

*Oracle*

*NoSQL Database  
Security Guide*

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# Preface

This document describes how you can configure security for Oracle NoSQL Database using the default database features.

This book is aimed at the systems administrator responsible for the security of an Oracle NoSQL Database installation.

## Conventions Used in This Book

The following typographical conventions are used within this manual:

Information that you are to type literally is presented in monospaced font.

Variable or non-literal text is presented in *italics*. For example: "Go to your *KVHOME* directory."

### Note

Finally, notes of special interest are represented using a note block such as this.

---

# Chapter 1. Introducing Oracle NoSQL Database Security

Oracle NoSQL Database can be configured securely. In a secure configuration, network communications between NoSQL clients, utilities, and NoSQL server components are encrypted using SSL/TLS, and all processes must authenticate themselves to the components to which they connect.

There are two levels of security to be aware of. These are network security, which provides an outer layer of protection at the network level, and user authentication/authorization. Network security is configured at the file system level typically during the installation process, while user authentication/authorization is managed through NoSQL utilities.

You can use the default Oracle NoSQL Database features to configure security in the following areas for your Oracle NoSQL Database installation;

- **Security Configuration Utility.** Allows you to configure and add security to a new or to an existing Oracle NoSQL Database installation.
- **Authentication methods.** Oracle NoSQL Database provides password authentication for users and systems. Oracle NoSQL Database EE version also supports Kerberos authentication.
- **Encryption.** You can encrypt data on the network to prevent unauthorized access to that data.
- **External Password Storage.** Oracle NoSQL Database provides two types of external password storage methods that you can manipulate (one type for CE deployments).
- **Security Policies.** Oracle NoSQL Database allows you to set up behaviors in order to ensure a secure environment.
- **Role-based authorization.** Oracle NoSQL Database provides predefined system roles, privileges, and user-defined roles to users. You can set desired privileges to users by role-granting.

In addition, [Keeping Oracle NoSQL Database Secure \(page 64\)](#) provides guidelines that you should follow when securing your Oracle NoSQL Database installation.

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## Chapter 2. Security Configuration

This chapter describes how to use either the `makebootconfig` or `securityconfig` tool to perform the security configuration of your store. If you are installing a store with security for the first time, you can skip ahead to the next chapter [Performing a Secure Oracle NoSQL Database Installation \(page 11\)](#).

### Note

For simpler use cases (lab environments) it is possible to perform a basic installation of your store by explicitly opting out of security on the command line. If you do this, your store loses all the security features described in this book. For more information see [Configuring Security with Makebootconfig \(page 4\)](#).

## Security Configuration Overview

To set up security, you need to create an initial security configuration. To do this, run `securityconfig` before, after or as part of the `makebootconfig` process before starting the SNA on an initial node. You should not create a security configuration at each node. Instead, you should distribute the initial security configuration across all the Storage Nodes in your store. If the stores do not share a common security configuration they will be unable to communicate with one another.

### Note

The `makebootconfig` utility embeds the functionality of `securityconfig` tool.

This tool creates a set of security files based on the standard configuration. It is possible to perform the same tasks manually, and advanced security configuration might require manual setup, but using this tool helps to ensure a consistent setup. For more information on the manual setup, see [SSL keystore generation \(page 70\)](#).

### Note

It is possible to modify the security configuration after it is created in order to use a non-standard configuration. It is recommended that you use a standard configuration.

Those security files are generated, by default, within a directory named "security". In a secure configuration, the bootstrap configuration file for a Storage Node includes a reference to that directory, which must be within the `KVROOT` directory for the Storage Node. The security directory contains:

```
security/security.xml
security/store.keys
security/store.trust
security/store.passwd (CE or EE installations)
security/store.wallet (EE installations only)
security/store.wallet/cwallet.sso (EE installations only)
security/client.security
security/client.trust
```



where:

- `security.xml`

A configuration file that tells the Oracle NoSQL Database server how to apply security.

- `store.keys`

A Java keystore file containing one or more SSL/TLS key pairs. This keystore is protected by a keystore password, which is recorded in an accompanying password store. The password store may be either an Oracle Wallet or a FileStore. The password is stored under the alias "keystore" in the password store. This file should be accessible only by the Oracle NoSQL Database server processes, and not to Oracle NoSQL Database clients.

- `store.trust`

A Java truststore file, which is a keystore file that contains only public certificates, and no private keys.

- `store.passwd` (CE or EE installations)

A password file that acts as the password store for a Community Edition (CE) installation. It contains secret information that should be known only to the server processes. Make sure the password file is readable and writable only by the Oracle NoSQL Database server. The file should not be copied to client machines.

For Enterprise Edition (EE) installations, Oracle Wallet usage is preferred over the password file option.

- `store.wallet` (EE installations only)

An Oracle Wallet directory that acts as the password store for an Enterprise Edition (EE) installation. It contains secret information that should be known only to the server processes. Make sure the directory and its contents are readable and writable only by the NoSQL DB server. The file should not be copied to client machines.

- `cwallet.sso` (EE installations only)

The wallet password storage file.

- `client.security`

A security configuration file that captures the communication transport properties for connecting clients to KVStore.

The generated `client.security` file should be copied to and used by Oracle NoSQL Database clients when connecting to the KVStore.

- `client.trust`

A truststore file used by clients is generated.

The generated client.trust file should be copied to and used by Oracle NoSQL Database clients when connecting to the KVStore.

## Note

In a multi-host store environment, the security directory and all files contained in it should be copied to each server that will host a Storage Node.

## Configuring Security with Makebootconfig

Use the makebootconfig command with the required -store-security option to set up the basic store configuration with security:

```
java -jar KVHOME/lib/kvstore.jar makebootconfig
-root <kvroot> -port <port>
-admin <adminport> -host <hostname> -harange <harange>
-store-security configure -capacity <capacity>
[-secdir <security dir>]
[-pwdmgr {pwdfile | wallet | <class-name>}]
[-kspwd <password>]
[-external-auth {kerberos}]
  [-krb-conf <kerberos configuration>]
  [-kadmin-path <kadmin utility path>]
  [-instance-name <database instance name>]
  [-admin-principal <kerberos admin principal name>]
  [-kadmin-keytab <keytab file>]
  [-kadmin-ccache <credential cache file>]
  [-princ-conf-param <param=value>]*
[-security-param <param=value>]*
```

where -store-security has the following options:

- -store-security none

No security will be used. If a directory named "security" exists, a warning message will be displayed. When you opt out of security, you lose all the security features in your store; you are not able to set password authentication for users and systems, encrypt your data to prevent unauthorized access, etc.

- -store-security configure

Security will be used and the security configuration utility will be invoked as part of the makebootconfig process. If the security directory already exists, an error message is displayed, otherwise the directory will be created.

For script-based configuration you can use the -kspwd<password> option to allow tools to specify the keystore password on the command line. If it is not specified, the user is prompted to enter the password.

Use the -pwdmgr option to select a password manager implementation. Its usage is introduced later in this section.

Use the `-external-auth` option to specify Kerberos as an external authentication service. This option is only available in the Oracle NoSQL Database EE version. If information for the Kerberos admin interface (e.g. password) is needed and no keytab or credential cache has been specified on the command line, an interactive version of `securityconfig config create` utility will run.

Using the `-external-auth` flag allows Oracle NoSQL Database to generate the security files needed for Kerberos authentication, based on a standard configuration. Although not recommended, it is possible to use a non-standard configuration. To do this, see [Manually Registering Oracle NoSQL Database Service Principal \(page 81\)](#)

- `-store-security enable`

Security will be used. You will need to configure security either by utilizing the security configuration utility or by copying a previously created configuration from another system.

For more information on configuring security with `makebootconfig`, see [Adding Security to a New Installation \(page 11\)](#).

## Configuring Security with Securityconfig

You can also run the `securityconfig` tool before or after the `makebootconfig` process by using the following command:

```
java -jar KVHOME/lib/kvstore.jar securityconfig
```

For more information on creating, adding, removing or merging the security configuration using `securityconfig`, see the following sections.

## Creating the security configuration

You can use the `config create` command to create the security configuration:

```
config create
-root <secroot> [ -secdir <security dir> ]
[-pwdmgr { pwdfile | wallet <class-name> } ]
[-kspwd <password> ]
[-external-auth {kerberos}]
  [-krb-conf <kerberos configuration>]
  [-kadmin-path <kadmin utility path>]
  [-instance-name <database instance name>]
  [-admin-principal <kerberos admin principal name>]
  [-kadmin-keytab <keytab file>]
  [-kadmin-ccache <credential cache file>]
  [-princ-conf-param <param=value>]*
  [-param [client:|ha:|internal:|]&lt;param>=&lt;value>]*
```

where:

- `-root <secroot>`

Specifies the directory in which the security configuration will be created. It is not required that this directory be a full KVROOT, but the directory must exist.

- `-external-auth {kerberos}` Specifies Kerberos as an external authentication service. This option is only available in the Oracle NoSQL Database EE version. If no keytab or credential cache has been specified on the command line, an interactive version of the `securityconfig` utility will run.

Using this flag allows Oracle NoSQL Database to generate the security files needed for Kerberos authentication, based on a standard configuration. Although not recommended, it is possible to use a non-standard configuration. To do this, see [Manually Registering Oracle NoSQL Database Service Principal \(page 81\)](#)

This flag is only permitted when the value of the `-store-security` flag is specified as `configure` or `enable`.

To remove Kerberos authentication from a running store, set the value of the `userExternalAuth` `security.xml` parameter to `NONE`.

where `-external-auth` can have the following flags:

- `-admin-principal <kerberos admin principal name>`

Specifies the principal used to login to the Kerberos admin interface. This is required while using `kadmin` keytab or password to connect to the admin interface.

- `-kadmin-ccache <credential cache file>`

Specifies the complete path name to the Kerberos credentials cache file that should contain a service ticket for the `kadmin/ADMINHOST`. `ADMINHOST` is the fully-qualified hostname of the admin server or `kadmin/admin` service.

If not specified, the user is prompted to enter the password for principal while logging to the Kerberos admin interface. This flag cannot be specified in conjunction with the `-kadmin-keytab` flag.

- `-kadmin-keytab <keytab file>`

Specifies the location of a Kerberos keytab file that stores Kerberos admin user principals and encrypted keys. The security configuration tool will use the specified keytab file to login to the Kerberos admin interface.

The default location of the keytab file is specified by the Kerberos configuration file. If the keytab is not specified there, then the system looks for the file `user.home/krb5.keytab`.

You need to specify the `-admin-principal` flag when using keytab to login to the Kerberos admin, otherwise the correct admin principal will not be recognized. This flag cannot be specified in conjunction with the `-kadmin-ccache` flag.

- `-kadmin-path <kadmin utility path>`

Indicates the absolute path of the Kerberos kadmin utility. The default value is `/usr/kerberos/sbin/kadmin`.

- `-krb-conf <kerberos configuration>`

Specifies the location of the Kerberos configuration file that contains the default realm and KDC information. If not specified, the default value is `/etc/krb5.conf`.

- `-princ-conf-param <param=value>*`

A repeatable argument that allows configuration defaults to be overridden.

Use the `krbPrincValidity` parameter to specify the expiration date of the Oracle NoSQL Database Kerberos service principal.

Use the `krbPrincPwdExpire` parameter to specify the password expiration date of the Oracle NoSQL Database Kerberos service principal.

Use the `krbKeysalt` parameter to specify the keysalt list used to generate the keytab file.

- `-secdir <security dir>`

Specifies the name of the directory within the KVRROOT that will hold the security configuration. This must be specified as a name relative to the specified secroot. If not specified, the default value is "security".

- `-pwmgr [ pwdfile | wallet ]`

Indicates the password manager mechanism used to hold passwords that are needed for accessing keystores, etc.

where `-pwmgr` can have the following options:

- `-pwmgr pwdfile`

Indicates that the password store is a read-protected clear-text password file. This is the only available option for Oracle NoSQL Database CE deployments. You can specify an alternate implementation. For more information on `pwdfile` manipulation, see [Password store file \(page 36\)](#)

- `-pwmgr wallet`

Specifies Oracle Wallet as the password storage mechanism. This option is only available in the Oracle NoSQL Database EE version. For more information on Oracle wallet manipulation, see [Oracle Wallet \(page 36\)](#)

- `-param [client:|ha:|internal:|]<param>=<value>]`

A repeatable argument that allows configuration defaults to be overridden. The value may be either a simple parameter, such as "truststore", or a qualified parameter such as "client:serverKeyAlias". If specified in qualified form, the qualifier (for example, "client") names a transport within the security configuration, and the assignment is specific to that transport. If in simple form, it applies to either the securityParams structure or to all transports within the file, depending on the type of parameter.

For more information on configuring security with securityconfig, see [Performing a Secure Oracle NoSQL Database Installation \(page 11\)](#).

For more information on configuring Kerberos with securityconfig, see [Kerberos Authentication Service \(page 23\)](#).

## Adding the security configuration

You can use the `config add-security` command to add the security configuration you created earlier:

```
config add-security  
-root <kvroot> [-secdir <security dir>]  
[-config <config.xml>]
```

### Note

When running this command, the `securityconfig` tool will verify the existence of the referenced files and will update the specified bootstrap configuration file to refer to the security configuration. This process is normally done with the KVStore instance stopped, and must be performed on each Storage Node of the store.

where:

- `-root <kvroot>`

A KVStore root directory must be provided as an argument.

- `-secdir <security dir>`

Specifies the name of the directory within the KVROOT that holds the security configuration. This must be specified as a name relative to the KVROOT. If not specified, the default value is "security".

- `-config <config.xml>`

Specifies the bootstrap configuration file that is to be updated. This must be specified as a name relative to the KVROOT. If not specified, the default value is "config.xml".

When using Kerberos as an external authentication service, you can use the `config add-kerberos` command to add the security configuration you created earlier:

```
config add-kerberos -root <secroot> [-secdir <security dir>]  
[-krb-conf <Kerberos configuration>]
```

```
[ -kadmin-path <kadmin utility path>]
[ -instance-name <database instance name>]
[ -admin-principal <kerberos admin principal name>]
[ -kadmin-keytab <keytab file> ]
[ -kadmin-ccache <credential cache file>]
[ -princ-conf-param <param=value>]*
[ -param <param=value>]*
```

## Removing the security configuration

If you want to disable security for some reason in an existing installation, you can use the `config remove-security` command:

```
config remove-security
-root <kvroot> [ -config <config.xml>]
```

### Note

When running this command, the `securityconfig` tool will update the specified bootstrap configuration file to refer to the security configuration. This process is normally done with the KVStore instance stopped, and must be performed on each Storage Node of the store.

where:

- `-root <kvroot>`

A KVStore root directory must be provided as an argument.

