IBM DB2 and Entrust KeyControl

Integration Guide

2024-12-20

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Chapter 1. Introduction

This document describes the integration of IBM DB2 with the Entrust KeyControl Key Management Solution (KMS). Entrust KeyControl can serve as a KMS to IBM DB2 using the open standard Key Management Interoperability Protocol (KMIP).

1.1. Documents to read first

This guide describes how to configure the Entrust KeyControl server as a KMS in IBM DB2.

To install and configure the Entrust KeyControl server as a KMIP server, see the *Entrust KeyControl nShield HSM Integration Guide*. You can access it from the Entrust Document Library and from the nShield Product Documentation website.

Also refer to the IBM DB2 online documentation.

1.2. Requirements

- Entrust KeyControl version 10.4.1 or later.

  An Entrust KeyControl license is required for the installation. You can obtain this license from your Entrust KeyControl and IBM DB2 account team or through Entrust KeyControl customer support.

- IBM DB2 Server 12.1 or later.

Entrust recommends that you allow only unprivileged connections unless you are performing administrative tasks.

1.3. High-availability considerations

Entrust KeyControl uses an active-active deployment, which provides high-availability capability to manage encryption keys. Entrust recommends this deployment configuration. In an active-active cluster, changes made to any KeyControl node in the cluster are automatically reflected on all nodes in the cluster. For information about Entrust KeyControl, see the Entrust KeyControl Product Overview.

1.4. Product configuration

The integration between the IBM DB2 Server and Entrust KeyControl has been successfully tested in the following configurations:

Product	Version
Linux	Red Hat 9
IBM DB2 Server	12.1
Entrust KeyControl	10.4.1

Chapter 2. Procedures

2.1. Installation overview

To integrate IBM DB2 with the Entrust KeyControl KMIP Vault - KMS:

1. Install the IBM DB2 server.
2. Install and configure KeyControl.
3. Set up a centralized KMIP keystore.
4. Configure the DB2 instance to use the keystore.
5. Verify that the encryption is working and that IBM DB2 is using KeyControl to manage the keys.
6. Configure the nShield HSM in the KeyControl Server.

2.2. Install the IBM DB2 server

Installing the IBM DB2 depends on the operating system on which you are installing it. See the IBM DB2 online documentation for details on how to install IBM DB2 in your environment.

To provide some background on the installation process performed for this guide, here is an example of a IBM DB2 installation on a Red Hat 9 Linux server.

2.2.1. Install Docker Engine on the IBM DB2 server

https://docs.docker.com/engine/install/rhel/

1. Uninstall Old Versions

```
% sudo dnf remove docker \
                  docker-client \
                  docker-client-latest \
                  docker-common \
                  docker-latest \
                  docker-latest-logrotate \
                  docker-logrotate \
                  docker-engine \
                  podman \
                  runc
```

2. Set up the repository

```
% sudo dnf -y install dnf-plugins-core
```

```
% sudo dnf config-manager --add-repo https://download.docker.com/linux/rhel/docker-ce.repo
```

3. Install docker packages

```
% sudo dnf install docker-ce docker-ce-cli containerd.io docker-buildx-plugin docker-compose-plugin
```

4. Start docker engine

```
% sudo systemctl enable --now docker
```

5. Verify that the installation is successful by running the hello-world image:

```
% sudo docker run hello-world
```

2.2.2. Install IBM DB2 on the server

https://www.ibm.com/docs/en/db2/12.1

1. Create a directory for the Docker image:

```
% mkdir Docker
```

2. Go to this Directory

```
% cd Docker
```

3. Pull the Docker image:

```
% sudo docker pull icr.io/db2_community/db2
```

4. Create an `.env_list` file with the following content:

```
LICENSE=accept
DB2INSTANCE=db2inst1
DB2INST1_PASSWORD=password
DBNAME=testdb
BLU=false
ENABLE_ORACLE_COMPATIBILITY=false
UPDATEAVAIL=NO
TO_CREATE_SAMPLEDB=false
REPODB=false
IS_OSXFS=false
PERSISTENT_HOME=true
HADR_ENABLED=false
ETCD_ENDPOINT=
ETCD_USERNAME=
```

```
ETCD_PASSWORD=
```

5. Run `db2server`:

```
% sudo docker run -h db2server --name db2server --restart=always --detach --privileged=true -p 50000:50000
--env-file .env_list -v /Docker:/database icr.io/db2_community/db2

a0157dd6b59127fde9c4a287436934161dd8da6fdb35b6800bfb3aa471d2925f
```

   Wait for five minutes to give time for the database to set up properly. If you need to troubleshoot, remove the `--detach` flag so you can see what is going on when the command executes.

