Cloudera Data Warehouse on premises 1.5.5

Securing Cloudera Data Warehouse on premises

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Contents

Authenticating users in Cloudera Data Warehouse on premises

Cloudera Data Warehouse supports LDAP and Kerberos for authenticating users to access databases and tables from Business Intelligence (BI) clients and tools such as Hue, Beeline, Impyla, Impala-shell, and other JDBC clients.

Note: Hive and Impala Virtual Warehouses can use LDAP or Kerberos for authentication, simultaneously, without any pre-configuration.

Authentication using LDAP

If you use LDAP to authenticate users connecting to a Virtual Warehouse from a client shell such as Beeline, Impyla, Impala-shell, and so on, then you must create Bind users. However, the Bind users must either specify the username and password inline with the command or after submitting the command from the client.

Note: You can now use an unsecured LDAP server for authenticating users in the Impala Virtual Warehouse. Cloudera Data Warehouse uses the LDAP configurations that you have configured in the Cloudera Management Console.

Authentication using Kerberos

Kerberos uses passwords stored in the Kerberos keytab files. This removes the need to specify username and password as parameters inline with the command or after submitting the command from a JDBC client to connect to a Virtual Warehouse in Cloudera Data Warehouse, while adding a layer of security.

Important:

- The Cloudera Base on premises cluster must be Kerberized to use Kerberos as the authentication mode for Cloudera Data Warehouse.
- Cloudera Data Warehouse requires all user Kerberos principals to be present in the configured LDAP server as well.
- When you enable warehouse-level access control for Hive warehouses and associate a user group with that Virtual Warehouse, Kerberos authentication is disabled. Only LDAP is used for authentication.

Related Information

Enabling warehouse-level access control in Cloudera Data Warehouse on premises

How predefined Kerberos principals are used in Cloudera Data Warehouse on premises

By default, Cloudera Data Warehouse creates Kerberos principal names for Database Catalogs and Environments using the service hostname and the deterministic namespace name based on the name of the Database Catalog or Environment when you create a Database Catalog or an Environment. However, you can generate and provide the keytabs, if needed.

The service principals for Cloudera Data Warehouse need to be the same as on the base cluster. For more information, see Customizing Kerberos principals in the Cloudera Base on premises documentation.

By default, the host principals are generated programmatically. You can generate and provide the keytabs, but the hostnames in the Kerberos principals are fixed. Cloudera Data Warehouse uses a deterministic namespace and environment IDs for the Kerberos principals.

When you specify an Environment or Database Catalog name, Cloudera Data Warehouse appends a prefix as shown in the following table, as well as the Kerberos principal name based on them:

Cloudera Data Warehouse entity	User-specified name	Namespace IDs with Cloudera Data Warehouse-assigned prefix	Hive Kerberos principal name
Environment	my-test-env	env-my-test-env-default	hive/dwx-env-my-test-env.cdp.local@REALM.EXAMPLE.COM
Database Catalog	my-test-catalog	warehouse-my-test-catalog	hive/metastore-service.warehouse-warehouse-my-test-catalog.svc.cluster.local@REALM.EXAMPLE.COM
Virtual Warehouse	my-impala-warehouse	impala-my-impala-warehouse	NA

Note: The length of the namespace ID after Cloudera Data Warehouse applies a prefix to the Environment or Database Catalog name, including the hyphen (-), should not exceed 63 characters. You can specify an Environment name 35 characters long and Database Catalog 53 characters long.

When using FreeIPA, the environment name can be maximum 17 characters long.

How to enable SSL for MariaDB, MySQL, and Oracle databases

Cloudera requires that you secure the network connection between the default Database Catalog Hive MetaStore (HMS) in Cloudera Data Warehouse and the relational database hosting the base cluster's HMS using SSL encryption.

You must provide the SSL certificate of the database either by:

- Providing the SSL certificate while installing the Cloudera Data Services on premises in the Install Cloudera Data Services on premises on Existing Container Cloud Configure Kubernetes step under the Additional Certificates section. See Installing in an internet environment.
- Importing the SSL certificate to the trust store on the base cluster before installing Cloudera on premises.

Configuring MySQL database to use SSL for Cloudera Data Warehouse

SSL encrypts the connection between the MySQL server and the Hive MetaStore (HMS) on the base cluster. You must enable SSL for the MySQL database before setting up the Cloudera Data Services on premises and add the MySQL root Certificate Authorities (CA) to the Cloudera Manager truststore.