- `-config <config.xml>`

Specifies the bootstrap configuration file that is to be updated. This must be specified as a name relative to the KVRTXROOT. If not specified, the default value is "config.xml".

## Merging truststore configuration

If you want to merge truststore entries from one security configuration into another security configuration use the `config merge-trust` command. This command is helpful when performing security maintenance, particularly when you need to update the SSL key/certificate. For more information, see [Guidelines for Updating the SSL key/certificate \(page 68\)](#)

```
config merge-trust
-root <secroot> [ -secdir <security dir>]
-source-root <secroot> [ -source-secdir <security dir>]
```

### Note

When running this command, the `securityconfig` tool will verify the existence of the referenced files and will combine trust entries from the source security configuration into the primary security configuration.

where:

- `-root <secroot>`

Specifies the directory that contains the security configuration that will be updated. It is not required that this directory be a full KVROOT, but the directory must exist and contain an existing security configuration.

- `-secdir <security dir>`

Specifies the name of the directory within the secroot that holds the security configuration. This must be specified as a name relative to the secroot. If not specified, the default value is "security".

- `-source-root <secroot>`

Specifies the directory that contains the security configuration that will provide new trust information. It is not required that this directory be a full KVROOT, but the directory must exist and must contain an existing security configuration.

- `-source-secdir <security dir>`

Specifies the name of the security directory within the source secroot that will provide new trust information. If not specified, the default value is "security".



---

## Chapter 3. Performing a Secure Oracle NoSQL Database Installation

It is possible to add security to a new or an existing Oracle NoSQL Database installation.

To add security to a new or an existing Oracle NoSQL Database single host deployment, see the next section. For multiple node deployments, see [Multiple Node Secure Deployment \(page 16\)](#).

If you want to use Kerberos as an external authentication service, you should instead complete the steps under [Performing a Secure Oracle NoSQL Database Installation with Kerberos \(page 29\)](#).

### Single Node Secure Deployment

The following examples describe how to add security to a new or an existing Oracle NoSQL Database single host deployment.

#### Adding Security to a New Installation

To install Oracle NoSQL Database securely:

1. Run the `makebootconfig` utility with the required `-store-security` option to set up the basic store configuration with security:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar makebootconfig \  
-root KVRROOT -port 5000 \  
-admin 5001 -host node01 -harange 5010,5020 \  
-store-security configure -pwdmgr pwdfile -capacity 1
```

2. In this example, `-store-security configure` is used, so the security configuration utility is run as part of the `makebootconfig` process and you are prompted for a password to use for your keystore file:

```
Enter a password for the Java KeyStore:
```

3. Enter a password for your store and then reenter it for verification. In this case, the password file is used, and the `securityconfig` tool will automatically generate the following security related files:

```
Enter a password for the Java KeyStore: *****  
Re-enter the KeyStore password for verification: *****  
Created files:  
security/client.trust  
security/client.security  
security/store.keys  
security/store.trust  
security/store.passwd
```

```
security/security.xml
```

## Note

In a multi-host store environment, the security directory and all files contained in it should be copied to each server that will host a Storage Node.

4. Start the Storage Node Agent (SNA):

```
nohup java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar start -root KVR00T&
```

When a newly created store with a secure configuration is first started, there are no user definitions available against which to authenticate access. In order to reduce risk of unauthorized access, an admin will only allow you to connect to it from the host on which it is running. This security measure is not a complete safeguard against unauthorized access. It is important that you do not provide local access to machines running KVStore. In addition, you should perform steps 5, 6 and 7 soon after this step in order to minimize the time period in which the admin might be accessible without full authentication. For more information on maintaining a secure store see [Guidelines for Securing the Configuration \(page 64\)](#).

5. Start runadmin in security mode on the KVStore server host (node01). To do this, use the following command:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar \  
runadmin -port 5000 -host node01 \  
-security KVR00T/security/client.security  
Logged in admin as anonymous
```

6. Use the `configure -name` command to specify the name of the KVStore that you want to configure:

```
kv-> configure -name mystore  
Store configured: mystore
```

7. Create an admin user. In this case, user root is defined:

```
kv-> plan create-user -name root -admin -wait  
Enter the new password: *****  
Re-enter the new password: *****  
Executed plan 6, waiting for completion...  
Plan 6 ended successfully
```

For more information on user creation and administration, see [User Management \(page 45\)](#).

8. Create a new password file to store the credentials needed to allow clients to login as the admin user (root):

```
java -Xmx256m -Xms256m \  

```

```
-jar KVHOME/lib/kvstore.jar securityconfig \  
pwdfile create -file KVR00T/security/login.passwd  
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar securityconfig pwdfile secret \  
-file KVR00T/security/login.passwd -set -alias root  
Enter the secret value to store: *****  
Re-enter the secret value for verification: *****  
Secret created  
OK
```

## Note

The password must match the one set for the admin in the previous step.

For more information on user creation and administration, see [User Management \(page 45\)](#).

9. At this point, it is possible to connect to the store as the root user. To login, you can use either the `-username <user> runadmin` argument or specify the "oracle.kv.auth.username" property in the security file.

In this example, a security file (mylogin.txt) is used. To login, use the following command:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 \  
-host localhost -security mylogin  
Logged in admin as root
```

The file mylogin.txt should be a copy of the client.security file with additional properties settings for authentication. The file would then contain content like this:

```
oracle.kv.auth.username=root  
oracle.kv.auth.pwdfile.file=KVR00T/security/login.passwd  
oracle.kv.transport=ssl  
oracle.kv.ssl.trustStore=KVR00T/security/client.trust  
oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1  
oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
```

For more information, see [User Login \(page 48\)](#).

## Adding Security to an Existing Installation

To add security to an existing Oracle NoSQL Database installation:

1. Shut down the KVStore instance:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar stop \  
-root KVR00T
```

2. Run the securityconfig utility to set up the basic store configuration with security:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar securityconfig
```

3. Use the `config create` command with the `-pwmgr` option to specify the mechanism used to hold passwords that is needed for accessing the stores. In this case, Oracle Wallet is used. Oracle Wallet is only available in the Oracle NoSQL Database EE version. CE deployments should use the `pwdfile` option instead.

```
config create -pwmgr wallet -root KVR00T  
Enter a password for the Java KeyStore:
```

4. Enter a password for your store and then reenter it for verification. The configuration tool will automatically generate some security related files:

```
Enter a password for the Java KeyStore: *****  
Re-enter the KeyStore password for verification: *****  
Created files:  
security/security.xml  
security/store.keys  
security/store.trust  
security/store.wallet/cwallet.sso  
security/client.security  
security/client.trust
```

## Note

In a multi-host store environment, the security directory and all files contained in it should be copied to each server that will host a Storage Node.

5. Use the `config add-security` command to add the security configuration you just created:

```
security-> config add-security -root KVR00T  
-secdir security -config config.xml  
Configuration updated.
```

## Note

When running this command, the `securityconfig` tool will verify the existence of the referenced files and will update the specified bootstrap configuration file to refer to the security configuration. This process is normally done with the KVStore instance stopped, and must be performed on each Storage Node of the store.

6. Start the Storage Node Agent (SNA):

```
nohup java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar start -root KVR00T&
```

7. Start `runadmin` in security mode on the KVStore server host (node01). To do this, use the following command:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar \  
runadmin -port 5000 -host node01 \  
-security KVROOT/security/client.security  
Logged in admin as anonymous.
```

This command sets SSL as a connection method and names a copy of the generated truststore file (client.security). For more information on SSL properties, see [SSL communication properties \(page 43\)](#).

8. Create an admin user. In this case, user root is defined:

```
kv-> plan create-user -name root -admin -wait  
Enter the new password: *****  
Re-enter the new password: *****  
Executed plan 8, waiting for completion...  
Plan 8 ended successfully
```

For more information on user creation and administration, see [User Management \(page 45\)](#).

9. Create a new wallet file to store the credentials needed to allow clients to login as the admin user (root):

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar securityconfig \  
wallet create -dir KVROOT/security/login.wallet  
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar securityconfig wallet secret \  
-dir KVROOT/security/login.wallet -set -alias root  
Enter the secret value to store: *****  
Re-enter the secret value for verification: *****  
Secret created  
OK
```

## Note

The password must match the one set for the admin in the previous step.

For more information on user creation and administration, see [User Management \(page 45\)](#).

10. At this point, it is possible to connect to the store as the root user. To login, you can use either the `-username <user>` `runadmin` argument or specify the "oracle.kv.auth.username" property in the security file.

In this example, the `oracle.kv.security` property is used. To login use the following command:

```
java -Xmx256m -Xms256m \  
-Doracle.kv.security=mylogin \  

```

```
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 -host localhost  
Logged in admin as root
```

The file `mylogin.txt` should be a copy of the `client.security` file with additional properties settings for authentication. The file would then contain content like this:

```
oracle.kv.auth.username=root  
oracle.kv.auth.wallet.dir=KVR00T/security/login.wallet  
oracle.kv.transport=ssl  
oracle.kv.ssl.trustStore=KVR00T/security/client.trust  
oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1  
oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
```

For more information, see [User Login \(page 48\)](#).

## Multiple Node Secure Deployment

The following examples describe how to add security to a new or to an existing Oracle NoSQL Database multiple host deployment.

### Adding Security to a New Installation

To install an Oracle NoSQL Database three node, capacity=3 (3x3) secure deployment:

1. Run the `makebootconfig` utility with the required `-store-security` option to set up the basic store configuration with security:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar makebootconfig \  
-root KVR00T -port 5000 \  
-admin 5001 -host node01 -harange 5010,5020 \  
-store-security configure -pwdmgr wallet -capacity 3
```

2. In this example, `-store-security configure` is used, so the security configuration utility is run as part of the `makebootconfig` process and you are prompted for a password to use for your keystore file:

```
Enter a password for the Java KeyStore:
```

3. Enter a password for your store and then reenter it for verification. For example, using `wallet`, the `securityconfig` tool will automatically generate the following security related files:

```
Enter a password for the Java KeyStore: *****  
Re-enter the KeyStore password for verification: *****  
Created files:  
security/security.xml  
security/store.keys  
security/store.trust  
security/store.wallet/cwallet.sso  
security/client.security  
security/client.trust
```

4. In a multi-host store environment, the security directory and all files contained in it should be copied from the first node to each server that will host a Storage Node, to setup internal cluster authentication. For example, the following commands assume that the different nodes are visible and accessible on the current node (node01):

```
cp -R node01/KVROOT/security node02/KVROOT/  
cp -R node01/KVROOT/security node03/KVROOT/
```

## Note

You may need to use a remote copying command, like scp, to do the copying if the files for the different nodes are not visible on the current node.

5. Enable security on the other two nodes using the `-store-security enable` command:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar makebootconfig \  
-root KVROOT \  
-host node02 \  
-port 6000 \  
-admin 6001 \  
-harange 6010,6020 \  
-capacity 3 \  
-store-security enable \  
-pwdmgr wallet
```

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar makebootconfig \  
-root KVROOT \  
-host node03 \  
-port 7000 \  
-admin 7001 \  
-harange 7010,7020 \  
-capacity 3 \  
-store-security enable \  
-pwdmgr wallet
```

6. Start the Storage Node Agent (SNA) on each node:

```
nohup java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar start -root KVROOT&
```

7. Start runadmin in security mode on the KVStore server host (node01). To do this, use the following command:

```
java -Xmx256m -Xms256m -jar KVHOME/lib/kvstore.jar \  
runadmin -port 5000 -host node01 \  
-security KVROOT/security/client.security  
Logged in admin as anonymous
```

8. Use the `configure -name` command to specify the name of the KVStore that you want to configure:

```
kv-> configure -name mystore
Store configured: mystore
```

9. Create an admin user. In this case, user root is defined:

```
kv-> plan create-user -name root -admin -wait
Enter the new password: *****
Re-enter the new password: *****
Executed plan 6, waiting for completion...
Plan 6 ended successfully
```

For more information on user creation and administration, see [User Management \(page 45\)](#).

10. Create the wallet to enable client credentials for the admin user (root):

```
java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar securityconfig \
wallet create -dir KVR00T/security/login.wallet
java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar securityconfig wallet secret \
-dir KVR00T/security/login.wallet -set -alias root
Enter the secret value to store: *****
Re-enter the secret value for verification: *****
Secret created
OK
```

## Note

The password must match the one set for the admin in the previous step.

11. At this point, it is possible to connect to the store as the root user. To login, you can use either the `-username <user> runadmin` argument or specify the "oracle.kv.auth.username" property in the security file.

In this example, a security file (adminlogin.txt) is used. To login, use the following command:

```
java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 \
-host localhost -security adminlogin
Logged in admin as root
```

The file adminlogin.txt should be a copy of the client.security file with additional properties settings for authentication. The file would then contain content like this:

```
oracle.kv.auth.username=root
oracle.kv.auth.wallet.dir=KVR00T/security/login.wallet
oracle.kv.transport=ssl
oracle.kv.ssl.trustStore=KVR00T/security/client.trust
oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1
```



```
oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
```

For more information, see [User Login \(page 48\)](#).

12. Once logged in as admin, you can create some users:

```
kv-> plan create-user -name user1 -wait
Enter the new password: *****
Re-enter the new password: *****
Executed plan 7, waiting for completion...
Plan 7 ended successfully
```

```
kv-> plan create-user -name user2 -wait
Enter the new password: *****
Re-enter the new password: *****
Executed plan 8, waiting for completion...
Plan 8 ended successfully
```

13. Create the wallet to enable client credentials for each user. Typically you will reuse this wallet for all your regular users:

```
java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar securityconfig \
wallet create -dir KVR00T/security/users.wallet
java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar securityconfig wallet secret \
-dir KVR00T/security/users.wallet -set -alias user1
Enter the secret value to store: *****
Re-enter the secret value for verification: *****
Secret created
OK
java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar securityconfig wallet secret \
-dir KVR00T/security/users.wallet -set -alias user2
Enter the secret value to store: *****
Re-enter the secret value for verification: *****
Secret created OK
```

## Note

Each password must match the one set for each user in the previous step. This wallet is independent from the admin one. It is possible to store admin/user passwords using the same wallet.