6. Run the following command to access the DB2 instance that is running in your Docker container:

```
% sudo docker exec -ti db2server bash -c "su - db2inst1"

Last login: Fri Dec 13 15:44:12 UTC 2024
[db2inst1@db2server ~]$
```

7. Create a sample database:

```
% db2sampl -force -sql

  Creating database "SAMPLE"...
  Connecting to database "SAMPLE"...
  Creating tables and data in schema "DB2INST1"...

  'db2sampl' processing complete.
```

8. Connect to the sample database:

```
% db2 connect to sample

   Database Connection Information

 Database server        = DB2/LINUXX8664 12.1.0.0
 SQL authorization ID   = DB2INST1
 Local database alias   = SAMPLE

% db2 "select * from department"

DEPTNO DEPTNAME                             MGRNO  ADMRDEPT LOCATION
------ ------------------------------------ ------ -------- ----------------
A00    SPIFFY COMPUTER SERVICE DIV.         000010 A00      -
B01    PLANNING                             000020 A00      -
C01    INFORMATION CENTER                   000030 A00      -
D01    DEVELOPMENT CENTER                   -      A00      -
D11    MANUFACTURING SYSTEMS                000060 D01      -
D21    ADMINISTRATION SYSTEMS               000070 D01      -
E01    SUPPORT SERVICES                     000050 A00      -
E11    OPERATIONS                           000090 E01      -
E21    SOFTWARE SUPPORT                     000100 E01      -
```

```
F22    BRANCH OFFICE F2                    -      E01      -
G22    BRANCH OFFICE G2                    -      E01      -
H22    BRANCH OFFICE H2                    -      E01      -
I22    BRANCH OFFICE I2                    -      E01      -
J22    BRANCH OFFICE J2                    -      E01      -

  14 record(s) selected.
```

9. Drop the database that was created:

```
% db2 force applications all

DB20000I  The FORCE APPLICATION command completed successfully.
DB21024I  This command is asynchronous and may not be effective immediately.

% db2 drop db sample
DB20000I  The DROP DATABASE command completed successfully.
```

2.3. Install and configure KeyControl

Follow the installation and setup instructions in the *KeyControl nShield HSM Integration Guide*. You can access it from the Entrust Document Library and from the nShield Product Documentation website.

Make sure the KeyControl KMIP Vault gets created and certificates are generated for IBM DB2. These certificates are used in the configuration of the KMS described below.

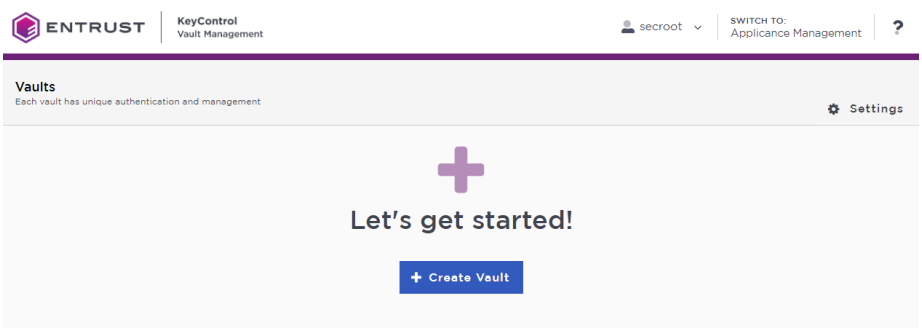
The following sections describe how to create the KeyControl KMIP Vault and certificates.

2.3.1. Create a KMIP Vault in the KeyControl Vault Server

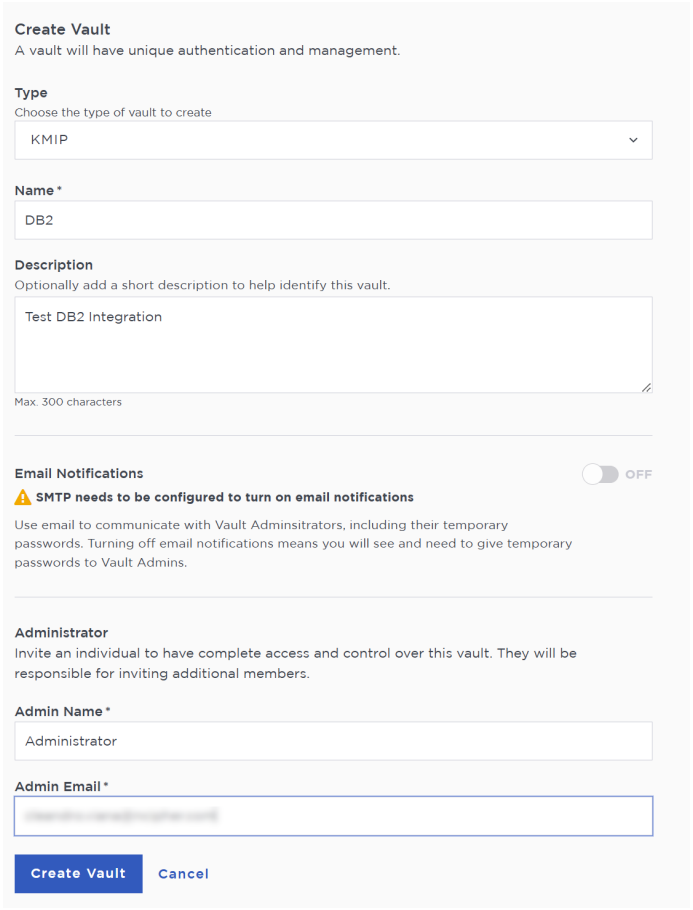
The KeyControl Vault appliance supports different type of vaults that can be used by all type of applications. This section describes how to create a KMIP vault in the KeyControl Vault Server.