Procedure

1. SSH into the MySQL database host.
2. Start the MySQL server:

```
service mysqld start
```

3. Establish an encrypted connection with the client:

```
mysql -p --ssl-mode=required
```

4. Verify whether SSL is enabled on MySQL by running the following command:

```
mysql> show global variables like '%ssl%';
```

If SSL is enabled, you see the value of have_ssl equal to YES, as follows. Otherwise, you see the value of have _ssl equal to DISABLED:

```
+---------------+----------+
| Variable_name | Value    |
+---------------+----------+
| have_openssl  | YES      |
| have_ssl      | YES      |
| ...           | ...      |
```

If SSL is enabled, then skip to step 11.

5. Create a certificate authority by running the following commands:

```
mkdir /etc/my.cnf.d/ssl/
cd /etc/my.cnf.d/ssl/
openssl genrsa 2048 > ca-key.pem
```

6. Create a certificate for the server using the CA certificate generated earlier by running the following command:

```
openssl req -new -x509 -nodes -days 365000 -key ca-key.pem -out ca-cert.
pem
openssl req -newkey rsa:2048 -days 365 -nodes -keyout server-key.pem -out
 server-req.pem
openssl rsa -in server-key.pem -out server-key.pem
```

7. Create a certificate for the clients using the same CA certificate by running the following command:

```
openssl x509 -req -in server-req.pem -days 365 -CA ca-cert.pem -CAkey ca-
key.pem -set_serial 01 -out server-cert.pem
```

8. Add the following lines in the /etc/my.cnf.d/server.cnf file under the [mysqld] section:

```
ssl-ca=/etc/my.cnf.d/ssl/ca-cert.pem
ssl-cert=/etc/my.cnf.d/ssl/server-cert.pem
ssl-key=/etc/my.cnf.d/ssl/server-key.pem
bind-address=*
```

You can view the content of the server.cnf file by running the following command:

```
vim /etc/my.cnf.d/server.cnf
```

9. Restart the MySQL server:

```
service mysqld restart
```

10. Check the SSL status by running the following commands:

```
mysql -p --ssl-mode=required
> SHOW VARIABLES LIKE '%ssl%';
> status
```

Sample output:

```
> SHOW VARIABLES LIKE '%ssl%';
+------------------------------------+-----------------+
| Variable_name                      | Value           |
+------------------------------------+-----------------+
| admin_ssl_ca                       |                 |
| admin_ssl_capath                   |                 |
| admin_ssl_cert                     |                 |
| admin_ssl_cipher                   |                 |
| admin_ssl_crl                      |                 |
| admin_ssl_crlpath                  |                 |
| admin_ssl_key                      |                 |
| have_openssl                       | YES             |
| have_ssl                           | YES             |
| mysqlx_ssl_ca                       |                 |
| mysqlx_ssl_capath                   |                 |
| mysqlx_ssl_cert                     |                 |
| mysqlx_ssl_cipher                   |                 |
| mysqlx_ssl_crl                      |                 |
| mysqlx_ssl_crlpath                  |                 |
| mysqlx_ssl_key                      |                 |
| performance_schema_show_processlist | OFF             |
| ssl_ca                              | ca.pem          |
| ssl_capath                          |                 |
| ssl_cert                            | server-cert.pem |
| ssl_cipher                          |                 |
| ssl_crl                             |                 |
| ssl_crlpath                         |                 |
| ssl_fips_mode                       | OFF             |
| ssl_key                             | server-key.pem  |
+-------------------------------------+-----------------+

> status
SSL:   Cipher in use is ECDHE-RSA-AES128-GCM-SHA256
```

11. View the contents of the ssl-client.xml file by running the following commands:

```
export SSL_CLIENT=/etc/hadoop/conf/ssl-client.xml
cat $SSL_CLIENT
```

12. Obtain the truststore's location and password by running the following commands:

```
export TRUSTSTORE_LOCATION=$(xmllint --xpath "//configuration/property[n
ame='ssl.client.truststore.location']/value/text()" $SSL_CLIENT)
```

```
export TRUSTSTORE_PASSWORD=$(xmllint --xpath "//configuration/property[n
ame='ssl.client.truststore.password']/value/text()" $SSL_CLIENT)
```

13. Verify the contents of the truststore by running the following command:

```
/usr/java/default/bin/keytool -list -rfc -keystore $TRUSTSTORE_LOCATION -
storetype JKS -storepass $TRUSTSTORE_PASSWORD
```

14. Import the MySQL root certificate by running the following command:

```
/usr/java/default/bin/keytool -importcert -alias mysql -file /var/lib/my
sql/ca.pem -keystore $TRUSTSTORE_LOCATION -storetype jks -noprompt -stor
epass $TRUSTSTORE_PASSWORD
```

15. Verify the contents of the truststore again by running the following command:

```
/usr/java/default/bin/keytool -list -rfc -keystore $TRUSTSTORE_LOCATION -
storetype JKS -storepass $TRUSTSTORE_PASSWORD
```

Results

When you install Cloudera Data Services on premises after adding the MySQL root CA to the Cloudera Manager truststore, the installer propogates the MySQL root CA from the Cloudera Manager truststore to Cloudera on premises. HMS in the default Database Catalog can now connect to the MySQL server on the base cluster using an SSL-encrypted connection.

