erased are accessible, perform the following steps to automatically generate a network boot configuration file for each node based on the template:

- a. Set up SSH equivalence with the nodes to be erased from the network boot server. The command will prompt for the `root` password of each node.

```
pxe_server# dcli -g nodes_to_be_erased -k -l root
```

- b. Create a list of network boot configuration files, one for each node to be erased based on the configuration template.

```
pxe_server# dcli -g nodes_to_be_erased -l root "ip addr show eth0"
|
awk '/link\/ether/ {print "01:"$3}' | sed "s:/-/g" | xargs -I {}
cp pxe_cfg.template {}
```

If the nodes are not accessible, perform the following steps to generate a network boot configuration file for each node.

- a. Manually collect the MAC address of the eth0 interface from each node and write them into a text file called `mac_addresses`. Write one MAC address per line. For example:

```
00:10:e0:62:c4:fa
00:10:e0:62:c2:8a
00:10:e0:62:b8:7c
00:10:e0:62:b8:3a
00:10:e0:62:c6:bc
```

- b. Use the following command to create a list of network boot configuration file, one for each node to be erased based on the configuration template.

```
pxe_server# cat mac_addresses | sed "s:/-/g;s/^/01-/g" | xargs -I
{} cp
pxe_cfg.template {}
```

In both cases, you should have a list of network boot configuration files, one for each node to be erased. For example, if the MAC addresses of the nodes in a quarter rack are 00:10:e0:62:c4:fa, 00:10:e0:62:c2:8a, 00:10:e0:62:b8:7c, 00:10:e0:62:b8:3a, and 00:10:e0:62:c6:bc, then you should get the following files:

```
01-00-10-e0-62-c4-fa
01-00-10-e0-62-c2-8a
01-00-10-e0-62-b8-7c
01-00-10-e0-62-b8-3a
01-00-10-e0-62-c6-bc
```

The files have the same content as the configuration template.

Check your specific network boot server requirements. Your network boot server may need slightly different names or settings.

6. Configure the nodes to boot from the network boot server and reboot the nodes.

If the nodes to be erased are accessible, run the following commands:

```
pxe_server# dcli -g nodes_to_be_erased -l root "ipmitool chassis
bootdev pxe"
```

```
pxe_server# dcli -g nodes_to_be_erased -l root "reboot"
```

If the nodes are not accessible, then perform the following steps:

- a. Create a file called `iloms_to_be_reset` containing the names of ILOMs. For example:

```
db1-ilom
db2-ilom
cell1-ilom
cell2-ilom
cell3-ilom
```

- b. Configure the nodes to boot from the network boot server through ILOMs. The command will prompt for ILOM `root` password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H {}
-U root chassis bootdev pxe
```

- c. Reboot the nodes from ILOMs. The command will prompt for ILOM `root` password.

```
pxe_server# cat iloms_to_be_reset | xargs -I {} ipmitool -I lanplus
-H {}
-U root chassis power cycle
```

7. If you get the following prompt on the remote or serial console, enter `e` at the prompt to enter the diagnostic shell:

```
Choose from following by typing letter in '()':
(e)nter interactive diagnostics shell. Must use credentials from Oracle
support to login (reboot or power cycle to exit the shell),
Select:e
```

8. Log in to the system as the `root` user.

You will be prompted for the password for the `root` user of diagnostic shell. The password can be retrieved from Oracle Support Services.

```
localhost login: root
Password: *****
-sh-3.1#
```

9. Run the Secure Eraser utility to sanitize all devices or one type of device.

```
-sh-3.1# /usr/sbin/secureeraser --erase --all --
output=REMOTE_NFS_LOCATION
```

`REMOTE_NFS_LOCATION` is the remote NFS location in the format of `IP:FILE_PATH`. The Secure Eraser utility will automatically mount the remote NFS location and save the certificate there.

For example, to erase all devices including hard drives, flash devices, internal USBs, and ILOM, and save the certificate at this NFS location:  
10.133.42.221:/export/exadata\_secure\_eraser\_certificate\_dir:

```
-sh-3.1# /usr/sbin/secureeraser --erase --all --output=10.133.42.221:/  
export  
/exadata_secure_eraser_certificate_dir
```

To erase just the hard drives:

```
-sh-3.1# /usr/sbin/secureeraser --erase --hdd --output=10.133.42.221:/  
export  
/exadata_secure_eraser_certificate_dir
```

Note that it is important to point the output option to an NFS location so that the certificate can be saved properly.

You will be prompted with a list of devices to be erased and to confirm that you want to proceed with the Secure Eraser.

A progress report, as shown in step 7 of [Automatic Secure Eraser through PXE Boot for X7 and Later Systems](#), will be printed to the console every 10 seconds.

In interactive mode, the server will be left on after the specified devices are securely erased. You can power off the node from the diagnostic shell.

The web console will no longer be accessible if ILOM is reset. You can power off the server from the serial console or with the power button.

### Related Topics

- [Secure Eraser Syntax](#)  
Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.
- [Securely Erasing Oracle Exadata Database Machine Servers \(My Oracle Support Doc ID 2180963.1\)](#)

## 5.6 Interactive Secure Eraser through External USB

You can securely erase a node using an external USB drive.

Before you begin:

- Review My Oracle Support note 2180963.1 for the latest information and to download the Secure Eraser package.
  - Make sure you have an external USB.
  - Make sure you have physical access to the nodes to be erased.
1. Copy the diagnostic image from the Secure Eraser package to an external USB.

```
# dd if=PATH_TO_DIAGNOSTIC_IMAGE of=USB_DEVICE
```



For example:

```
# dd if=image_diagnostics_12.2.1.1.0_LINUX.X64_161015-1.x86_64.usb  
of=/dev/sdm
```

2. Insert the external USB to the node to be securely erased.

External USB slots are located at both the front panel and the back panel of 2-socket database servers and storage servers. On 8-socket database servers, external USB slots are located at the back panel.

3. Reboot the node from the external USB by pressing `CTRL+P` after BIOS initialization splash screens and selecting the inserted external USB device.
4. Login to the server.

- a. If you are erasing a storage server, then login to the diagnostic shell.

Enter `e` to enter the diagnostic shell as follows:

```
Choose from following by typing letter in '()':  
(e)nter interactive diagnostics shell. Must use credentials from  
Oracle  
support to login (reboot or power cycle to exit the shell),  
Select:e
```

- b. If you are erasing database servers, then log in as the `root` user.

You will be prompted for the password for the `root` user of diagnostic shell. The password can be retrieved from Oracle Support Services.

```
localhost login: root  
Password: *****  
-sh-3.1#
```

5. Run the Secure Eraser utility to sanitize all devices or one type of device.

For example, to erase all devices:

```
-sh-3.1# /usr/sbin/secureeraser --erase --all --output=/mnt/iso
```

To erase just the hard drives:

```
-sh-3.1# /usr/sbin/secureeraser --erase --hdd --output=/mnt/iso
```

By default, `/mnt/iso` is the mount point for the external USB when system is booted from the diagnostic ISO on the external USB. It is important to point the output option to the external USB mount point `/mnt/iso` so that the certificate can be saved properly.

6. Secure Eraser prompts you with a list of devices to be erased. Confirm that you want to proceed with the secure erasure.

A progress report, as shown in step 7 of [Automatic Secure Eraser through PXE Boot](#), is printed to the console every 10 seconds.

In interactive mode, the server will be left on after the specified devices are securely erased. You can power off the node from the diagnostic shell.

The web console will no longer be accessible if ILOM is reset. You need to power off the server from the serial console or with the power button.

### Related Topics

- [Secure Eraser Syntax](#)  
Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.
- [Securely Erasing Oracle Exadata Database Machine Servers \(My Oracle Support Doc ID 2180963.1\)](#)

## 5.7 Secure Eraser Syntax

Secure Eraser securely erases all data on both database servers and storage servers, and resets InfiniBand switches, Ethernet switches, and power distribution units back to the factory default.

### Syntax