For more information, see Creating a Vault in the KeyControl documentation.

1. Sign in to the KeyControl Vault Server webGUI. Use your browser to access the IP address of the server and sign in using the **secroot** credentials.
2. If you are not in **Vault Management**, select **SWITCH TO: Manage Vaults** in the Menu Header.
3. In **KeyControl Vault Management**, select **Create Vault**.

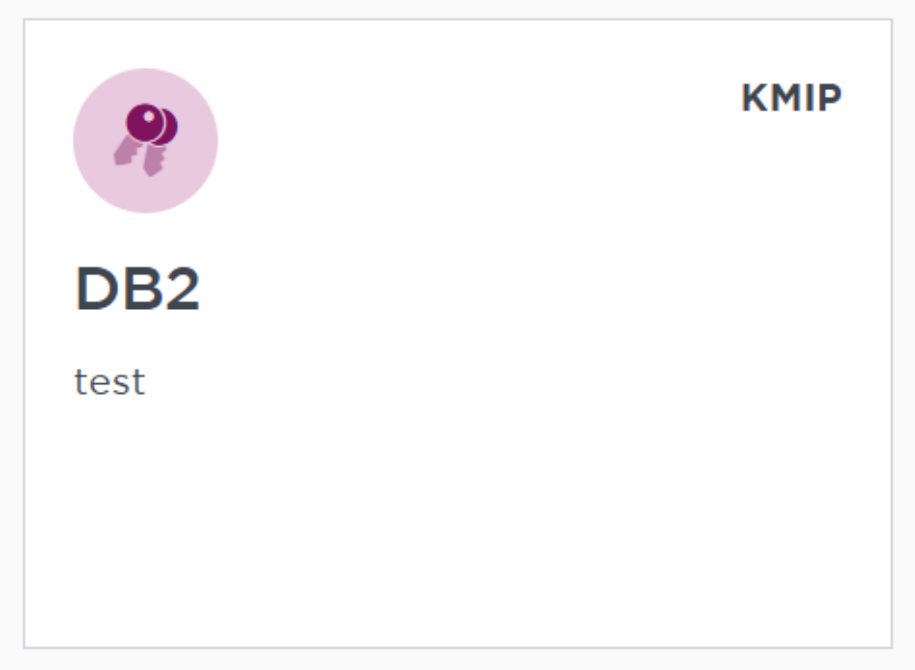


4. In the **Create Vault** page, create a **KMIP** vault.



   A temporary password will be emailed to the administrator's email address. This is the password that will be used to sign in for the first time to the KMIP vault's space in KeyControl. In a closed-gap environment where email is not available, the password for the user is displayed when you first create the vault. That can be copied and sent to the user.

5. Select **Create Vault**.
6. When the vault creation completed, select **Close**.
7. The new vault is added to the Vault dashboard and the KMIP server settings on the appliance are **enabled**.



2.3.2. KMIP server settings

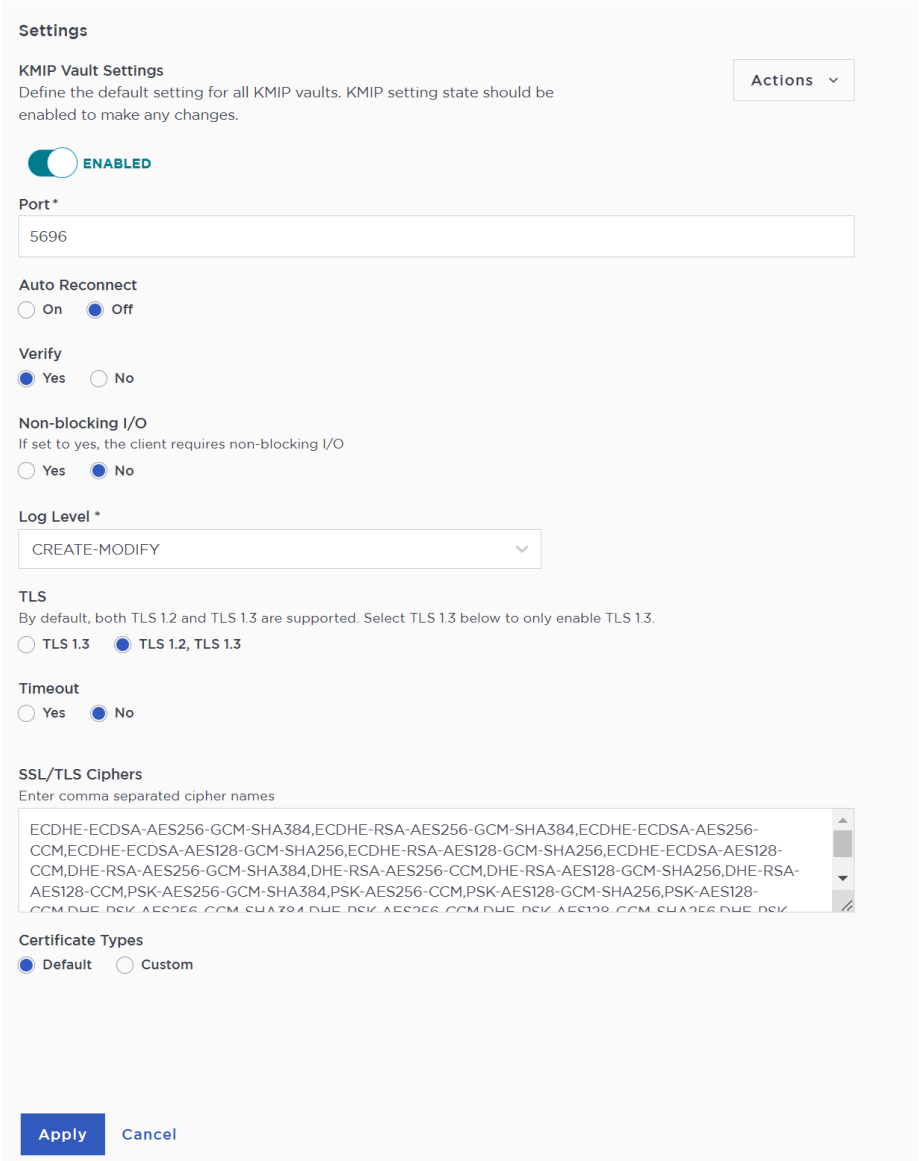
The KMIP server settings are set at the KeyControl appliance level and apply to all the KMIP vaults in the appliance. After a KMIP vault is created, it is automatically set to **ENABLED**.