Configuring MariaDB database to use SSL for Cloudera Data Warehouse

SSL encrypts the connection between the MariaDB server and the Hive MetaStore (HMS) on the base cluster. You must enable SSL for the MariaDB database before setting up the Cloudera Data Services on premises.

Procedure

1. SSH into the MariaDB database host.
2. Start the MariaDB server:

```
service mysqld start
```

3. Establish an encrypted connection with the client:

```
mysql -p --ssl=true
```

4. Verify whether SSL is enabled on MariaDB by running the following command:

```
mysql> show global variables like '%ssl%';
```

   If SSL is enabled, you see the value of have_ssl equal to YES, as follows. Otherwise, you see the value of have _ssl equal to DISABLED:

```
+---------------+----------+
| Variable_name | Value    |
+---------------+----------+
| have_openssl  | YES      |
| have_ssl      | YES      |
| ...           | ...      |
```

   If SSL is enabled, then skip to step 11.
5. Create a certificate authority by running the following commands:

```
mkdir /etc/my.cnf.d/ssl/
cd /etc/my.cnf.d/ssl/
openssl genrsa 2048 > ca-key.pem
```

6. Create a certificate for the server using the CA certificate generated earlier by running the following command:

```
openssl req -new -x509 -nodes -days 365000 -key ca-key.pem -out ca-cert.
pem
openssl req -newkey rsa:2048 -days 365 -nodes -keyout server-key.pem -out
 server-req.pem
openssl rsa -in server-key.pem -out server-key.pem
```

7. Create a certificate for the clients using the same CA certificate by running the following command:

```
openssl x509 -req -in server-req.pem -days 365 -CA ca-cert.pem -CAkey ca-
key.pem -set_serial 01 -out server-cert.pem
```

8. Add the following lines in the /etc/my.cnf.d/server.cnf file under the [mysqld] section:

```
ssl-ca=/etc/my.cnf.d/ssl/ca-cert.pem
ssl-cert=/etc/my.cnf.d/ssl/server-cert.pem
ssl-key=/etc/my.cnf.d/ssl/server-key.pem
```

```
bind-address=*
```

You can view the content of the server.cnf file by running the following command:

```
vim /etc/my.cnf.d/server.cnf
```

9. Restart the MariaDB server:

```
service mysqld restart
```

10. Check the SSL status by running the following commands:

```
mysql -p --ssl=true
> SHOW VARIABLES LIKE '%ssl%';
> status
```

Sample output:

```
> SHOW VARIABLES LIKE '%ssl%';
+---------------------+-----------------------------------+
| Variable_name       | Value                             |
+---------------------+-----------------------------------+
| have_openssl        | YES                               |
| have_ssl            | YES                               |
| ssl_ca              | /etc/my.cnf.d/ssl/ca-cert.pem     |
| ssl_capath          |                                   |
| ssl_cert            | /etc/my.cnf.d/ssl/server-cert.pem |
| ssl_cipher          |                                   |
| ssl_crl             |                                   |
| ssl_crlpath         |                                   |
| ssl_key             | /etc/my.cnf.d/ssl/server-key.pem  |
| version_ssl_library | OpenSSL 1.0.2k-fips  26 Jan 2017  |
+---------------------+-----------------------------------+

> status
SSL:   Cipher in use is DHE-RSA-AES256-GCM-SHA384
```

11. View the contents of the ssl-client.xml file by running the following commands:

```
export SSL_CLIENT=/etc/hadoop/conf/ssl-client.xml
cat $SSL_CLIENT
```

12. Obtain the truststore's location and password by running the following commands:

```
export TRUSTSTORE_LOCATION=$(xmllint --xpath "//configuration/property[n
ame='ssl.client.truststore.location']/value/text()" $SSL_CLIENT)
```

```
export TRUSTSTORE_PASSWORD=$(xmllint --xpath "//configuration/property[n
ame='ssl.client.truststore.password']/value/text()" $SSL_CLIENT)
```