14. At this point, it is possible to connect to the store as a user. To login, you can use either the `-username <user> runadmin` argument or specify the "oracle.kv.auth.username" property in the security file.

In this example, a security file (userlogin.txt) is used. To login, use the following command:

```
java -Xmx256m -Xms256m \
```

```
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 \  
-host localhost -security userlogin  
Logged in admin as user1
```

The file `userlogin.txt` should be a copy of the `client.security` file with additional properties settings for authentication. The file would then contain content like this:

```
oracle.kv.auth.username=user1  
oracle.kv.auth.wallet.dir=KVR00T/security/users.wallet  
oracle.kv.transport=ssl  
oracle.kv.ssl.trustStore=KVR00T/security/client.trust  
oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1  
oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
```

For more information, see [User Login \(page 48\)](#).

## Adding Security to an Existing Installation

To add security to an existing three node, capacity=3 (3x3) Oracle NoSQL Database installation:

1. Shut down the KVStore instance on each node:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar stop \  
-root KVR00T
```

2. Run the `securityconfig` utility to set up the basic store configuration with security:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar securityconfig
```

3. Use the `config create` command with the `-pwdmgr` option to specify the mechanism used to hold passwords that is needed for accessing the stores. In this case, Oracle Wallet is used:

```
config create -pwdmgr wallet -root KVR00T  
Enter a password for the Java KeyStore:
```

4. Enter a password for your store and then reenter it for verification. The configuration tool will automatically generate some security related files:

```
Enter a password for the Java KeyStore: *****  
Re-enter the KeyStore password for verification: *****  
Created files:  
security/security.xml  
security/store.keys  
security/store.trust  
security/store.wallet/cwallet.sso  
security/client.security  
security/client.trust
```

5. In a multi-host store environment, the security directory and all files contained in it should be copied from the first node to each server that will host a Storage Node, to

setup internal cluster authentication. For example, the following commands assume that the different nodes are visible and accessible on the current node (node01):

```
cp -R node01/KVROOT/security node02/KVROOT/  
cp -R node01/KVROOT/security node03/KVROOT/
```

## Note

You may need to use a remote copying command, like `scp`, to do the copying if the files for the different nodes are not visible on the current node.

6. Use the `config add-security` command on each node to add the security configuration you just created:

```
security-> config add-security -root KVROOT -secdir security
```

## Note

When running this command, the `securityconfig` tool will verify the existence of the referenced files and will update the specified bootstrap configuration file to refer to the security configuration. This process is normally done with the KVStore instance stopped, and must be performed on each Storage Node of the store.

7. Start the Storage Node Agent (SNA) on each node:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar start -root KVROOT&
```

8. Start `runadmin` in security mode on the KVStore server host (node01). To do this, use the following command:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar \  
runadmin -port 5000 -host node01 \  
-security KVROOT/security/client.security
```

This command sets SSL as a connection method and names a copy of the generated truststore file (`client.security`). For more information on SSL properties, see [SSL communication properties \(page 43\)](#).

9. Create an admin user. In this case, user `root` is defined:

```
kv-> plan create-user -name root -admin -wait  
Enter the new password: *****  
Re-enter the new password: *****  
Executed plan 8, waiting for completion...  
Plan 8 ended successfully
```

For more information on user creation and administration, see [User Management \(page 45\)](#).

10. Create the wallet to enable client credentials for the admin user (`root`):

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar securityconfig \  
wallet create -dir KVR00T/security/login.wallet  
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar securityconfig wallet secret \  
-dir KVR00T/security/login.wallet -set -alias root  
Enter the secret value to store: *****  
Re-enter the secret value for verification: *****  
Secret created  
OK
```

## Note

The password must match the one set for the admin in the previous step.

11. At this point, it is possible to connect to the store as the root user. To login, you can use either the `-username <user> runadmin` argument or specify the `"oracle.kv.auth.username"` property in the security file.

In this example, the `oracle.kv.security` property is used. To login use the following command:

```
java -Xmx256m -Xms256m \  
-Doracle.kv.security=adminlogin \  
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 -host localhost  
Logged in admin as root >
```

The file `adminlogin.txt` should be a copy of the `client.security` file with additional properties settings for authentication. The file would then contain content like this:

```
oracle.kv.auth.username=root  
oracle.kv.auth.wallet.dir=KVR00T/security/login.wallet  
oracle.kv.transport=ssl  
oracle.kv.ssl.trustStore=KVR00T/security/client.trust  
oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1  
oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
```

For more information, see [User Login \(page 48\)](#).

---

## Chapter 4. Kerberos Authentication Service

Existing or new installations of Oracle NoSQL Database can be configured to use Kerberos as an external authentication service. Kerberos is an industry standard authentication protocol for large client/server systems.

Setting up and configuring a Kerberos deployment is beyond the scope of this chapter. This chapter assumes that you have a running Key Distribution Center (KDC) and realm setup.

This chapter first describes some Kerberos concepts and then shows you how to configure existing or new installations of Oracle NoSQL Database to use Kerberos as an external authentication service.

### Installation Prerequisites

Make sure that you have Kerberos V5 installed. Oracle NoSQL Database is compatible and tested with MIT Kerberos V5.

### Kerberos principal

A Kerberos Principal represents a unique identity in a Kerberos system to which Kerberos can assign tickets to access Kerberos-aware services. A service principal should be created for each Storage Node. Oracle NoSQL Database service principals follow this naming format: `<service_name>/instance@REALM`.

where:

- `service_name`

Is a case-sensitive string that represents the Oracle NoSQL Database service. The default value is `oraclenosql`.

All Oracle NoSQL Database service principals should use the same service name across different Storage Nodes.

- `instance`

Represents the service principal instance name. It is recommended to use the fully qualified domain name (FQDN) of the Storage Node where Oracle NoSQL Database is running.

If `instance` is not specified, the default principal will be created as `oraclenosql@REALM`.

- `REALM`

Represents the Kerberos realm name where the database service is registered. It must be specified in UPPERCASE and is typically the DNS domain name.

If no realm is given, the service principal is assumed to belong to the default realm, as configured in the Kerberos configuration file.

## Keytabs

A keytab is a file containing pairs of Kerberos principals and an encrypted copy of that principal's key.

Keytabs are used to authenticate a principal on a host to Kerberos.

### Note

Because having access to the keytab file for a principal allows one to act as that principal, access to the keytab files should be tightly secured.

## Kadmin and kadmin.local

Kadmin and kadmin.local are command-line interfaces to the Kerberos administration system.

In general, both interfaces provide the same functionality. When creating Kerberos principals and keytabs, you can use kadmin.local or kadmin depending on your access and account.

For more information, see the MIT Kerberos documentation [http://web.mit.edu/kerberos/krb5-latest/doc/admin/admin\\_commands/kadmin\\_local.html](http://web.mit.edu/kerberos/krb5-latest/doc/admin/admin_commands/kadmin_local.html).

## Kerberos Security Properties

To setup the Kerberos security properties, you can set them in a login file or through the KVStoreConfig class.

The minimal configuration needed to setup Kerberos includes setting the following properties:

- `oracle.kv.auth.username`

Specifies the Kerberos user name in Oracle NoSQL Database. It must match the principal name in KDC and match the Kerberos user account name created in the database. The client will use the value of this option to create the credential which is used in the client-server authentication. If the short name of principal is specified in this field, you must also specify `oracle.kv.auth.kerberos.realm`.

If KerberosCredentials is not used, this field has to be specified in the login file or security properties field of KVStoreConfig.

- `oracle.kv.auth.kerberos.services`

Specifies the Kerberos principals for services associated with each helper host. Setting this property is required if, as recommended, each host uses a different principal that includes its own principal name. All principals should specify the same service and realm. If this property is not set, the client will use `oraclenosql` as the principal name for services on all helper hosts.

Each entry should specify the helper host name followed by the Kerberos service name, and optionally an instance name and realm name. The entries are separated by commas,

ignoring spaces. If any entry does not specify a realm, each entry will use the default realm specified in Kerberos configuration file. If any entry specifies a realm name, then all entries must specify the same one. The syntax is:

```
host:service[:instance[@realm]][, host:service[:instance[@realm]]]*
```

For example:

```
host37:nosql/host37@EXAMPLE.COM,  
host53:nosql/host53@EXAMPLE.COM
```

- `oracle.kv.auth.kerberos.keytab`

The default location of the keytab file is specified by the Kerberos configuration file. If the keytab is not specified there, then the system looks for the file `user.home/krb5.keytab`.

- `oracle.kv.auth.kerberos.realm`

Specifies the Kerberos realm for the user principal if using a short name to specify the client login principal.

- `oracle.kv.auth.kerberos.ccache`

Specifies the path of the Kerberos ticket cache. This field is optional. The default ticket cache is `"/tmp/krbcc_<uid>"`. If the credential cache is not found, the system will look for the file `user.home/krb5cc_user.name`. If you want to use your own ticket cache, set this field to the path of the ticket cache.

- `oracle.kv.auth.kerberos.mutualAuth`

Specifies whether the client should use mutual authentication. If this value is set to true, the client will authenticate the server's identity in the login results.

The default value is false, so mutual authentication is disabled.

## Setting Security Properties in a security login file

To set the properties in a security file, specify the location of the login file by setting the `oracle.kv.security` Java system property. For example:

```
java -Doracle.kv.security=kerberoslogin.txt HelloWorld
```

where the file `kerberoslogin.txt` should be a copy of the `client.security` file with additional properties settings for Kerberos authentication. The file would then contain content like this:

```
oracle.kv.auth.username=krbuser@EXAMPLE.COM  
oracle.kv.auth.external.mechanism=kerberos  
oracle.kv.auth.kerberos.keytab=/kerberos/krb5.keytab  
oracle.kv.auth.kerberos.services=  
    node01:oraclenosql/node01.example.com@EXAMPLE.COM  
oracle.kv.auth.kerberos.mutualAuth=false
```

You can specify the location of the Kerberos configuration file by specifying the `java.security.krb5.conf` Java system property. For example:

```
java -Djava.security.krb5.conf=/kerberos/krb5.conf \  
-Doracle.kv.security=kerberoslogin.txt HelloWorld
```

You can also set the default realm using `java.security.krb5.realm`. To set the default kdc, use `java.security.krb5.kdc`.

## Note

Set the Java system properties for both the realm and the KDC or neither of them. These properties override the default realm and KDC values specified in the `krb5.conf` file.

## Setting Security Properties through KVStoreConfig

You can also set security properties using `KVStoreConfig`. For example:

```
Properties securityProps = new Properties();  
securityProps.setProperty("oracle.kv.auth.username",  
                           "krbuser@EXAMPLE.COM");  
securityProps.setProperty("oracle.kv.auth.external.mechanism", "kerberos");  
securityProps.setProperty("oracle.kv.auth.kerberos.keytab",  
                           "/kerberos/krb5.keytab");  
securityProps.setProperty("oracle.kv.auth.kerberos.services",  
                           "node01:oraclenosql/node01.example.com@EXAMPLE.COM");  
securityProps.setProperty("oracle.kv.auth.kerberos.ccache",  
                           "/kerberos/krbcc_501");  
securityProps.setProperty("oracle.kv.auth.kerberos.mutualAuth", "false");  
  
KVStoreConfig kvConfig = new KVStoreConfig("mystore", "node01:5000");  
kvConfig.setSecurityProperties(securityProps);
```

## Using security properties to login

To login to Oracle NoSQL Database using security properties, you can use credential cache, a keytab file or the principal password.

## Note

When connecting through the Admin CLI, if credential cache or keytabs login attempts fail, Oracle NoSQL Database prompts for the principal's password.

## Using credential cache

To login to Oracle NoSQL Database using credential cache:

1. Run the `kinit` Kerberos tool to save the credential in the credential cache.

For example, to authenticate the client principal `krbuser@EXAMPLE.COM` to KDC:

```
kinit krbuser@EXAMPLE.COM
```



```
Password for krbuser@EXAMPLE.COM: *****
```

The granted TGT will be saved in the default credential cache for later authentication.

2. You can also generate a separate cache. To do this run the following command:

```
kinit krbuser@EXAMPLE.COM -c krbcc_krbuser
```

3. Perform the login by specifying `oracle.kv.auth.kerberos.ccache` in a security login file or through `KVStoreConfig`. In this case, a security login file is used:

```
java -Xmx256m -Xms256m \  
-Doracle.kv.security=mylogin.txt \  
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 -host localhost  
Logged in admin as krbuser
```

The file `mylogin.txt` should be a copy of the `client.security` file with additional properties settings for Kerberos authentication. The file would then contain content like this:

```
oracle.kv.auth.kerberos.ccache=/kerberos/krbcc_krbuser  
oracle.kv.auth.username = krbuser@EXAMPLE.COM  
oracle.kv.auth.external.mechanism=kerberos  
oracle.kv.auth.kerberos.services=  
node01:oraclenosql/node01.example.com@EXAMPLE.COM  
oracle.kv.auth.kerberos.mutualAuth=false
```

In this case, Oracle NoSQL Database reads the credential cache and logs in to Kerberos without needing a password.

## Using a keytab

To login to Oracle NoSQL Database using a keytab:

1. Run the `kinit` Kerberos tool to extract the keytab:

```
kadmin.local: ktadd -k /tmp/mykeytab krbuser@EXAMPLE.COM  
Entry for principal krbuser@EXAMPLE.COM added to  
keytab WRFILE:/tmp/mykeytab.
```

2. Copy the keytab file to any client machine that will use the `krbuser@EXAMPLE.COM` principal to login automatically to Oracle NoSQL Database.
3. Set the Kerberos security properties, including the keytab file location, on each client by specifying them in a security file or through the `KVStoreConfig` class.

In this example, a security file (login) is used. To login, specify the keytab location by using `oracle.kv.auth.kerberos.keytab`. You must also specify the username using `oracle.kv.auth.username`. For example, the login file would then contain content like this:

```
oracle.kv.auth.kerberos.keytab = /kerberos/mykeytab  
oracle.kv.auth.username = krbuser@EXAMPLE.COM
```