To use external key management and configure the KeyControl Vault KMIP settings, refer to the KeyControl Vault for KMIP section of the admin guide.

When you are using external key management, as is the case in this solution, the KeyControl server is the KMIP server and the IBM DB2 server is the KMIP client.

1. Select the **Settings** icon on the top right to view/change the KMIP settings.

   The defaults settings are appropriate for most applications but you can change settings to suit your environment.



2. Select **Apply**.

2.3.3. Establish trust between the KeyControl Server and IBM DB2

Certificates are required to facilitate the KMIP communications from the KeyControl KMIP vault and the IBM DB2 application and conversely. The built-in capabilities in the KeyControl KMIP Vault are used to create and publish the certificates.

For more information on how to create a certificate bundle, refer to Establishing a Trusted Connection with a KeyControl Vault-Generated CSR.

Certificates are required to facilitate all KMIP communications between the

KeyControl Server and IBM DB2.

1. Sign in to the KeyControl webGUI using the **VAULT** URL.

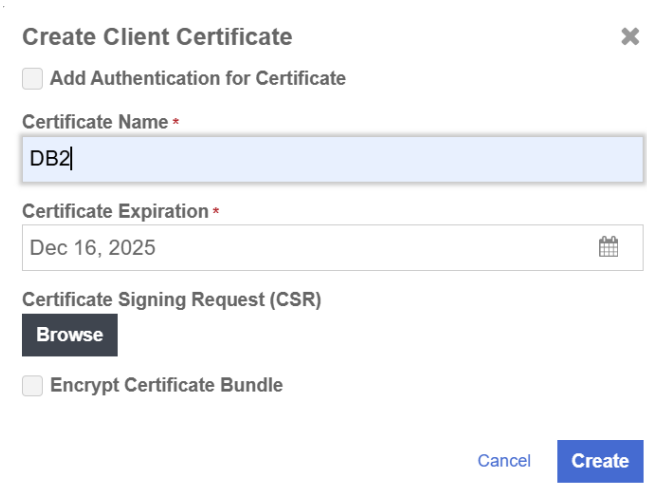
   Use the Administrator credentials that you created during the vault creation.

   > The **VAULT** URL was displayed at the end of the Create a KMIP Vault in the KeyControl Vault Server procedure. It is different from the URL of the standard KeyControl webGUI.

2. Select **Security**, then select **Client Certificates**.

   The **Manage Client Certificate** tab appears.

3. Select the **+** icon on the right to create a new certificate.
4. In the **Create Client Certificate** dialog:
   a. For **Certificate Name**, enter a name.
   b. For **Certificate Expiration**, set the date on which you want the certificate to expire.
   c. Accept the defaults for remaining properties. For example:



   d. Select **Create**.
5. Select the new certificate once it is created and then select **Download**.

   A .zip file downloads, which contains:

- A `<cert_name>.pem` file that includes both the client certificate and private key.

  The client certificate section of the `<cert_name>.pem` file includes the lines "`-----BEGIN CERTIFICATE-----`" and "`-----END CERTIFICATE-----`" and all text between them.

  The private key section of the `<cert_name>.pem` file includes the lines "`-----BEGIN PRIVATE KEY-----`" and "`-----END PRIVATE KEY-----`" and all text in between them.

- A `cacert.pem` file, which is the root certificate for the KMS cluster. It is always named `cacert.pem`.

These files will be used to establish trust between KeyControl and IBM DB2. In this example, the `<cert_name>.pem` file is called `DB2.pem` and the `cacert.pem` file is called `cacert.pem`.