```
secureeraser options
```

### Command-Line Options for Secure Eraser

- `--all`  
Perform the action (`--list` or `--erase`) on all devices on the system. Devices include hard drives, flash devices, USB devices, and ILOM.
- `--devices_to_erase`  
This option allows you specify individual disks to be erased by providing their serial numbers. Multiple serial numbers can be provided separated with commas. Introduced with Oracle Exadata System Software release 19.1.0.
- `--erase`  
Perform a secure erase of data.
- `--erase_data_only`  
When this option is specified, only the data disks are erased. System disks, USB disks, M2 disks, and ILOM are excluded. Introduced with Oracle Exadata System Software release 19.1.0.
- `--erasure_method_optional`  
If a device is not eligible to be erased with the provided erasure method, the erasure method will silently fall back to the default method. Otherwise erasure will fail. This option can be used with all types of disks. Introduced with Oracle Exadata System Software release 19.1.0.
- `--flash`  
Erase all flash devices.
- `--flash_erasure_method=FLASH_ERASURE_METHOD`  
Force all flash devices to be erased using the specified method. The following values are supported:

- 3pass
- 7pass
- crypto (Oracle Exadata System Software release 19.1.0 or later)
- --help, -h  
Show this help message and exit.
- --hdd  
Erase all hard drives.
- --hdd\_erasure\_method=*HDD\_ERASURE\_METHOD*  
Force all hard drives to be erased using the specified method. The following values are supported:
  - 3pass
  - 7pass
  - crypto (Oracle Exadata System Software release 19.1.0 or later)
- --ilom  
Reset ILOM to factory default.
- --list  
List devices (hard drives, flash devices, USB devices, and ILOM) on the system.
- --m2  
Erase all M.2 devices.
- --m2\_erasure\_method=*M2\_ERASURE\_METHOD*  
Force all M.2 devices to be erased using the specified method. The following values are supported:
  - 3pass
  - 7pass
  - crypto (Oracle Exadata System Software release 19.1.0 or later)
- --output=*CERTIFICATE\_DIRECTORY*, -o  
Specify a full path to the directory for the certificate output location. The default is `/var/log/cellos`.
- --quiet, -q  
Quietly skip prompts.
- --technician=*TECHNICIAN\_NAME*, -t *TECHNICIAN\_NAME*  
Specify the name of the technician performing the erasure. This name will be recorded in the certificate.
- --usb  
Erase all internal USB devices.
- --usb\_erasure\_method=*USB\_ERASURE\_METHOD*  
Force all internal USB devices to be erased using the specified method. The following values are supported:

- 3pass
- 7pass
- crypto (Oracle Exadata System Software release 19.1.0 or later)
- --witness=*WITNESS\_NAME*, -w *WITNESS\_NAME*  
Specify the name of the person witnessing the erasure. This name will be recorded in the certificate.

### Examples of Secure Eraser Syntax

List all devices (hard drives, flash devices, USB devices, and ILOM) on the system.

```
secureeraser --list --all
```

List all hard drives.

```
secureeraser --list --hdd
```

Securely erase all devices, and enter the names of the technician and witness in the certificate.

```
secureeraser --erase --all --technician="jdoe" --witness="jsmith"
```

Reset ILOM to factory default.

```
secureeraser --erase --ilom
```

Securely erase all hard drives.

```
secureeraser --erase --hdd
```

Securely erase all hard drives, all flash devices, and all internal USB devices. Force "3-pass" method on flash devices.

```
secureeraser --erase --hdd --flash --usb --flash_erasure_method 3pass
```

## 5.8 Resetting InfiniBand Switches, Ethernet Switch, and Power Distribution Units to Factory Default

Before you begin:

- Review My Oracle Support note 2180963.1 for the latest information and to download the Secure Eraser package
- Print out the Exadata Factory Reset Certificate template in the Secure Eraser package.

The following figure shows the Factory Reset certificate:

Figure 5-2 Factory Reset Certificate

**ORACLE**  
EXADATA

---

**Factory Reset Certificate**

This is to certify the following components have been reset to factory default.

Component	Serial Number	Technician's Signature	Date
Sun Datacenter InfiniBand Switch 36	_____	_____	_____
Sun Datacenter InfiniBand Switch 36	_____	_____	_____
Sun Datacenter InfiniBand Switch 36	_____	_____	_____
Cisco Catalyst 4948 Ethernet Switch	_____	_____	_____
Power Distribution Unit	_____	_____	_____
Power Distribution Unit	_____	_____	_____

- [Resetting InfiniBand Switches to Factory Default](#)
- [Resetting Ethernet Switch to Factory Default](#)  
You can reset the Ethernet switch configuration to the original default factory settings.
- [Resetting Power Distribution Units to Factory Default](#)  
You can reset the power distribution units (PDUs) configuration to the original default factory settings.

**Related Topics**

- [Securely Erasing Oracle Exadata Database Machine Servers \(My Oracle Support Doc ID 2180963.1\)](#)

### 5.8.1 Resetting InfiniBand Switches to Factory Default

To reset Sun Datacenter InfiniBand Switch 36 to factory default, refer to My Oracle Support note 2180877.1.

Record the serial numbers of the switches that have been reset to factory default in the Exadata Factory Reset certificate template. Sign and date the entries.

You can identify the serial number of an InfiniBand switch by running the following command on the switch:

```
[root@switch1 ~]# version | grep "Serial Number"
```

### Related Topics

- [Sun Datacenter InfiniBand Switch Reset to Factory Default Setting \(My Oracle Support Doc ID 2180877.1\)](#)

## 5.8.2 Resetting Ethernet Switch to Factory Default

You can reset the Ethernet switch configuration to the original default factory settings.

### For Oracle Exadata Database Machine X6-2 or earlier

To reset the Ethernet switch to factory default, refer to "Reset Catalyst Switches Running Cisco IOS Software" in the Cisco Troubleshooting TechNotes Document ID: 24328.

Record the serial number of the Ethernet switch that has been reset to factory default in the Exadata Factory Reset certificate template. Sign and date the entry.

The serial number of an Ethernet switch can be identified by the "Processor board ID" field in the "show version" command output.