```
oracle.kv.auth.external.mechanism=kerberos
oracle.kv.auth.kerberos.services=
    node01:oraclenosql/node01.example.com@EXAMPLE.COM
oracle.kv.auth.kerberos.mutualAuth=false
```

In this case, Oracle NoSQL Database reads the keytab and logs in to Kerberos without needing a password.

For more information on Kerberos security properties, see [Kerberos Security Properties \(page 24\)](#).

## JAAS programming framework integration

Oracle NoSQL Database allows client applications to integrate with programs using the Java Authentication and Authorization Service (JAAS) programming framework.

Use the `oracle.kv.jaas.login.conf.entryName` security property to specify the JAAS login configuration.

### Note

If a JAAS login configuration file is set, you cannot specify keytab or credential cache in security properties.

A login configuration file would then contain content like this:

```
oraclenosql {
    com.sun.security.auth.module.Krb5LoginModule required
    useKeyTab=true
    keyTab=test.keytab
    storeKey=true
    principal=krbuser
    doNotPrompt=false;
};
```

where `oraclenosql` is the value for `oracle.kv.jaas.login.conf.entryName`. This configuration file can be used for Kerberos login.

In the following example, assume the client application has already obtained the Kerberos credentials for user `krbuser` before it tries to connect to Oracle NoSQL Database. You do not have to specify security properties in the login file. You can specify the credentials using the `Subject.doAs` method:

```
final LoginContext lc =
    new LoginContext("oraclenosql", new TextCallbackHandler());

// Attempt authentication
lc.login();

// Get the authenticated Subject
final Subject subj = lc.getSubject();
```

```
// Specify configuration
final KVStoreConfig kvConfig =
    new KVStoreConfig("mystore", "nosql1:5000");

// Set security properties SSL needed
final Properties securityProps = new Properties();
securityProps.setProperty(KVSecurityConstants.TRANSPORT_PROPERTY,
    KVSecurityConstants.SSL_TRANSPORT_NAME);
securityProps.setProperty(KVSecurityConstants.SSL_TRUSTSTORE_FILE_PROPERTY,
    trustStore);
kvConfig.setSecurityProperties(securityProps);

// Set Kerberos properties
final Properties krbProperties = new Properties();

// Set service principal associated with helper host
krbProperties.setProperty(KVSecurityConstants.AUTH_KRB_SERVICES_PROPERTY,
    hostName + ":" + servicePrincipal);

// Set default realm name, because the short name
// for user principal is used.
krbProperties.setProperty(KVSecurityConstants.AUTH_KRB_REALM_PROPERTY,
    "EXAMPLE.COM");

// Specify Kerberos principal
final KerberosCredentials krbCreds =
    new KerberosCredentials("krbuser", krbProperties);

// Get store using credentials in subject
KVStore kvstore = Subject.doAs(
    subj, new PrivilegedExceptionAction<KVStore>() {
        @Override
        public KVStore run() throws Exception {
            return KVStoreFactory.getStore(kvConfig, krbCreds, null);
        }
    });
```

In this case, a `KerberosCredentials` instance is used to set the security properties needed to retrieve the credentials of the specified user principal from KDC.

## Performing a Secure Oracle NoSQL Database Installation with Kerberos

It is possible to add Kerberos to a new or an existing Oracle NoSQL Database secure installation.

At a high-level, to configure a Oracle NoSQL Database installation to use Kerberos, you first need to register Oracle NoSQL Database as a service principal in KDC and extract

corresponding keytab files on each database server node. Then, to allow client login, a user principal must be added in KDC and a mapped user account with the same name of principal needs to be created in the database. Finally, login can be performed through the CLI or the kvclient driver.

## Adding Kerberos to a New Installation

To install Oracle NoSQL Database with Kerberos authentication:

### Note

The following example assumes you have configured an admin/admin principal on the KDC and that you distributed its keytab (kadm5.keytab) to the Oracle NoSQL Database Storage Nodes. For more information, see [Configuring the Kerberos Administrative Utility \(page 80\)](#).

1. Run the makebootconfig utility with the `-store-security configure` and `-external-auth kerberos` flags to set up the basic store configuration with Kerberos security:

```
java -jar KVHOME/lib/kvstore.jar makebootconfig \  
-root KVR00T -port 5000 \  
-admin 5001 -host node01 -harange 5010,5020 \  
-capacity 3 \  
-store-security configure \  
-external-auth kerberos \  
-instance-name node01.example.com \  
-kadmin-keytab /kerberos/kadm5.keytab \  
-admin-principal admin/admin
```

2. In this example, `-store-security configure` is used, so the security configuration utility is run as part of the makebootconfig process and you are prompted for a password to use for your keystore file:

```
Enter a password for the Java KeyStore:
```

3. Enter a password for your store and then reenter it for verification. In this case, Oracle Wallet is used. Oracle Wallet and Kerberos support are only available in the Oracle NoSQL Database EE version.

```
Enter a password for the Java KeyStore: *****  
Re-enter the KeyStore password for verification: *****
```

4. In this case, `-kadmin-keytab` points to the admin/admin keytab file you distributed earlier. Once authenticated, the configuration tool will automatically generate some security related files:

```
Login Kerberos admin via  
keytab /kerberos/kadm5.keytab  
Adding principal oraclenosql/node01.example.com@EXAMPLE.COM  
Authenticating as principal admin/admin with  
keytab /kerberos/kadm5.keytab
```

```
Extracting keytab KVR00T/security/store.keytab
Created files:
security/security.xml
security/store.keys
security/store.trust
security/store.wallet/cwallet.sso
security/store.keytab
security/client.security
security/client.trust
```

5. In a multi-host store environment, the security directory and all files contained in it should be copied from the first node to each server that will host a Storage Node, to setup internal cluster authentication. For example, the following commands assume that the different nodes are visible and accessible on the current node (node01):

```
cp -R node01/KVR00T/security node02/KVR00T/
cp -R node01/KVR00T/security node03/KVR00T/
```

## Note

You may need to use a remote copying command, like `scp`, to do the copying if the files for the different nodes are not visible on the current node.

6. Run `makebootconfig` on the other two nodes to enable Kerberos authentication.

```
java -jar KVHOME/lib/kvstore.jar makebootconfig \
-root KVR00T -port 6000 \
-admin 5001 -host node01 -harange 6010,6020 \
-capacity 3 \
-store-security configure \
-external-auth kerberos \
-instance-name node02.example.com \
-kadmin-keytab /kerberos/kadm5.keytab \
-admin-principal admin/admin
```

```
java -jar KVHOME/lib/kvstore.jar makebootconfig \
-root KVR00T -port 7000 \
-admin 5001 -host node01 -harange 7010,7020 \
-capacity 3 \
-store-security configure \
-external-auth kerberos \
-instance-name node03.example.com \
-kadmin-keytab /kerberos/kadm5.keytab \
-admin-principal admin/admin
```

7. Start the Storage Node Agent (SNA) on each node:

```
nohup java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar start -root KVR00T&
```

When a newly created store with a secure configuration is first started, there are no user definitions available against which to authenticate access. In order to reduce

risk of unauthorized access, an admin will only allow you to connect to it from the host on which it is running. This security measure is not a complete safeguard against unauthorized access. It is important that you do not provide local access to machines running KVStore. In addition, you should perform the following steps soon after this step in order to minimize the time period in which the admin might be accessible without full authentication. For more information on maintaining a secure store see [Guidelines for Securing the Configuration \(page 64\)](#).

8. Start runadmin in security mode on the KVStore server host (node01). To do this, use the following command:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar \  
runadmin -port 5000 -host node01 \  
-security KVROOT/security/client.security  
Logged in admin as anonymous
```

9. Use the configure -name command to specify the name of the KVStore that you want to configure:

```
kv-> configure -name mystore  
Store configured: mystore
```

10. Register the user principal on the KDC. To do this, use kadmin or kadmin.local:

```
kadmin.local: addprinc krbuser@EXAMPLE.COM  
Enter password for principal: "krbuser@EXAMPLE.COM": *****  
Re-enter password for principal: "krbuser@EXAMPLE.COM": *****
```

11. After user principal is registered on KDC, create the user in Oracle NoSQL Database. The username needs to match the full principal name in the KDC (includes realm name). In this case, user krbuser is defined:

```
kv-> execute 'CREATE USER "krbuser@EXAMPLE.COM" IDENTIFIED EXTERNALLY'
```

For more information on user creation and administration, see [User Management \(page 45\)](#).

12. At this point, it is possible to connect to the store as the krbuser. To login, you can use credential cache, a keytab file or enter the principal password.

In this example, a keytab file is used. To do this, first extract the keytab of principal krbuser@EXAMPLE.COM on the KDC host by using kadmin.local.

```
kadmin.local: ktadd -k /tmp/mykeytab krbuser@EXAMPLE.COM  
Entry for principal krbuser@EXAMPLE.COM added to  
keytab WRFILE:/tmp/mykeytab.
```

13. Copy the keytab file to client machines that will use the krbuser@EXAMPLE.COM principal to login automatically to Oracle NoSQL Database.
14. Set the Kerberos security properties, including the keytab file location, on each client by specifying them in a security file or through the KVStoreConfig class.

In this example, a security file (mylogin.txt) is used. To login, specify the file location by using the `oracle.kv.security` property. For example:

```
java -Xmx256m -Xms256m \  
-Doracle.kv.security=mylogin.txt \  
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 -host localhost  
Logged in admin as krbuser
```

The file `mylogin.txt` should be a copy of the `client.security` file with additional properties settings for Kerberos authentication. The file would then contain content like this:

```
oracle.kv.auth.kerberos.keytab = kerberos/mykeytab  
oracle.kv.auth.username = krbuser@EXAMPLE.COM  
oracle.kv.auth.external.mechanism=kerberos  
oracle.kv.auth.kerberos.services=  
node01:oraclenosql/node01.example.com@EXAMPLE.COM  
oracle.kv.auth.kerberos.mutualAuth=false
```

In this case, Oracle NoSQL Database reads the keytab and logs in to Kerberos without needing a password.

For more information on Kerberos security properties, see [Kerberos Security Properties \(page 24\)](#).

## Adding Kerberos to an Existing Secure Installation

To add Kerberos to an existing Oracle NoSQL Database secure installation:

### Note

The following example assumes you have configured an admin/admin principal on the KDC and that you distributed its keytab (`kadm5.keytab`) to the Oracle NoSQL Database Storage Nodes. For more information, see [Configuring the Kerberos Administrative Utility \(page 80\)](#).

1. Shut down the KVStore instance:

```
java -Xmx256m -Xms256m \  
-jar KVHOME/lib/kvstore.jar stop \  
-root KVR00T
```

2. Use the `config add-kerberos` command to add Kerberos authentication:

```
java -jar KVHOME/lib/kvstore.jar securityconfig  
config add-kerberos -root KVR00T \  
-secdir security \  
-admin-principal admin/admin
```

```
Adding principal oraclenosql@EXAMPLE.COM  
Password for admin/admin: *****
```

```
Created files:
    security/store.keytab
Updated Kerberos configuration
```

## Note

When running this command, the securityconfig tool will verify the existence of the referenced files and will update the specified bootstrap configuration file to refer to the security configuration. This process is normally done with the KVStore instance stopped, and must be performed on each Storage Node of the store.

3. Start the Storage Node Agent (SNA) on each node:

```
nohup java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar start -root KVROOT&
```

4. Start runadmin in security mode on the KVStore server host (node01). To do this, use the following command:

```
java -Xmx256m -Xms256m \
-jar KVHOME/lib/kvstore.jar \
runadmin -port 5000 -host node01 \
-security KVROOT/security/client.security
Logged in admin as anonymous.
```

This command sets SSL as a connection method and names a copy of the generated truststore file (client.security). For more information on SSL properties, see [SSL communication properties \(page 43\)](#).

5. Register the user principal on the KDC. To do this, use kadmin or kadmin.local:

```
kadmin.local: addprinc krbuser@EXAMPLE.COM
Enter password for principal: "krbuser@EXAMPLE.COM": *****
Re-enter password for principal: "krbuser@EXAMPLE.COM": *****
```

6. After user principal is registered on KDC, create the user in Oracle NoSQL Database. The username needs to match the full principal name in the KDC (includes realm name). In this case, user krbuser is defined:

```
kv-> execute 'CREATE USER "krbuser@EXAMPLE.COM" IDENTIFIED EXTERNALLY'
```

For more information on user creation and administration, see [User Management \(page 45\)](#).

7. At this point, it is possible to connect to the store as the krbuser. To login, you can use credential cache, a keytab file or enter the principal password.

In this example, a keytab file is used. To do this, first extract the keytab of principal krbuser@EXAMPLE.COM on the KDC host by using kadmin.local.

```
kadmin.local: ktadd -k /tmp/mykeytab krbuser@EXAMPLE.COM
Entry for principal krbuser@EXAMPLE.COM added to
```



```
keytab WRFILE:/tmp/mykeytab.
```

8. Copy the keytab file to any client machine that will use the `krbuser@EXAMPLE.COM` principal to login automatically to Oracle NoSQL Database.
9. Set the Kerberos security properties, including the keytab file location, on each client by specifying them in a security file or through the `KVStoreConfig` class.

In this example, a security file (`mylogin.txt`) is used. To login, specify the file location by using the `oracle.kv.security` property. For example:

```
java -Xmx256m -Xms256m \  
-Doracle.kv.security=mylogin.txt \  
-jar KVHOME/lib/kvstore.jar runadmin -port 5000 -host localhost  
Logged in admin as krbuser
```

The file `mylogin.txt` should be a copy of the `client.security` file with additional properties settings for Kerberos authentication. The file would then contain content like this:

```
oracle.kv.auth.kerberos.keytab = kerberos/mykeytab  
oracle.kv.auth.username = krbuser@EXAMPLE.COM  
oracle.kv.auth.external.mechanism=kerberos  
oracle.kv.auth.kerberos.services=  
                                node01:oraclenosql/node01.example.com@EXAMPLE.COM  
oracle.kv.auth.kerberos.mutualAuth=false
```

In this case, Oracle NoSQL Database reads the keytab and logs in to Kerberos without needing a password.

For more information on Kerberos security properties, see [Kerberos Security Properties \(page 24\)](#).

---

## Chapter 5. External Password Storage

Depending on the type of store deployment, there are two ways passwords can be externally stored. For Enterprise Edition (EE) deployments, Oracle Wallet is used. For Community Edition (CE) deployments, a simple read protected clear-text password file is used.

In the most basic mode of operation, external passwords are used only by the server to track the keystore password. User passwords, which are stored securely within the database, can also be supplied during client authentication.

When a password store is used as a component of a login file, the alias that is used for either password store type should be the username to which the password applies. For example, for a user named root, the password should be stored under the alias root.