For more information on how to create a certificate bundle, see Establishing a Trusted Connection with a KeyControl-Generated CSR.

2.4. Set up a centralized KMIP keystore

To set up a centralized keystore, with a key manager that is configured for the Key Management Interoperability Protocol (KMIP), for use with DB2 native encryption, you need to create a KMIP keystore configuration file.

After you have created the configuration file, you can enter parameter values to configure DB2 communication between the DB2 instance and the key manager. For more information, see Setting up a centralized KMIP keystore in the IBM documentation site.

2.4.1. Copy the Certificate Zip file you downloaded earlier to the DB2 Server.

1. Copy the KeyControl certificate zip file to the DB2 server:

```
% scp DB2_XXXX.zip xxxxx@10.XXX.XXX.XXX:/home/xxxxx/.
```

2. In the DB2 server, go to the folder that is mounted and used by the db2 Docker container so you can unzip the Certificate zip file there:

```
% cd /Docker/config/db2inst1
```

3. Unzip the certificates:

```
% sudo unzip ~/DB2*.zip

Archive:  /home/xxxxx/DB2_XXXXX.zip
  inflating: DB2.pem
  inflating: cacert.pem
```

4. Set the permissions so the files can be read inside the container:

```
% sudo chmod 777 DB2.pem
% sudo chmod 777 cacert.pem
```

2.4.2. Create the keycontrol-kmip.p12 and .sth files

1. Connect to the docker container running the DB2 server:

```
% sudo docker exec -ti db2server bash -c "su - db2inst1"

Last login: Fri Dec 13 15:44:12 UTC 2024
[db2inst1@db2server ~]$
```

2. Export the libraries for GSKit from the IBM DB2 installation directory:

```
% export LD_LIBRARY_PATH=/opt/ibm/db2/V12.1/lib64/gskit:$LIBPATH
% export PATH=/opt/ibm/db2/V12.1/gskit/bin:$PATH
```

3. Run the utility to create the `.p12` and `.sth` files.:

```
% mkdir temp
% cd temp
% gsk8capicmd_64 -keydb -create -db "keycontrol-kmip.p12" -pw "mypassword" -type pkcs12 -stash
% ls -al
-rw-------.  1 db2inst1 db2iadm1 1432 Dec 12 18:41 keycontrol-kmip.p12
-rw-------.  1 db2inst1 db2iadm1  193 Dec 12 18:41 keycontrol-kmip.sth
```

4. Add the client certificate and key to the SSL keystore.
   a. Copy the `DB2.pem` file to the `temp` directory.

      This is one of the certificate files that came in the certificate bundle that you downloaded from KeyControl. It was unzipped earlier into the db2inst1 user's home directory.

```
% cp ~/DB2.pem .
```

b. Add the client cert and key to the SSL keystore by running the following command:

```
% gsk8capicmd_64 -cert -add -db "keycontrol-kmip.p12" -stashed -label "keycontrol_app_cert" -file
"DB2.pem" -format ascii
```

c. Copy the `cacert.pem` file to the temp directory.

The file is typically located in the user's home directory. It was unzipped earlier into the db2inst1 user's home directory.

```
% cp ~/cacert.pem .
```

d. Import CA Certificate into the SSL keystore by running the following command:

```
% gsk8capicmd_64 -cert -add -db "keycontrol-kmip.p12" -stashed -label "trustedCA" -file cacert.pem
-format ascii -trust enable
```

5. List the certificates in the keystore.

```
% gsk8capicmd_64 -cert -list -db keycontrol-kmip.p12 -stashed

Certificates found
* default, - personal, ! trusted, # secret key
!       trustedCA
-       keycontrol_app_cert
```

6. Copy the `keycontrol-kmip.p12` and `keycontrol-kmip.sth` files to the location where they will be used by IBM DB2.

```
% sudo mkdir -p ~/security
% sudo cp keycontrol-kmip.p12 ~/security/.
% sudo cp keycontrol-kmip.sth ~/secuiryt/.
% sudo chmod 644 ~/security/*
% ls -al ~/security

-rw-r--r--. 1 db2inst1 db2iadm1 6066 Dec 16 15:21 keycontrol-kmip.p12
-rw-r--r--. 1 db2inst1 db2iadm1  193 Dec 16 15:21 keycontrol-kmip.sth
```

2.4.3. Create the KMIP keystore configuration file

To use DB2 native encryption to store your master key or keys in a centralized keystore using KMIP, you need to create a configuration file that lists details about

the keystore.