```
Switch# show version
```



### See Also:

"Reset Catalyst Switches Running Cisco IOS Software" at [http://www.cisco.com/c/en/us/support/docs/switches/catalyst-2900-x1-series-switches/24328-156.html#reset\\_ios](http://www.cisco.com/c/en/us/support/docs/switches/catalyst-2900-x1-series-switches/24328-156.html#reset_ios)

### For Oracle Exadata Database Machine X7-2 or later

To reset the Ethernet switch to factory default:

1. Display the start up configuration.

```
# show startup-config
```

2. Display the boot configuration.

```
# show boot
```

3. Display the debug configuration.

```
# show debug
```

4. Erase the startup-configuration file.

```
# write erase
```

```
Warning: This command will erase the startup-configuration.
```

```
Do you wish to proceed anyway? (y/n) [n] y
```

5. Erase the boot variable definitions.

```
# write erase boot
```

Warning: This command will erase the boot variables and the ip configuration of interface mgmt 0

Do you wish to proceed anyway? (y/n) [n] **y**

6. Erase the debugging configuration.

```
# write erase debug
```

7. Reload the Cisco Nexus 93108-1G or Cisco Nexus 9348 Ethernet switch.

```
# reload
```

This command will reboot the system. (y/n) [n] **y**



**See Also:**

"Erasing a Configuration" in *Cisco Nexus 9000 Series NX-OS Fundamentals Configuration Guide, Release 6.x*

## 5.8.3 Resetting Power Distribution Units to Factory Default

You can reset the power distribution units (PDUs) configuration to the original default factory settings.

There are two types of power distribution units (PDUs): original PDUs and enhanced PDUs. Enhanced PDUs have SER MGT port that can be connected to a host using an RS-232 cable, whereas the original PDUs do not have SER MGT port. Typically, Oracle Exadata Database Machine V2 to Oracle Exadata Database Machine X3 racks have the original PDUs, and Oracle Exadata Database Machine X4-2 and later have the enhanced PDUs.

You can reset both the original power distribution units and the enhanced power distribution units, as described in the *Sun Rack II Power Distribution Units User's Guide* or the *Oracle Rack Cabinet 1242 Power Distribution Units User's Guide* (for Oracle Exadata Database Machine X7-2 and later systems).

Record the serial numbers of the power distribution units that have been reset to factory default in the Exadata Factory Reset certificate template. Sign and date the entries.

The serial number can be found on the "View Module Information" topic of the appropriate *Power Distribution Units User's Guide*.

For enhanced PDUs, the serial number can also be retrieved through the following CLI command:

```
pducli -> get pdu_serial_number
```

 **See Also:**

- "[View Module Information](#)" (Original or Enhanced PDU) in *Sun Rack II Power Distribution Units User's Guide*
- "[View Module Information](#)" (Original or Enhanced PDU) in *Oracle Rack Cabinet 1242 Power Distribution Units User's Guide*
- "[Restore the PDU to Factory Default Settings](#)" (Original or Enhanced PDU) in *Sun Rack II Power Distribution Units User's Guide*
- "[Restore the PDU to Factory Default Settings](#)" (Original or Enhanced PDU) in *Oracle Rack Cabinet 1242 Power Distribution Units User's Guide*

## 5.9 Actions After Using Secure Eraser

After performing a secure erase, the system is ready for return or re-imaging.

If you plan to re-image the machine, you must perform the following steps:

1. Connect to and configure ILOM. See "[Oracle ILOM – Quick Start](#)" in the *Oracle ILOM Getting Started Guide Firmware Release 4.0.x*.

Perform the following tasks:

- a. Connect to Oracle ILOM
  - b. Log In to Oracle ILOM
  - c. Modify Default Network Connectivity Settings
2. Re-image the system. Refer to Imaging a New System in *Oracle Exadata Database Machine Installation and Configuration Guide*.

If you are preparing to return the machine, refer to <http://www.oracle.com/us/products/servers-storage/take-back-and-recycling/index.html>



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