When a password store is used as part of the server, the alias keystore is used. The user password store should be a completely different file than the one in the security directory located under KVRROOT.

### Oracle Wallet

The following commands provide functionality to manipulate Oracle wallet stores within the securityconfig tool. These commands are available in EE only. For more information on the securityconfig tool, see [Configuring Security with Securityconfig \(page 5\)](#).

To create a new auto-login wallet, run the `wallet create` command:

```
wallet create
-dir <wallet directory>
```

Auto-login wallets store passwords in an obfuscated state. Access to the wallet is secured against reading by unauthorized users using the OS-level login.

To manipulate secrets (passwords), which are associated with a name (alias), run the `wallet secret` command:

```
wallet secret
-dir <wallet directory>
{-set | -delete} -alias <alias>
```

If the `-set` option is specified, the user is prompted for a new password for the specified alias and required to verify the new secret.

If the `-delete` option is specified, the secret is deleted from the store.

Special considerations should be taken if Oracle wallet is used and you are deploying your Oracle NoSQL Database. For more information, see [Guidelines for Deploying Secure Applications \(page 64\)](#).

### Password store file

The following commands are used to create and manipulate CE password store files within the securityconfig tool. CE password store files managed through this interface are never

password protected. For more information on the securityconfig tool, see [Configuring Security with Securityconfig \(page 5\)](#).

To create a new password store file, run the `pwdfile create` command:

```
pwdfile create  
-file <password store file>
```

To manipulate secrets (passwords), which are associated with a name (alias), run the `pwdfile secret` command:

```
pwdfile secret  
-file <password store file>  
{-set | -delete} -alias <alias>
```

If the user specifies the `-set` option, the user is prompted for a new password for the specified alias and required to verify the new password.

If the `-delete` option is specified, the alias is deleted from the store.

---

## Chapter 6. Security.xml parameters

This chapter describes the parameters that can be set to the security.xml configuration file. This file is generated by makebootconfig or securityconfig and tells the Oracle NoSQL Database server how to apply security.

The security.xml file specifies parameters that primarily control network communications. It contains top-level parameters, plus nested transport parameters. A transport is a grouping of parameter settings that are specific to a particular type of network connection.

### Note

A subset of all the configuration options listed below related to SSL can be specified through Java system properties, security file properties, or through the KVStoreConfig API. For more information, see [SSL communication properties \(page 43\)](#).

## Top-level parameters

The following top-level parameters can be set to the security.xml file:

- internalAuth

Specifies how internal systems authenticate. This parameter must be set to SSL.

- keystore

Identifies the keystore file within the security directory. This parameter is normally set to store.keys.

- keystoreType

Identifies the type of keystore that the keystore property references. If not set, the Java default keystore type is assumed.

- securityEnabled

To enable security this parameter must be set to true.

- certMode

Specifies the key/certificate management model in use. This must be set to "shared".

- truststore

Identifies the truststore file within the security directory. This is normally set to store.trust.

- keystoreType

Identifies the type of keystore that the truststore property references. If not set, the Java default keystore type is assumed.

- **walletDir**  
Identifies a directory within the security directory that contains a wallet password store, which in turn holds the password for the keystore.
- **passwordFile**  
Identifies a file within the security directory that contains a file password store, which in turn holds the password for the keystore.
- **krbServiceName**  
Specifies the service name of the Oracle NoSQL Database Kerberos service principal.
- **krbInstanceName**  
Specifies the service principal instance name.
- **krbServiceKeytab**  
Specifies the keytab file name in the security directory that contains the KVStore server service principal and encrypted copy of principal's key.
- **krbConf**  
Specifies the location of the Kerberos configuration file that contains the default realm and KDC information. If not specified, the default value is `/etc/krb5.conf`.
- **krbRealmName**  
Specifies the realm name of service principal. If not specified, this value is acquired from the Kerberos configuration file.
- **userExternalAuth**  
Specifies and enables the external mechanism used for authentication. Kerberos is supported. Set the value to `KERBEROS` to enable Kerberos authentication. To remove Kerberos authentication from a running store, set the value to `NONE`.

## Transport parameters

There are three standard transport types:

- **ha**  
Controls the communications between the data replication layer.
- **client**  
Controls most RMI communication.
- **internal**

Controls the SSL internal authentication mechanism.

The following parameters can be set and associated to a transport type:

- transportType

This parameter should be set to SSL.

- serverKeyAlias

The keystore alias that identifies the keypair used by the server end of a connection.

- clientKeyAlias

The keystore alias that identifies the keypair used by the client end of a connection.

- clientAuthRequired

Should always be true for ha and internal transports and should be false for client transports.

- clientIdentityAllowed

When clientAuthRequired is true, this specifies what client identification check should be applied. This should be set to dnmatch(XXX) where XXX is the Distinguished name from the client certificate.

- serverIdentityAllowed

This specifies what server verification should be performed. This should normally be set to dnmatch(XXX) where XXX is the Distinguished name from the server certificate.

- allowCipherSuites

This is a comma-delimited list of SSL/TLS cipher suites that should be considered for use. For valid options, see the Java JSSE documentation corresponding to your JDK version. If not specified, the JDK default set of cipher suites is allowed.

- allowProtocols

This is a comma-delimited list of SSL/TLS protocols that should be considered for use. For valid options, see the Java JSSE documentation corresponding to your JDK version. If not specified, the JDK default set of protocols is used.

- clientAllowCipherSuites

See allowCipherSuites for a description of the format. This parameter sets the cipher suite requirements only for the initiating side of a connection. If set, it overrides any setting of allowCipherSuites for the connection initiator.

- clientAllowProtocols

See allowProtocols for a description of the format. This parameter sets the protocol requirements only for the initiating side of a connection. If set, it overrides any setting of allowProtocols for the connection initiator.

---

## Chapter 7. Encryption

Encryption of network data provides data privacy so that unauthorized parties are not able to view plain text data as it passes over the network.

Oracle NoSQL Database uses SSL-based encryption to encrypt network traffic between applications and the server, command line-utilities and the server, as well as between server components.

### Note

JMX access requires the use of SSL. The web Admin interface does not operate over SSL.

## SSL model

Oracle NoSQL Database uses a simple SSL key management strategy. A single, shared, RSA key is used to protect communication. In this shared key model, you must be sure that there is a master copy of the security directory and that it gets copied to each server. You should not run `makebootconfig` with the `-store-security` configure option on all servers. Most servers should have the `-store-security enable` option specified in their `makebootconfig` command.

The shared key has an associated self-signed certificate with a Subject Distinguished Name that is not server-specific. The automatically-created certificates are generated with the Distinguished Name: `CN=NoSQL`.

Each server component listens on SSL interfaces and presents the shared certificate to clients and other servers that connect to it, as proof of its authenticity. Each client and server component uses a Java truststore containing a copy of the shared certificate to validate the certificate presented by servers.

When accessing a NoSQL instance that is secured using SSL/TLS, you must specify at least the following information:

1. You must specify that the client will connect using SSL. This is done by setting the security property `oracle.kv.transport` to "ssl".
2. You must specify the Java truststore file that is used to validate the server certificate. This is done by setting the security property `oracle.kv.ssl.trustStore`.

For example, to start `runadmin` in security mode use the following command:

```
java -Doracle.kv.security=mylogin.txt \  
-jar KVHOME/lib/kvstore.jar runadmin
```

where the file `mylogin.txt` should be a copy of the `client.security` file with additional properties settings for authentication. The file would then contain content like this:

```
oracle.kv.auth.username=root  
oracle.kv.auth.wallet.dir=login.wallet
```



```
oracle.kv.transport=ssl
oracle.kv.ssl.trustStore=client.trust
oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1
oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
```

## Note

If you fail to correctly specify the `oracle.kv.transport` property or the truststore, the client will fail to connect to the server.

## SSL communication properties

Assuming that the NoSQL server is secured by SSL, client connections from Oracle NoSQL Database administrative clients will need to connect over SSL as well. This can be achieved by providing security properties for the connection.

For Oracle-provided command line tools, a security file must be specified. The security configuration process automatically generates a basic security file (`client.security`) that can be used to connect to the store. You may wish to make a copy of this and modify it to include additional configuration properties.

The minimal configuration needed to connect to a secure store includes setting the following properties:

- `oracle.kv.transport=ssl`

Directs KVStore clients and utilities to connect to the KVStore RMI registry via SSL.

- `oracle.kv.ssl.trustStore=<path-to-ssl-truststore>`

Names a copy of the truststore file generated by `makebootconfig` or `securityconfig` to enable validation of the KVStore server SSL certificate.

## Note

You can use SSL to communicate an application with other SSL servers without using truststore-based certification validation.

In addition to the two properties listed above, the following properties are also supported for control of SSL communications:

- `oracle.kv.ssl.ciphersuites`

Specifies a comma-separated list of SSL cipher suites that should be allowed in communication with the server.

- `oracle.kv.ssl.protocols`

Specifies a comma-separated list of SSL protocols that should be allowed in communication with the server.

- `oracle.kv.ssl.trustStoreType`

Specifies the type of truststore being used. If not specified, the default type for the Java runtime is used.

### **Note**

Applications may also set these security properties through API methods on `KVStoreConfig`.

---

## Chapter 8. Configuring Authentication

Authentication means verifying the identity of someone (a user, server, or other entity) who wants to use data, resources, or applications. Validating that identity establishes a trust relationship for further interactions. Authentication also enables accountability by making it possible to link access and actions to specific identities.

Within a secure Oracle NoSQL Database, access to the database and internal APIs is generally limited to authenticated users. When a secure Oracle NoSQL Database is first started, there are no users defined, and login to the administrative interface is allowed without authentication. However, no data access operations can be performed without user authentication.

### User Management

Users can be created, modified or removed in the Oracle NoSQL Database through the admin CLI. The administrative commands of manipulating users are exposed in SQL format via DDL API. Information about a specific user account as well as a summary listing of registered users can also be displayed. For more information, see the next sections describing each user management operation .

### User Creation

To create a user, use the following command:

```
CREATE USER user_name (IDENTIFIED BY password
[PASSWORD EXPIRE] [PASSWORD LIFETIME duration] | IDENTIFIED EXTERNALLY)
[ACCOUNT LOCK|UNLOCK] [ADMIN]
```

where:

- `user_name`

The name of the user. If specifying a Kerberos user, the name must match the fully qualified principal name created in KDC.

Kerberos users need to have different names from existing users, as you cannot change the authentication type of an existing user.

- `IDENTIFIED` Clause

Indicate how Oracle NoSQL Database authenticates the users (currently by password). Kerberos users can be identified by using the `IDENTIFIED EXTERNALLY` clause instead.

- `BY password`

Create an Oracle NoSQL Database local user and indicates that the user must specify password to log on to the Oracle NoSQL Database.

### Note

The password must be quoted by double-quotation marks, for example, "123@abc".

- IDENTIFIED EXTERNALLY

Indicate that Oracle NoSQL Database will use an external mechanism to authenticate the user.

Kerberos is supported as an external authentication service.

- ACCOUNT Clause

Specify ACCOUNT LOCK to lock the user's account and disable access. Specify ACCOUNT UNLOCK to enable the user.

- ADMIN Clause

Specify ADMIN to make the user granted with sysadmin role by default.

- PASSWORD EXPIRE

Specify PASSWORD EXPIRE if you want the user's password to expire immediately on first login. This setting forces the user or the user having sysadmin role to change the password before the user can log in to the database.

- PASSWORD LIFETIME duration

Specify the duration that current password can be used for authentication.

```
duration: [0-9]+ unit
unit: S | M | H | SECONDS | MINUTES | HOURS | DAYS
```

A simple example to create an admin user Kate with password of "123":

```
kv-> execute 'CREATE USER Kate IDENTIFIED BY \"123\" ADMIN'
```

## Note

To create the first user in an Oracle NoSQL Database instance, you need to log in to the Admin CLI as an anonymous user and use the “plan create-user” command. To do this, see, [Performing a Secure Oracle NoSQL Database Installation \(page 11\)](#).

## User Modification

To alter a user, use the following command:

```
ALTER USER user_name [IDENTIFIED BY password
[RETAIN CURRENT PASSWORD]] [CLEAR RETAINED PASSWORD] [PASSWORD EXPIRE]
[PASSWORD LIFETIME duration] [ACCOUNT UNLOCK|LOCK]
```

where:

- user\_name

Name of user to alter. If specifying a Kerberos user, you can only alter the ACCOUNT clause options.

- IDENTIFIED Clause

Specify BY password to specify a new password for the user.

- RETAIN CURRENT PASSWORD

Used with BY password clause. If specified, causes the current password defined for the user to be remembered as a valid alternate password for a limited duration (24 hours by default), or until the password is explicitly cleared. Only one alternate password may be retained at a time. This option allows a password to be changed while an application is still running without affecting its operation.

- CLEAR RETAINED PASSWORD Clause

Erases the current alternate retained password.

- PASSWORD EXPIRE

Causes the user's password to expire immediately, then the user or the user having sysadmin role must change the password before attempting to log in to the database following the expiration.

- PASSWORD LIFETIME duration

Specify the duration that current password can be used for authentication.

```
duration: [0-9]+ unit  
unit: S | M | H | SECONDS | MINUTES | HOURS | DAYS
```

- ACCOUNT Clause

Specify ACCOUNT LOCK to lock the user's account and disable access. Specify ACCOUNT UNLOCK to enable the user.

## User Removal

```
DROP USER user_name
```

Use the DROP USER user\_name command to remove the specified user account (users cannot remove themselves):

where, user\_name is the name of user to drop.

For example:

```
kv->execute 'DROP USER Kate'
```

## User Status

```
SHOW [AS JSON] USERS | USER user_name
```

Use the SHOW USERS command to list all existing users in the system.

where, user\_name is the name of the registered user.

For example, we have created 3 users in the system:

```
kv-> execute 'SHOW USERS'
user: id=u1 name=Ken
user: id=u2 name=Kate
user: id=u3 name=Alice
```

## Note

These IDs are an internal mechanism for ensuring uniqueness, which will be increased sequentially.