1. On the DB2 server, create the KMIP keystore configuration file in a text editor. For example:

```
VERSION=1
PRODUCT_NAME=OTHER
ALLOW_NONCRITICAL_BASIC_CONSTRAINT=TRUE
ALLOW_KEY_INSERT_WITHOUT_KEYSTORE_BACKUP=TRUE
SSL_KEYDB=/database/config/db2inst1/security/keycontrol-kmip.p12
SSL_KEYDB_STASH=/database/config/db2inst1/security/keycontrol-kmip.sth
SSL_KMIP_CLIENT_CERTIFICATE_LABEL=keycontrol_app_cert
PRIMARY_SERVER_HOST=XXX.XXX.XXX.126
PRIMARY_SERVER_KMIP_PORT=5696
CLONE_SERVER_HOST=XXX.XXX.XXX.127
CLONE_SERVER_KMIP_PORT=5696
```

   Attention should be given to the following keywords:

   ALLOW_NONCRITICAL_BASIC_CONSTRAINT

   Set it to TRUE, this allows DB2 to use local Certificate Authority within KMIP server that does not have a "critical" keyword set and avoids "414" error that is returned by GSKit.

   SSL_KEYDB

   This is the absolute path and name of the local keystore file that holds the TLS certificates for communication between the DB2 server and the KMIP key manager. (Required)

   SSL_KEYDB_STASH

   Absolute path and name of the stash file for the local keystore that holds the TLS certificates for communication between the DB2 server and the KMIP key manager. Default value: None. (Optional)

   SSL_KMIP_CLIENT_CERTIFICATE_LABEL

   The label of the TLS certificate for authenticating the client during communication with the KMIP key manager. This is the label you used when you created the keystore. (Required)

   PRIMARY_SERVER_HOST*

   Host name or IP address of the KMIP key manager. (Required)

   PRIMARY_SERVER_KMIP_PORT

   The KMIP TLS port of the KMIP key manager. (Required)

CLONE_SERVER_HOST

Host name or IP address of secondary KMIP keystore. Default value: None. You can specify up to five clone servers by repeating the `CLONE_SERVER_HOST` and `CLONE_SERVER_KMIP_PORT` parameter pairs in the configuration file, each host with a different value. Clone servers are considered read-only and are only used for retrieving existing master keys from the KMIP keystore. Clone servers are not used when inserting a new key, which occurs when an existing master key label has not been specified for the `CREATE DATABASE ENCRYPT` or `ADMIN_ROTATE_MASTER_KEY` commands, or for the `db2p12tokmip` executable. (Optional)

CLONE_SERVER_KMIP_PORT

The KMIP TLS port of the secondary KMIP keystore. Default value: None. (Optional)

For a list of the keywords that can be used in this configuration file, see the IBM documentation at https://www.ibm.com/docs/en/db2/12.1?topic=keystore-kmip-configuration-file

2. Name this file `kmipdb2config.txt` and copy it to where the `.p12` and `.sth` files are.

```
% sudo cp kmipdb2config.txt ~/security/.
```

2.5. Configure the DB2 instance to use the keystore

After the keystore is configured, it is ready to be used by DB2. First, add the location of the configuration files and enable the configuration. To configure a DB2 instance to use a keystore for native encryption, you need to set two database manager configuration parameters:

- `KEYSTORE_TYPE`
- `KEYSTORE_LOCATION`

For a centralized keystore, where the key manager product uses the Key Management Interoperability Protocol (KMIP), set `KEYSTORE_TYPE` to `KMIP`, and set `KEYSTORE_LOCATION` to the absolute path and file name of the centralized keystore configuration file.

1. Connect to the docker container running the DB2 server if not connected yet.

```
% sudo docker exec -ti db2server bash -c "su - db2inst1"
```

```
Last login: Fri Dec 13 15:44:12 UTC 2024
[db2inst1@db2server ~]$
```

2. Update the database parameters:

```
% db2 update dbm cfg using keystore_location /database/config/db2inst1/security/kmipdb2config.txt
keystore_type kmip

DB20000I  The UPDATE DATABASE MANAGER CONFIGURATION command completed
successfully.
SQL1362W  One or more of the parameters submitted for immediate modification
were not changed dynamically. Client changes will not be effective until the
next time the application is started or the TERMINATE command has been issued.
Server changes will not be effective until the next DB2START command.
```

3. Restart DB2 again so that the keystore changes take effect:

```
% db2stop

12/16/2024 15:28:05     0   0   SQL1064N  DB2STOP processing was successful.
SQL1064N  DB2STOP processing was successful.

% db2start

12/16/2024 15:28:32     0   0   SQL1063N  DB2START processing was successful.
SQL1063N  DB2START processing was successful.
```

4. Verify that `dbm cfg` is set correctly by running the following command.

```
% db2 get dbm cfg | grep Keystore

 Keystore type                           (KEYSTORE_TYPE) = KMIP
 Keystore location                   (KEYSTORE_LOCATION) =
/database/config/db2inst1/security/kmipdb2config.txt
```

   Look at value of `KEYSTORE_TYPE` and `KEYSTORE_LOCATION`.

2.6. Verify that the encryption is working and that IBM DB2 is using KeyControl to manage the keys

Now that IBM DB2 is configured to use KeyControl, check that encryption is working and KeyControl is used.

Before starting, connect to the docker container running the DB2 server if not connected yet.

```
% sudo docker exec -ti db2server bash -c "su - db2inst1"

Last login: Fri Dec 13 15:44:12 UTC 2024
```

```
[db2inst1@db2server ~]$
```

2.6.1. Reset connections

Reset all connections in the database first.