If a user name is specified, view the detailed information of a user using the `SHOW USER user_name` command. For example:

```
kv-> execute 'SHOW USER Kate'
id=u2 name=kate enabled=true auth-type=LOCAL retain-passwd=inactive
granted-role=[public]
```

If a Kerberos user is specified, then the `auth-type` field shows `EXTERNAL`:

```
kv-> execute 'SHOW USER krbuser@EXAMPLE.COM'
user: id=u4 name=krbuser@EXAMPLE.COM enabled=true auth-type=EXTERNAL
retain-passwd=inactive granted-roles=[readwrite, public, sysadmin]
```

## User Login

You can use either the `-username <user>` or the `-security <path to security file>` `runadmin` argument to login to the admin CLI:

- `-username <user>`

Specifies the username to log in as. This option is used in conjunction with security properties like `oracle.kv.transport`.

- `-security <path-to-security-file>`

Specifies the security file that contains property settings for the login. Relative filename references within the security file are interpreted relative to the location of the security properties file. For example, if a security properties file contains the setting `oracle.kv.ssl.truststore=client.trust` then, the `client.trust` file should be in the same directory as the security properties file. If the file is named with an absolute path then it can be anywhere in the file system.

The following properties can be set in the file in addition to any of the SSL communication properties documented in the previous chapter:

```
oracle.kv.auth.username
oracle.kv.auth.wallet.dir
oracle.kv.auth.pwdfile.file
```

where the `oracle.kv.auth.wallet.dir` and `oracle.kv.auth.pwdfile.file` properties in this file indicate the location of an EE wallet directory or CE password store file, respectively.

## Note

The oracle.kv.security Java system property can be used as an alternative mechanism for providing a security file path. Setting this system property is equivalent to adding the -security option to the command line. This property is supported by all tools as well as by the KVStore client library.

## Password Management

The user can configure the lifetime of users' passwords, or make them expire immediately. When a password expires, the user needs to renew it to log in Oracle NoSQL Database successfully. The two ways to manage passwords from expiring are as follows:

- Explicit Expiration

It makes current password expire immediately as well as retained password if it exists. For this user, the password must be changed before attempting to log in the database.

For example:

```
kv->execute 'CREATE USER John IDENTIFIED BY \"123\" PASSWORD EXPIRE'
```

- Password Lifetime Configuration

If a user logs into the database with John's account, the user must input the new password for John.

```
Logged in admin as John
The password of John has expired, it is required to change the password.
Enter the new password:
Re-enter the new password:
```

Password lifetime limits the duration that current password can be used for authentication.

## Note

This configuration only works for current password but not the retained one.

For example:

```
kv->execute 'ALTER USER John PASSWORD LIFETIME 15 days'
```

In the example above, the current password for the user John will expire after 15 days. After expiration, if the user attempts to log into the database, the user will be prompted with a notification to change the password.

A retained password is used to allow a password to be changed while an application is still running without affecting its operation. It is only remembered by the system for a limited duration (24 hours) and there is no way to specify individual duration for each user. For retained password, only explicit expiration is supported using the following command:

```
kv->execute 'ALTER USER John CLEAR RETAINED PASSWORD'
```

## Sessions

When a user successfully logs in, it receives an identifier for a login session that allows a single login operation to be shared across Storage Nodes. That session has an initial lifetime associated with it, after which the session is no longer valid.

The server notifies the user with an error once the session is no longer valid. The application then needs to re-authenticate.

### Note

The KVStoreFactory API provides a reauthentication handler, which allows the reauthentication to be completed transparently, except for the delay in reauthentication processing.

If allowed, the Oracle NoSQL Database client will transparently attempt to extend session lifetime. For best results, your application should include logic to deal with reauthentication, as operational issues could prevent it from succeeding initially. In this way, you can avoid the use of extended logic in your application to reacquire a valid session state.

You can configure the behavior regarding session management to meet the needs of the application and environment. To do this, you can modify the following parameters using the `plan change-parameters` command: `sessionTimeout`, `sessionExtendAllowed` and `loginCacheTimeout`. For more information, see [Security Policy Modifications \(page 61\)](#)



---

## Chapter 9. Configuring Authorization

Oracle NoSQL Database provides role-based authorization which enables the user to assign kvstore roles to user accounts to define accessible data and allow database administrative operations for each user account.

Users can acquire desired privileges by role-granting. The user-defined role feature allows the user to create new roles using kvstore built-in privileges, and add new privilege groups to users by assigning newly-defined roles to users. You can grant users multiple roles.

For more information, see:

- [Privileges \(page 51\)](#)
- [Roles \(page 54\)](#)
- [Managing Roles, Privileges and Users \(page 56\)](#)

### Privileges

A privilege is an approval to perform an operation on one or more Oracle NoSQL Database objects. In Oracle NoSQL Database, all privileges fall into the two general categories:

- System privileges

This gives a user the ability to perform a particular action, or to perform an action on any data objects of a particular type.

- Object privileges

This gives a user the ability to perform a particular action on a specific object, such as a table.

### System Privileges

Oracle NoSQL Database provides the following system privileges, covering both data access and administrative operations:

- SYSDBA

Can perform Oracle NoSQL Database management, including table create/drop/evolve, index create/drop and Avro schema create/evolve.

- SYSVIEW

Can view/show system information, configuration and metadata.

- DBVIEW

Can query data object information. The object is defined as a resource in Oracle NoSQL Database, subject to access control. At present, you can have this privilege to query the table, index and Avro schema's information.

- **USRVIEW**  
Can query users' own information, like their own user information, the status of commands they issued.
- **SYSOPER**  
Can perform Oracle NoSQL Database system configuration, topology management, user privilege/role management, diagnostic and maintenance operations. Allows a role to perform cancel, execute, interrupt, and wait on any plan.
- **READ\_ANY**  
Can get/iterate keys and values in the entire store, including any tables.
- **WRITE\_ANY**  
Can put/delete values in the entire store, including any tables.
- **CREATE\_ANY\_TABLE**  
Can create any table in the store.
- **DROP\_ANY\_TABLE**  
Can drop any table from the store.
- **EVOLVE\_ANY\_TABLE**  
Can evolve any table in the store.
- **CREATE\_ANY\_INDEX**  
Can create any index on any table in the store.
- **DROP\_ANY\_INDEX**  
Can drop any index from any table in the store.
- **READ\_ANY\_TABLE**  
Can read from any table in the store.
- **DELETE\_ANY\_TABLE**  
Can delete data from any table in the store.
- **INSERT\_ANY\_TABLE**  
Can insert and update data in any table in the store.

## Object Privileges

The object privileges defined in Oracle NoSQL Database are:

- **READ\_TABLE**  
Can read from a specific table in the.
- **DELETE\_TABLE**  
Can delete data from a specific table in the store
- **INSERT\_TABLE**  
Can insert and update data to a specific table in the store.
- **EVOLVE\_TABLE**  
Can evolve a specific table.
- **CREATE\_INDEX**  
Can create indexes on a specific table.
- **DROP\_INDEX**  
Can drop indexes from a specific table.

For more information on the privileges required by the user to access specific KVStore APIs as well as CLI commands, see [KVStore Required Privileges \(page 72\)](#).

## Table Ownership

When you are using a secure store, tables are owned by the user that created them. A table's owner has by default full privileges to the table. That is, the owner has all the table object privileges.

### Note

For tables created in a non-secured store, or tables created prior to the 3.3 release, the table's owner is null.

Once a table is created, its owner cannot be changed. If a table is dropped and then recreated, all previously granted table privileges must be granted again.

Parent and child tables are required to have the same owner. However, table privileges are not automatically granted to the table's children. For example, if **READ\_TABLE** is granted to table `myTable`, then that privilege is not automatically granted to any of that table's children. To grant **READ\_TABLE** to the child tables, you must individually grant the privilege to each child table in turn.

A table's owner can grant or revoke all table privileges to or from other roles. To do this, use the **GRANT** DDL statement. (See [Grant Roles or Privileges \(page 58\)](#) for details.) To make a user other than the owner be able to read/insert/delete a specific table, two conditions must be met:

1. The user has the read/insert/delete privilege for the table in question; and
2. The user has the same privilege, or read privilege, for all parent tables of that table.

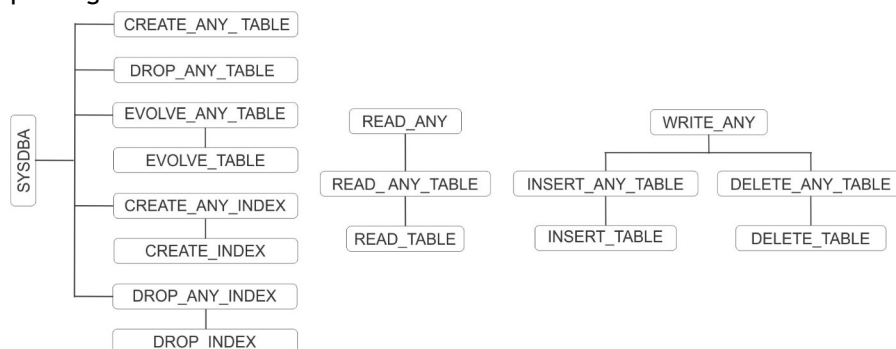
For example, for table `myTable` and its child `myTable.child1`, a non-owner user can only insert data to `myTable.child1` when she has insert privilege (or better) on `myTable.child1`, and read and/or insert privilege on `myTable`.

## Privilege Hierarchy

In Oracle NoSQL Database, there is a relationship between parts of existing privileges, called 'implications'. Implication means that a privilege may be a superset of some other privileges.

For example, Privilege A implies ( $\Rightarrow$ ) B means that privilege A has all the permissions defined in privilege B.

The following illustration depicts all implication relationship among Oracle NoSQL Database privileges:



## Note

All implications are transitive, that is, if  $A \Rightarrow B$  and  $B \Rightarrow C$ , then  $A \Rightarrow C$ .

## Roles

In Oracle NoSQL Database a role is a set of privileges that defines the authority and responsibility of users assigned to the role. Oracle NoSQL Database provides a set of system built-in roles. Users can create new roles to group together privileges or other roles.

## System Built-in Roles

The following system roles are predefined:

- `readonly`

Contains the `READ_ANY` privilege. Users with this role can read all data in the KVStore.

- `writeonly`

Contains the `WRITE_ANY` privilege. Users with this role can write to the entire KVStore.

- readwrite

Contains both the READ\_ANY and WRITE\_ANY privileges. Users with this role can both read and write the entire KVStore.

- dbadmin

Contains the SYSDBA privilege. Users with this role can execute data definition operations, including table, index and Avro schema administration.

- sysadmin

Contains the SYSDBA, SYSVIEW and SYSOPER privileges. Users with this role can execute the same operations as dbadmin, and have the ability of executing all Oracle NoSQL Database management tasks. A user created with the -admin option is granted with the sysadmin role besides the default public role.

- public

Contains the USRVIEW and DBVIEW privileges. A default role for all Oracle NoSQL Database users, which cannot be revoked. Users with this role can login to database, view and change their own user information, as well as check and operate the plans owned by them. Users with this role can also obtain a read-only view of the data object information, for example, table names, indices, and others.

## User-Defined Roles

Oracle NoSQL Database allows the user to create new roles using kvstore built-in privileges, and add new privilege groups to users by assigning defined roles to the users. To perform role and privilege granting and revocation operations, the user must have a role having SYSOPER privilege, for example, the sysadmin role.

To manage user-defined roles, use the following commands:

```
kv-> execute 'CREATE ROLE role_name'
```

```
kv-> execute 'DROP ROLE role_name'
```

### Note

The names of user-defined roles are case-insensitive, and are not the same as any existing privilege names or names of system built-in roles. Also, a reserved keyword cannot be used as a role name. For a list of reserved keywords, see Name Constraints in the *Table Data Definition Language Overview* appendix of the *Oracle NoSQL Database Getting Started with the Table API* guide.

The following example shows how to create user-defined roles and grant/revoke them to/from the users:

Create 2 users using the following commands:

```
kv-> execute 'CREATE USER Ken IDENTIFIED BY \"123\" '
```

```
kv-> execute 'CREATE USER Kate IDENTIFIED BY \"123\" '
```

Now, for example, create 2 roles - 'manager' with the 'write\_any' privilege and 'employee' with 'read\_any' privilege:

```
kv->execute 'CREATE ROLE manager'  
kv->execute 'GRANT WRITE_ANY TO manager'  
kv->execute 'CREATE ROLE employee'  
kv->execute 'GRANT READ_ANY TO employee'
```

Role 'employee' is granted to 'manager' (sub-role of manager). Then grant role manager to user Kate, who will have both 'manager' and 'employee' role. In this way, she can read and write any data to the store.

For example:

```
kv-> execute 'GRANT employee TO ROLE manager'  
kv-> execute 'GRANT manager TO USER Kate'
```

Use the following command to see the user's role status:

```
kv->execute 'SHOW USER Kate'  
id=u2 name=Kate enabled=true type=LOCAL retain-passwd=inactive  
granted-role=[public, manager]
```

Once the user drops a role, this role and its sub-roles will be revoked automatically from any users and user-defined roles having this role. However, all of its sub-roles will not be removed from the Oracle NoSQL Database.

For example:

```
kv->execute 'DROP ROLE manager'  
kv->execute 'SHOW USER Kate'  
id=u2 name=Kate enabled=true type=LOCAL retain-passwd=inactive  
granted-role=[public]
```

Now, the show roles command will list the roles in the system without the 'manager' role.

If the administrator decides to drop the 'manager' role, the role manager is revoked from the user Kate automatically as well as the role 'employee'. In the above example, Kate cannot perform any read or write operations.

## Note

Circular granting of roles is not allowed. For example, role 'manager' cannot be granted to role 'employee' if role 'employee' has previously been granted to role 'manager'.

## Managing Roles, Privileges and Users

Oracle NoSQL Database provides a set of declarative language of security operations, including the commands allowing to create, drop, show, grant or revoke roles to or from users, and

grant or revoke privileges to or from roles. All these statements can be executed via the “execute” command in Admin CLI, or the API of KVStore.execute() or KVStore.executeSync().

## Role Creation

```
CREATE ROLE role_name
```

Where, role\_name is the name of the role, which is case insensitive.

For example,

```
kv-> execute 'CREATE ROLE administrator'  
Statement completed successfully
```

## Role Removal

```
DROP ROLE role_name
```

Where, role\_name is the name of the role, which is case insensitive.

For example,

```
kv-> execute 'DROP ROLE administrator'  
Statement completed successfully
```

## Role Status

```
SHOW [AS JSON] ROLES | ROLE role_name
```

Where, role\_name is the name of the role.

List all available role names by running 'SHOW ROLES', or view the detailed information of a role if the role name is specified.