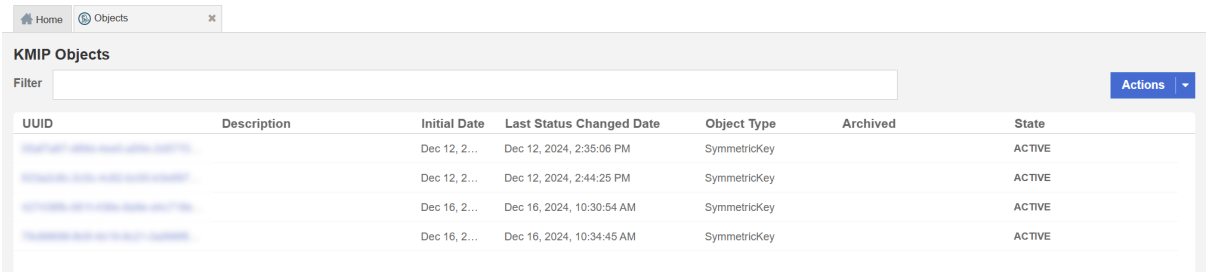
```
% db2 QUIESCE DATABASE IMMEDIATE FORCE CONNECTIONS;

SQL1224N  The database manager is not able to accept new requests, has
terminated all requests in progress, or has terminated the specified request
because of an error or a forced interrupt.  SQLSTATE=00000

% db2 CONNECT RESET

DB20000I  The SQL command completed successfully.
```

2.6.2. Create an encrypted database

Try to create an encrypted database:

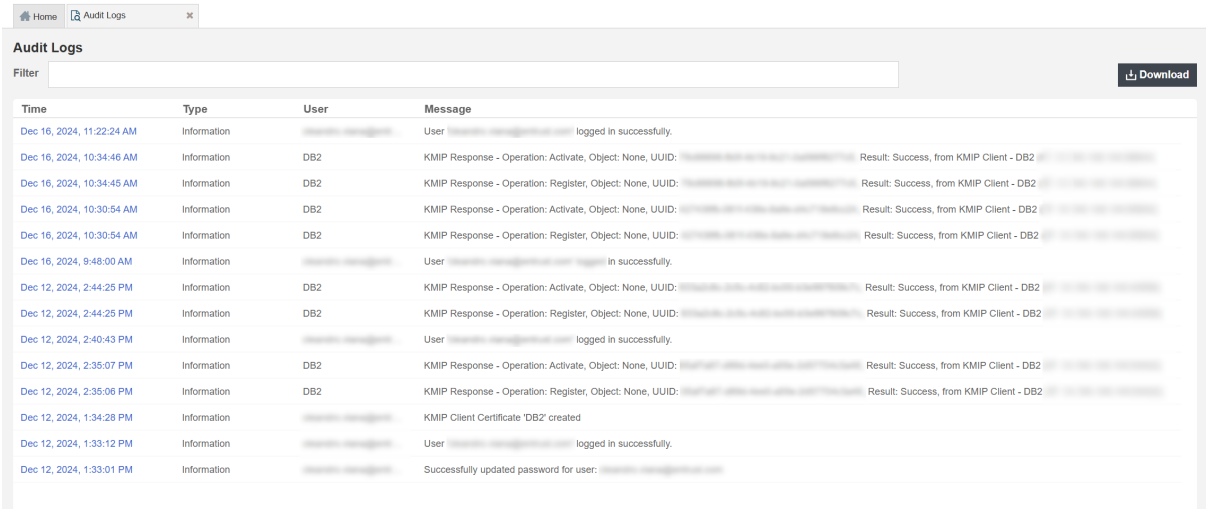
```
% db2 create db mydb1 encrypt

DB20000I  The CREATE DATABASE command completed successfully.
```

To confirm that the master key was successfully created, sign in to KeyControl using the Tenant URL (KMIP credentials) and look at **KMIP Objects** as shown below.



Additionally, you can use the `db2diag` program on the DB2 server to see the operational status.

You can find the Activity logs about the key creation on the **Audit Logs** page in KeyControl. For example:



With KeyControl you will see a complete audit trail every time the key is retrieved. You will also have complete control on these keys and you can revoke access to a key or disable it, in case you want to lock down your data at rest.

The **Objects** tab in the KeyControl UI as described in the Managing KMIP Objects section of the Entrust KeyControl admin guide.

If you try to create the encrypted database and it fails with return code 414, the certificate is not valid:

```
SQL1782N  The command or operation failed because an error was encountered
accessing the centralized key manager. Reason code "5:414".
```

Either the local certificate or the peer certificate is not valid.