For example,

```
kv->execute 'SHOW ROLES'  
role:name=dbadmin  
role:name=public  
role:name=readonly  
role:name=readwrite  
role:name=sysadmin  
role:name=writeonly
```

The detailed information of a role can be viewed by specifying the role name:

```
kv->execute 'SHOW ROLE dbadmin'  
name=dbadmin assignable=true readonly=true  
granted-privileges=[SYSDBA, DBVIEW]
```

## Note

Assignable indicates whether this role can be explicitly granted to or revoked from a user.

Object privileges will appear in the form of PRIVILEGE(obj). For example, privilege of READ\_TABLE on table 'emp' will appear as:

```
kv->execute 'CREATE ROLE emptablereader'
kv->execute 'GRANT READ_TABLE ON emp TO emptablereader'
kv->execute 'SHOW ROLE emptablereader'
name=emptablereader assignable=true readonly=false
granted-privileges=[READ_TABLE(emp)]
```

## Grant Roles or Privileges

```
GRANT { grant_roles | grant_system_privileges
| grant_object_privileges }
grant_roles ::= role [, role]... TO { USER user | ROLE role }
grant_system_privileges ::=
{system_privilege | ALL PRIVILEGES}
[, {system_privilege | ALL PRIVILEGES}]...
TO role
grant_object_privileges ::=
{object_privileges| ALL [PRIVILEGES]}
[, {object_privileges| ALL [PRIVILEGES]}]...
ON object TO role
```

where:

- role  
The role that is granted.
- user  
The user to which the privileges are granted.
- system\_privileges  
The system privileges that are granted.
- object\_privileges  
The object privileges that are granted.
- object  
The object on which the privilege is granted. Currently only table privileges are supported.
- ALL PRIVILEGES  
Grants all of the system privileges. This is a shortcut for specifying all system privileges.
- ALL [PRIVILEGES]  
Grants all object privileges defined for the object. The keyword PRIVILEGES is provided for semantic clarity and is optional.



For example, to grant a role 'manager' to another role 'employee':

```
kv-> execute 'GRANT EMPLOYEE TO ROLE manager'
kv-> execute 'GRANT MANAGER TO USER Kate'
Statement completed successfully
```

If you repeat the command:

```
kv-> execute 'GRANT employee to ROLE manager'
```

You will receive an error of "Could not recursively grant role employee to role manager" because this would lead to a cyclic definition of role manager.

The user can now add new privileges to their defined role. For example:

```
kv-> execute 'GRANT READ_ANY TO Kate'
```

For example, to grant read permission on table T1 to Kate:

```
kv-> execute 'GRANT READ_TABLE on T1 TO Kate'
```

See also notes on granting table privileges in [Table Ownership \(page 53\)](#).

## Revoke Roles or Privileges

```
REVOKE { revoke_roles | revoke_system_privileges
| revoke_object_privileges}
revoke_roles ::= role [, role]... FROM { USER user | ROLE role }
revoke_system_privileges ::=
{ system_privilege | ALL PRIVILEGES }
[, {system_privilege | ALL PRIVILEGES}]...
FROM role
revoke_object_privileges ::=
{ object_privileges| ALL [PRIVILEGES] }
[, { object_privileges | ALL [PRIVILEGES] }]...
ON object FROM role
```

where:

- role

The role to revoke.

- user

The user from which the privileges are revoked.

- system\_privileges

The system privileges to revoke.

- object\_privileges

The object privileges to revoke.

- object

The table from which the privileges are revoked. Currently, the only objects supported are tables.

- ALL PRIVILEGES

Revokes all of the system privileges that have been granted to the revokee.

- ALL [PRIVILEGES]

Revokes all object privileges defined on the object from the revokee. The keyword PRIVILEGES is provided for semantic clarity and is optional.

For example, to revoke role 'employee' from role 'manager':

```
kv-> execute 'REVOKE employee FROM ROLE manager'  
Statement completed successfully
```

To revoke the role 'manager' from user 'Kate':

```
kv-> execute 'REVOKE manager FROM USER Kate'  
Statement completed successfully
```

---

## Chapter 10. Security Policies

The following default policies in Oracle NoSQL Database may be used to tailor system behavior to meet your security requirements:

- Login sessions have a limited duration of validity. After that duration has passed, the session needs re-authentication.
- Session login errors are tracked at the component level. Access to an account for a single client host is temporarily disabled if too many failed logins occur at that component within a configurable time duration.

### Note

Both of these behaviors can be customized by modifying the values of their respective security parameters. For more information, see the following section.

## Security Policy Modifications

You can use the `plan change-parameters` command in order to change a security policy in the system:

```
plan change-parameters -security <id>...
```

Security parameters are applied implicitly and uniformly across all SNs, RNs and Admins.

The following security parameters can be set:

- `sessionTimeout=<Long TimeUnit>`

Specifies the length of time for which a login session is valid, unless extended. The default value is 24 hours.

- `sessionExtendAllowed=<Boolean>`

Indicates whether session extensions should be granted. Default value is true.

- `accountErrorLockoutThresholdInterval=<Long TimeUnit>`

Specifies the time period over which login error counts are tracked for account lockout monitoring. The default value is 10 minutes.

- `accountErrorLockoutThresholdCount=<Integer>`

Number of invalid login attempts for a user account from a particular host address over the tracking period needed to trigger an automatic account lockout for a host. The default value is 10 attempts.

- `accountErrorLockoutTimeout=<Long TimeUnit>`

Time duration for which an account will be locked out once a lockout has been triggered. The default value is 30 minutes.

- loginCacheTimeout=<Long TimeUnit>

Time duration for which KVStore components cache login information locally to avoid the need to query other servers for login validation on every request. The default value is 5 minutes.

---

## Chapter 11. Audit Logging

Oracle NoSQL Database monitors and records security sensitive activities. These log messages are available through the SN-local log files and the store-wide logging view. High risky security activities are also visible by using the `show events` command.

### Security Log Messages

For ease of grepping and analysis, the auditing log message uses `KVAuditInfo` as a prefix. For example:

```
# General audit logging:
<Timestamp>: KVAuditInfo[user: <user_name>,
clienthost: <client_host>, operation:
<operation_description>, status: <SUCCESS/FORBIDDEN>,
reason: <failure_reason>]
```

```
# General audit logging:
# Particular logging for successful execution of plan:
<Timestamp>: KVAuditInfo[<plan_name>, owned by <plan_owner>,
executed by <plan_executor> from <client_host>,
state=<end state of plan execution>]
```

To distinguish security related messages from standard log messages, the following two security related logging levels are introduced:

- `SEC_WARNING`

Logs unauthenticated login, unauthorized read/write data access and unauthorized execution of CLI commands. Unauthenticated login does not log the reasons of failure.

- `SEC_INFO`

Logs the success of a user login and the successful execution of plans that require `dbadmin` or `sysadmin` role related privileges.

---

## Chapter 12. Keeping Oracle NoSQL Database Secure

This chapter provides a set of guidelines to keep your Oracle NoSQL Database secure. To maximize the security features offered by Oracle NoSQL Database, it is imperative that the database itself be well protected.

Security guidelines provide advice about how to securely configure Oracle NoSQL Database by recommending security practices for operational database deployments.

### Guidelines for Securing the Configuration

Follow these guidelines to keep the security configuration secure:

- The initial security configuration should be generated on a host that is not intended for KVStore operational use, using the `securityconfig create config` command.
- Storage Nodes should be deployed by running `makebootconfig` with the `-store-security enable` argument. The configured security directory from the reference host should be copied to the new Storage Node KVROOT using a secure copy mechanism prior to starting the store.
- The security configuration should be kept in a protected location for future use.
- Updates to the security configuration should be performed on the configuration host and copied to the operational Storage Node hosts using a secure copy mechanism.
- After the first user is configured but before allowing applications to use the store, you may wish to restart all SNA processes on hosts running Admin processes and then use the Admin CLI `show users` command to ensure that there is only the single user definition that is expected. This step validates that no other user creation occurred during the period when administrative login was not required.

### Guidelines for Deploying Secure Applications

Follow these guidelines when deploying your Oracle NoSQL Database and if the properties include `oracle.kv.auth.wallet.dir` in order to use Oracle wallet to hold a user password:

- Include the `kvstore-ee.jar` file in the application classpath.
- The `kvstore-ee.jar`, `oraclepki.jar`, `osdt_cert.jar`, `osdt_core.jar` files should all be made available on the application machine.

#### Note

`kvstore-ee` references the other files, so they do not need to be included in the classpath explicitly.

## Guidelines for Securing the SSL protocol

Follow these guidelines to keep the SSL protocol secure:

- When configuring SSL communication for your store, you should consider both performance and security.
- For a more secure store you should opt for higher security where possible.
- The Oracle JDK 7 supports TLSv1.2 as an SSL protocol level.

## Guidelines for using JMX securely

Follow these guidelines to securely use your Java Management Extensions (JMX) agent:

- If you enable JMX for a secure store, your JMX monitoring application must access the store using SSL.
- You should consult the configuration details for the JMX product you wish to use. In this case, you can use jconsole with a secure store by running the following command:

```
jconsole -J-Djavax.net.ssl.trustStore=/home/nosql/client.trust \  
node01:5000
```

where node01 is the registry host to be monitored and 5000 is the registry port configured for the Storage Node.

## Guidelines for Updating Keystore Passwords

Follow these steps to update the keystore passwords:

1. In the security directory on the configuration host run the keytool command. The keytool prompts for the current password and then for a new password to set.

```
keytool -storepasswd -keystore store.keys
```

2. If using a Password File store, skip ahead to the next step. To update the keystore password for wallets, use the following command:

```
java -jar KVHOME/lib/kvstore.jar securityconfig \  
wallet secret -directory store.wallet -set -alias keystore
```

Securityconfig will prompt for the new password. The new password should match the new one provided earlier to the keytool command.

3. If using Password File stores instead of wallets, use the following command to update the keystore password:

```
java -jar KVHOME/lib/kvstore.jar securityconfig \  
pwdfile secret -file store.pwd -set -alias keystore
```

Securityconfig will prompt for the new password. The new password should match the new one provided earlier to the keytool command.

4. Copy the updated store.keys file and either store.pwd or the contents of store.wallet to the security directory on each host and restart the Storage Node using the following commands:

```
java -jar KVHOME/lib/kvstore.jar stop -root KVROOT
```

```
java -jar KVHOME/lib/kvstore.jar start -root KVROOT&
```

## Guidelines for Updating Kerberos Passwords

The password of Kerberos principal should be periodically changed. To do this, you can either manually specify it by using `kadmin.local` or automatically randomize principal keys by using the `config renew-keytab` command of the `securityconfig` tool.

The syntax for this command is:

```
config renew-keytab -root < secroot > [-secdir <security dir>]  
[-keysalt <enc:salt[,enc:salt,..]>]  
[-kadmin-path <kadmin utility path>]  
[-instance-name <database instance name>]  
[-admin-principal <kerberos admin principal name>]  
[-kadmin-keytab <keytab file> ]  
[-kadmin-ccache <credential cache file>]
```

where:

- `-keysalt`

Sets the list of encryption types and salt types to be used for any new keys created. The default value is `des3-cbc-sha1:normal,aes128-cts-hmac-sha1-96:normal,arcfour-hmac:normal`.

- `-kadmin-path`

Indicates the absolute path of Kerberos `kadmin` utility. The default value is `/usr/kerberos/sbin/kadmin`.

- `-instance-name`

Specifies the service principal name. The default value is the fully qualified domain name (FQDN) of the Storage Node where Oracle NoSQL Database is running.

- `-admin-principal`

Specifies the principal used to login to the Kerberos admin interface. This is required while using `kadmin` keytab or password to connect to the admin interface.

- `-kadmin-keytab`

Specifies the location of a Kerberos keytab file that stores Kerberos admin user principals and encrypted keys. The security configuration tool will use the specified keytab file to login to the Kerberos admin interface.



You need to specify the `-admin-principal` flag when using `keytab` to login to the Kerberos admin, otherwise the correct admin principal will not be recognized. This flag cannot be specified in conjunction with the `-kadmin-ccache` flag.

- `-kadmin-ccache`

Specifies the complete path name to the Kerberos credentials cache file that should contain a service ticket for the `kadmin/ADMINHOST`. `ADMINHOST` is the fully-qualified hostname of the admin server or `kadmin/admin` service.

If not specified, the user is prompted to enter the password for principal while logging to the Kerberos admin interface. This flag cannot be specified in conjunction with the `-kadmin-keytab` flag.

To manually update the Kerberos principal password instead, you should follow these steps:

1. Use `kadmin.local` utility to change the service principal password:

```
kadmin.local: cpw nosql/myhost
Enter password for principal nosql/myhost@EXAMPLE.COM
Re-enter password for principal nosql/myhost@EXAMPLE.COM
```

2. Regenerate the keytab file for Oracle NoSQL Database service principal.

```
kadmin.local: ktadd -norandkey -k new.keytab
```

3. Copy the new keytab file for Oracle NoSQL Database service principal to each Storage Node. For example:

```
scp new.keytab kvuser@mystore:KVR00T/security/store.keytab
...
```

4. Validate the keytab file by comparing the key version number (kvno):

```
kadmin.local:getprinc nosql/myhost@EXAMPLE.COM
Principal: nosql/myhost@EXAMPLE.COM
Expiration date: [never]
Last password change: Thu Jun 04 03:16:38 UTC 2015
Password expiration date: [none]
Maximum ticket life: 1 day 00:00:00
Maximum renewable life: 0 days 00:00:00
Last modified: Thu Jun 04 03:16:38 UTC 2015 (root/admin@US.ORACLE.COM)
Last successful authentication: [never]
Last failed authentication: [never]
Failed password attempts: 0
Number of keys: 4
Key: vno 12, aes256-cts-hmac-sha1-96
Key: vno 12, aes128-cts-hmac-sha1-96
Key: vno 12, des3-cbc-sha1
Key: vno 12, arcfour-hmac
MKey: vno 1
```

```
Attributes:
Policy: [none]
Kadmin.local: quit
# klist -k new.keytab
KVNO Principal
-----
12 nosql/myhost@EXAMPLE.COM
12 nosql/myhost@EXAMPLE.COM
12 nosql/myhost@EXAMPLE.COM
12 nosql/myhost@EXAMPLE.COM
```

Client side user principals require similar password rotation. Keytab or credential cache used to login to the database should be renewed. If kinit tool is used to create a credential cache, you should run kdestroy to clear cached tickets and re-run kinit to generate a new credential cache.

For example:

```
# kdestroy -c /tmp/krb5ccache
# kinit -c /tmp/krb5ccache
```

## Guidelines for Updating the SSL key/certificate

Follow these steps to update the SSL key/certificate:

1. On the configuration host, run securityconfig to create a new configuration in a directory in parallel to the standard configuration directory.
2. On the configuration host, merge the truststore entries by using the config merge-trust command:

```
java -jar KVHOME/lib/kvstore.jar securityconfig \
config merge-trust -root <standard config dir> \
-source-root <new config dir>
```

3. In the security directory on the configuration host run the keytool command. The keytool prompts for the current password and then for a new password to set.

```
keytool -storepasswd -keystore store.keys
```

Securityconfig will prompt for the new password. The new password should match the new one provided earlier to the keytool command.

4. If using a Password File store, skip ahead to the next step. To update the keystore password for wallets, use the following command:

```
java -jar KVHOME/lib/kvstore.jar securityconfig \
wallet secret -directory store.wallet -set -alias keystore
```

Securityconfig will prompt for the new password. The new password should match the new one provided earlier to the keytool command.

5. If using Password File stores instead of wallets, use the following command to update the keystore password:

```
java -jar KVHOME/lib/kvstore.jar securityconfig \  
pwdfile secret -file store.pwd -set -alias keystore
```

Securityconfig will prompt for the new password. The new password should match the new one provided earlier to the keytool command.

6. Copy the updated store.keys file and either store.pwd or the contents of store.wallet to the security directory on each host and restart the Storage Node using the following commands:

```
java -jar KVHOME/lib/kvstore.jar stop -root KVROOT
```

```
java -jar KVHOME/lib/kvstore.jar start -root KVROOT&
```

## Guidelines for Operating System Security

Follow these guidelines regarding operating system security:

- There should be a single user identity that runs the KVStore software.
- The KVStore user should be in its own group, independent of other users.
- JE log files, audit log files, and password stores should have mode 0600 on Linux/UNIX platforms with equivalent settings for Windows systems. The simplest way to achieve this on Linux/UNIX is to set an umask of 0077.
- Security configuration files must be write-protected.
- The KVROOT directory and the security directory must be protected from modification by other users. On UNIX/Linux this should include having the sticky bit (01000) set in order to prevent renaming and deletion of files/directories.
- Access to the systems that are running KVStore should be limited in order to avoid the risk of tampering.

### Note

Access protections do not guard against users who have sufficiently elevated access rights (for example, the UNIX root user).

---

# Appendix A. SSL keystore generation

The keystores (store.keys and store.trust) that are automatically generated by makebootconfig or securityconfig can also be manually created using the following keytool commands:

To generate the keypair, use the keytool -genkeypair command:

```
keytool -genkeypair \  
-keystore store.keys \  
-storepass <passwd> \  
-keypass <passwd> \  
-alias shared \  
-dname "CN=NoSQL" \  
-keyAlg RSA \  
-keysize 1024 \  
-validity 365
```

To export the keypair, use the keytool -export command:

```
keytool -export \  
-file <temp file> \  
-keystore store.keys \  
-storepass <passwd> \  
-alias shared
```

To import the keypair, use the keytool -import command:

```
keytool -import \  
-file <temp file> \  
-keystore store.keys \  
-storepass <passwd> \  
-noprompt
```

You can also use the keytool commands described above to manually generate other keystore and truststore keys and substitute them for the ones that Oracle NoSQL Database generates, provided you adhere to the following rules:

- The store.keys file should have a key pair with the alias "shared".
- The store.keys store password (-storepass) must match the key password (-keypass)
- If a subject distinguished name other than CN=NoSQL is chosen for the self-signed certificate, then you must specify the following options to the makebootconfig or securityconfig command:

```
-param "ha:serverIdentityAllowed=dnmatch(SOMEDN)"  
-param "ha:clientIdentityAllowed=dnmatch(SOMEDN)"
```

```
-param "internal:serverIdentityAllowed=dnmatch(SOMEDN)"  
-param "internal:clientIdentityAllowed=dnmatch(SOMEDN)"  
-param "client:serverIdentityAllowed=dnmatch(SOMEDN)"
```

where SOMEDN is the distinguished name (-dname) chosen.

- The store password for store.trust should match the store password for store.keys.

---

# Appendix B. KVStore Required Privileges

This section lists the user required privileges to access specific KVStore APIs as well as CLI commands.

## Privileges for Accessing CLI Commands

READ\_ANY:

- get kv

READ\_ANY\_TABLE or READ\_TABLE (on \$table\_name):

- get table -name table\_name

WRITE\_ANY:

- delete kv
- put kv

INSERT\_ANY\_TABLE or INSERT\_TABLE (on \$table\_name):

- put table -name table\_name

DELETE\_ANY\_TABLE or DELETE\_TABLE (on \$table\_name):

- delete table -name table\_name

SYSDBA:

- ddl
- plan add-index
- plan add-table
- plan evolve-table
- plan remove-index
- plan remove-table

CREATE\_ANY\_TABLE:

- plan add-table

DROP\_ANY\_TABLE:

- plan remove-table

EVOLVE\_ANY\_TABLE or EVOLVE\_TABLE (on \$table\_name):

- plan evolve-table -name table\_name

CREATE\_ANY\_INDEX or CREATE\_INDEX (on \$table\_name):

- plan add-index -table table\_name

DROP\_ANY\_INDEX or DROP\_INDEX (on \$table\_name):

- plan remove-index -table table\_name

SYSVIEW:

- await-consistency
- logtail
- ping
- show admins
- show events
- show topology
- show upgrade-order
- show users (all users)
- show zones
- verify
- show parameters
- show perf
- show plans (plans created by all users)
- show pools
- show snapshots

DBVIEW:

- show indexes
- show schemas
- show tables

## USRVIEW:

- show users (for self)
- show plans (plans created by self)
- plan change-user (for self)

## DBVIEW and READ\_ANY:

- aggregate

## SYSOPER:

- change-policy
- configure
- plan change-parameters
- plan change-storagedir
- plan change-user (for all users)
- plan deploy-admin
- plan deploy-datacenter
- plan deploy-sn
- plan deploy-topology
- plan deploy-zone
- plan drop-user
- plan failover
- plan grant
- plan migrate-sn
- plan remove-admin
- plan remove-sn
- plan remove-zone
- plan repair-topology
- plan revoke
- plan start-service



- plan stop-service
- pool (all sub-commands)
- repair-admin-quorum
- snapshot (all sub-commands)
- topology (all sub-commands)

No privilege is required for the following commands:

- connect
- exit
- help
- hidden
- history
- verbose
- show faults
- table (all sub-commands)

Privilege required depends on the command being timed:

- time

Privilege required depends on the commands contained in the script file:

- load

Privilege required depends on the privilege needed for the plan being referred to:

- plan cancel
- plan execute
- plan interrupt
- plan wait

## Privileges for DDL Commands

SYSDBA:

- CREATE TABLE
- CREATE INDEX

- DROP INDEX

- DROP TABLE

- ALTER TABLE

CREATE\_ANY\_TABLE:

- CREATE TABLE

DROP\_ANY\_TABLE:

- DROP TABLE

EVOLVE\_ANY\_TABLE or EVOLVE\_TABLE (on \$table\_name):

- ALTER TABLE table\_name

CREATE\_ANY\_INDEX or CREATE\_INDEX (on \$table\_name):

- CREATE INDEX ON table\_name

DROP\_ANY\_INDEX or DROP\_INDEX (on \$table\_name):

- DROP INDEX ON table\_name

SYSOPER:

- CREATE USER

- CREATE ROLE

- DROP USER

- DROP ROLE

- ALTER USER

- GRANT

- REVOKE

DBVIEW:

- SHOW TABLE

- SHOW INDEX

- DESCRIBE TABLE

- DESCRIBE INDEX

SYSVIEW:

- SHOW USERS
- SHOW ROLES

USRVIEW:

- SHOW USERS (for self only)

## Privileges for Accessing KVStore APIs

Privilege(s) required: READ\_ANY, or READ\_TABLE/READ\_ANY\_TABLE if accessing key-values are in tables.

- get
- multiGet
- multiGetIterator
- multiGetKeys
- multiGetKeysIterator

### Note

For multi-XYZ and storeXYZiterator APIs, the parentKey may be null for scanning the whole store. In this case, if the user has no required roles, an empty result set will be returned rather than throwing the UnauthorizedException.

- storeIterator
- storeKeysIterator

Privilege(s) required: WRITE\_ANY, or DELETE\_TABLE/DELETE\_ANY\_TABLE if accessing key-values are in tables:

- delete
- deleteIfVersion
- multiDelete

Privilege(s) required: WRITE\_ANY, or INSERT\_TABLE/INSERT\_ANY\_TABLE if accessing key-values are in tables:

- put
- putIfAbsent
- putIfPresent
- putIfVersion

Privilege(s) required: DBVIEW

- getAvroCatalog

Privilege(s) required: None:

- getOperationFactory
- getStats

Privilege(s) required: Union of all required roles of each single operation in the operation list:

- execute

Privilege required depends on the privilege needed for the statement being executed:

- execute(String statement)
- executeSync(String statement)

## Privileges for Accessing KVStore TableAPIs

Privileges(s) required: READ\_TABLE/READ\_ANY\_TABLE:

- get
- multiGet
- multiGetKeys
- tableIterator
- tableKeysIterator

Privilege(s) required: DELETE\_TABLE/DELETE\_ANY\_TABLE:

- delete
- deleteIfVersion
- multiDelete

Privilege(s) required: INSERT\_TABLE/INSERT\_ANY\_TABLE:

- put
- putIfAbsent
- putIfPresent
- putIfVersion

Privilege(s) required: USRVIEW:

- getTable
- getTables

Privilege(s) required: None:

- getTableOperationFactory

Privilege(s) required: Union of all required roles of each single operation in the operation list:

- execute

## **Privileges for Accessing KvLargeObject APIs**

Privilege(s) required: READ\_ANY:

- getLOB

Privilege(s) required: READ\_ANY and WRITE\_ANY:

- appendLOB
- deleteLOB
- putLOB
- putLOBIfAbsent
- putLOBIfPresent

---

# Appendix C. Configuring the Kerberos Administrative Utility

Before using `kadmin`, you first need to configure permissions on the KDC. Kerberos uses an Access Control List (ACL) file to determine which principals have administrative access to the Kerberos database and their level of access.

The default location of the Kerberos ACL file is `<LOCALSTATEDIR>/krb5kdc/kadm5.acl`, where `LOCALSTATEDIR` is the directory prefix where the KDC databases are located. This location can be modified by the `acl_file` variable in `kdc.conf`.

Lines containing ACL entries have this format:

```
principal permissions [target_principal [restrictions] ]
```

## Note

Line order in the ACL file is important. The first matching entry will control access for an actor principal on a target principal.

To configure `kadmin`, perform the following steps:

1. Create an access control list file and put the Kerberos principal of at least one of the administrators into it. For example:

```
*/admin@EXAMPLE.COM *
```

In this case, any principal in the `EXAMPLE.COM` realm with an `admin` instance has all administrative privileges on the KDC.

For example, `joe/admin@EXAMPLE.com` has all privileges over the realm's Kerberos database.

2. Create the first principal before accessing the KDC remotely:

```
kadmin.local: addprinc -randkey admin/admin
kadmin.local: ktadd -k kadm5.keytab admin/admin
```

## Note

To enable passwordless authentication, copy `kadm5.keytab` to any client machine.

`Kadmin` can also be used to perform security maintenance. For more information, see [Guidelines for Updating Kerberos Passwords \(page 66\)](#).

---

# Appendix D. Manually Registering Oracle NoSQL Database Service Principal

The securityconfig tool allows you to create service principals and generate keytabs assuming that each Storage Node is able to access the Kerberos admin interface remotely. Although this is the typical configuration most Kerberos deployments have, you may want to use a non-standard configuration. You can manage service principals by using only kadmin.local or ktutil utility on the KDC host.

To register Oracle NoSQL Database service principal by using kadmin.local:

1. Register the service principal:

```
kadmin.local: addprinc -randkey nosql/abc.example.com
```

2. Extract the keytab file using the ktadd command:

```
kadmin.local: ktadd -norandkey -k keytab nosql/abc.example.com
```

3. Verify the entries of the generated keytab using the klist tool:

```
klist -k -e /tmp/keytab
Keytab name: FILE:keytab
KVNO Principal
-----
12  nosql/abc.example.com@EXAMPLE.COM
    (AES-128 CTS mode with 96-bit SHA-1 HMAC)
12  nosql/abc.example.com@EXAMPLE.COM
    (AES-256 CTS mode with 96-bit SHA-1 HMAC)
```

4. Copy the keytab of Oracle NoSQL Database server principal to each Storage Node. The default location is under kvroot/security. You need to create the security directory.
5. Run makebootconfig or securityconfig utility to complete the rest of the Kerberos security configuration.

To register Oracle NoSQL Database service principal by using ktutil utility:

1. Add principal entries:

```
ktutil: add_entry -password -p \
nosql/abc.example.com -k 1 -e aes128-cts-hmac-sha1-96
Password for nosql/abc.example.com@EXAMPLE.COM:
ktutil:add_entry -password -p nosql/abc.example.com \
-k 1 -e aes256-cts-hmac-sha1-96
Password for nosql/abc.example.com@EXAMPLE.COM
```

2. Write the current keylist into the keytab file:

```
Ktutil: write_kt keytab
```

3. Verify the entries of the generated keytab using the klist tool:

```
klist -k -e /tmp/keytab
Keytab name: FILE:keytab
KVNO Principal
-----
12  nosql/abc.example.com@EXAMPLE.COM
    (AES-128 CTS mode with 96-bit SHA-1 HMAC)
12  nosql/abc.example.com@EXAMPLE.COM
    (AES-256 CTS mode with 96-bit SHA-1 HMAC)
```

4. Copy the keytab of Oracle NoSQL Database server principal to each Storage Node. The default location is under kvroot/security. You need to create the security directory.
5. Run makebootconfig or securityconfig utility to complete the rest of the Kerberos security configuration.



---

# Appendix E. Third Party Licenses

All of the third party licenses used by Oracle NoSQL Database are described in the LICENSE.txt file, which you can find in your KVHOME directory.