Use the following command to validate the certificates. Do this as the user who created the SSL Store and in the same directory where the SSL store files are located:

```
% cd ~/security
% gsk8capicmd_64 -cert -validate -db keycontrol-kmip.p12 -stashed

trustedCA : OK
keycontrol_app_cert : CTGSK2052W An invalid basic constraint extension was found.
Additional untranslated info: GSKKM_VALIDATIONFAIL_SUBJECT: GSKNativeValidator:: [IssuerName=]CN=HyTrust
KeyControl Certificate Authority,O=HyTrust Inc.,C=US[Serial#=]60da35b2[SubjectName=]CN=HyTrust KeyControl
Certificate Authority,O=HyTrust Inc.,C=US[Class=]GSKVALMethod::PKIX[Issuer=]CN=HyTrust KeyControl Certificate
Authority,O=HyTrust Inc.,C=US[#=]60da35b2[Subject=]CN=HyTrust KeyControl Certificate Authority,O=HyTrust
Inc.,C=US
CTGSK2052W An invalid basic constraint extension was found.
```

To address this issue, add the following option to the KMIP keystore configuration file:

```
ALLOW_NONCRITICAL_BASIC_CONSTRAINT=TRUE
```

The encrypted database can then be created.

2.6.3. Rotate the Master Key in KeyControl with IBM DB2

1. List your DB directory:

```
% db2 list db directory

 System Database Directory

 Number of entries in the directory = 2

Database 1 entry:

 Database alias                       = TESTDB
 Database name                        = TESTDB
 Local database directory             = /database/data
 Database release level               = 16.00
 Comment                              =
 Directory entry type                 = Indirect
 Catalog database partition number    = 0
 Alternate server hostname            =
 Alternate server port number         =

Database 2 entry:

 Database alias                       = MYDB1
 Database name                        = MYDB1
 Local database directory             = /database/data
 Database release level               = 16.00
 Comment                              =
 Directory entry type                 = Indirect
 Catalog database partition number    = 0
 Alternate server hostname            =
 Alternate server port number         =
```

2. Connect the DB to the same database:

```
% db2 connect to MYDB1

   Database Connection Information

 Database server        = DB2/LINUXX8664 12.1.0.0
 SQL authorization ID   = DB2INST1
 Local database alias   = MYDB1
```

3. Check the encryption information:

```
% db2 "select * from table(sysproc.admin_get_encryption_info())"


OBJECT_NAME
OBJECT_TYPE          ALGORITHM        ALGORITHM_MODE   KEY_LENGTH MASTER_KEY_LABEL
KEYSTORE_NAME
```

```
KEYSTORE_TYPE        KEYSTORE_HOST
KEYSTORE_PORT KEYSTORE_IP                              KEYSTORE_IP_TYPE PREVIOUS_MASTER_KEY_LABEL
AUTH_ID
APPL_ID
ROTATION_TIME
------------------------------------------------------------------------------------------------------------------
------------------- ------------------- --------------- --------------- ----------
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MYDB1
DATABASE             AES              CBC                     256 DB2_SYSGEN_db2inst1_MYDB1_2024-12-16-
15.30.54_A4E769D6
/database/config/db2inst1/security/kmipdb2config.txt
KMIP                 10.194.148.126
5696                                        Unknown IP Type  DB2_SYSGEN_db2inst1_MYDB1_2024-12-16-
15.30.54_A4E769D6
DB2INST1
*LOCAL.db2inst1.241216153054
2024-12-16-15.30.54.000000

  1 record(s) selected.
```

4. Rotate the master key from DB2.

```
% db2 "CALL SYSPROC.ADMIN_ROTATE_MASTER_KEY (NULL)"


  Value of output parameters
  --------------------------
  Parameter Name  : LABEL
  Parameter Value : DB2_SYSGEN_db2inst1_MYDB1_2024-12-16-15.34.45_7E908063

  Return Status = 0
```

5. When the key is rotated, check on KeyControl if the Master Key is rotated.

   You will find a new key created in KeyControl.

6. For the new key to take effect, stop and start db2.

```
% db2stop
% db2start
```

2.6.4. Test access only when KeyControl is available

1. Stop the network services on the IBM DB2 server and try to connect to the database:

```
% db2 connect to MYDB1
```

   If KeyControl is not available, the database fails to connect.

2. Restart Network services on the IBM DB2 server and try to connect to the database:

```
% db2 connect to MYDB1

   Database Connection Information

 Database server        = DB2/LINUXX8664 12.1.0.0
 SQL authorization ID   = DB2INST1
 Local database alias   = MYDB1
```

   All databases that are encrypted using KeyControl are only accessible when KeyControl is available and Master Key is found.

2.6.5. Validate access when a KeyControl node in the cluster is not available

1. Bring down one of the KeyControl nodes and validate you can access the encrypted database.
2. Attempt to connect to the database when one of the KeyControl nodes in the cluster is down:

```
% db2 connect to MYDB1

   Database Connection Information

 Database server        = DB2/LINUXX8664 12.1.0.0
 SQL authorization ID   = DB2INST1
 Local database alias   = MYDB1
```

When one of its nodes is down, the KeyControl cluster goes out of `Healthy` status. New keys can only be created when the cluster is in `Healthy` status. Therefore, rotating keys should not be attempted when one of the nodes in the cluster is down.

2.7. Configure the nShield HSM in the KeyControl Server

It is important to note that if you want to use an HSM to further protect the keys using KeyControl, you can configure the HSM in KeyControl. Follow the installation and setup instructions in the `KeyControl nShield 10.4.1 HSM Integration Guide`.

Chapter 3. Additional resources and related products