13. Verify the contents of the truststore by running the following command:

```
/usr/java/default/bin/keytool -list -rfc -keystore $TRUSTSTORE_LOCATION -
storetype JKS -storepass $TRUSTSTORE_PASSWORD
```

14. Import the MariaDB root certificate by running the following command:

```
/usr/java/default/bin/keytool -importcert -alias mariadb -file /etc/my.c
nf.d/ssl/ca-cert.pem -keystore $TRUSTSTORE_LOCATION -storetype jks -nopr
ompt -storepass $TRUSTSTORE_PASSWORD
```

15. Verify the contents of the truststore again by running the following command:

```
/usr/java/default/bin/keytool -list -rfc -keystore $TRUSTSTORE_LOCATION -
storetype JKS -storepass $TRUSTSTORE_PASSWORD
```

Results

When you install Cloudera Data Services on premises after adding the MariaDB root CA to the Cloudera Manager truststore, the installer propogates the MariaDB root CA from the Cloudera Manager truststore to Cloudera on premises. HMS in the default Database Catalog can now connect to the MariaDB server on the base cluster using an SSL-encrypted connection.

Configuring Oracle database to use SSL for Cloudera Data Warehouse

You must enable SSL for the Oracle database before setting up the Cloudera Data Services on premises. Enabling SSL establishes a secure channel between the client (Cloudera-side) and the server (Oracle database server).

About this task

To enable SSL, you need to configure SSL only on the server side. The client-side configurations are present in Cloudera.

Procedure

1. SSH into the Oracle database server host.
2. Change to the "oracle" user as follows:

```
sudo -su oracle
```

3. Append the location of ORACLE_HOME to the PATH environment variable by running the following commands:

```
export ORACLE_HOME=/opt/oracle/product/19c/dbhome_1
export PATH=${PATH}:${ORACLE_HOME}/bin
```

4. Create an auto-login wallet by running the following command:

```
orapki wallet create -wallet /opt/oracle/product/19c/dbhome_1/wallet -au
to_login
```

   An auto-login wallet uses SSL's single sign-on functionality. The users do not need to specify password each time they open the wallet.

5. Add a self-signed certificate to this wallet by running the following command:

```
orapki wallet add -wallet /opt/oracle/product/19c/dbhome_1/wallet -dn "C
N=server" -keysize 4096 -self_signed -validity 365
```

6. Export the certificate from the Oracle wallet by running the following command:

```
orapki wallet export -wallet /opt/oracle/product/19c/dbhome_1/wallet -dn
 "CN=server" -cert server_ca.cert
```

   This exports a certificate with the subject's distinguished name (-dn) (CN=server) from a wallet to the file that is specified by -cert (server_ca.cert).

7. Add the following lines to the /opt/oracle/product/19c/dbhome_1/network/admin/listener.ora configuration file:

```
SSL_CLIENT_AUTHENTICATION = FALSE
WALLET_LOCATION =
  (SOURCE =
    (METHOD = FILE)
    (METHOD_DATA =
      (DIRECTORY = /opt/oracle/product/19c/dbhome_1/wallet)
    )
  )
Register a new address in LISTENER:
(ADDRESS = (PROTOCOL = TCPS)(HOST = [***HOST***])(PORT = 2484))
```

8. Add the following lines to the /opt/oracle/product/19c/dbhome_1/network/admin/sqlnet.ora profile configuration file:

```
SSL_CLIENT_AUTHENTICATION = FALSE
WALLET_LOCATION =
  (SOURCE =
    (METHOD = FILE)
    (METHOD_DATA =
      (DIRECTORY = /opt/oracle/product/19c/dbhome_1/wallet)
    )
  )
```

9. Add the following lines to the /opt/oracle/product/19c/dbhome_1/network/admin/tnsnames.ora configuration file:

```
ORCLPDB1_SSL =
    (DESCRIPTION =
      (ADDRESS = (PROTOCOL = TCPS)(HOST = [***HOST***])(PORT = 2484))
      (CONNECT_DATA =
        (SERVER = DEDICATED)
        (SERVICE_NAME = ORCLPDB1)
      )
      (SECURITY =
        (MY_WALLET_DIRECTORY = /opt/oracle/product/19c/dbhome_1/wallet)
      )
    )
```

10. Restart the listener by running the following commands:

```
lsnrctl stop
lsnrctl start
```

11. Copy the content of the certificate that you exported earlier and add it to the keystore on the base cluster instances.

    Paste the copied content to the ca-cert.pem file.

12. Fetch the keystore password from the /etc/hadoop/conf/ssl-client.xml file by running the following command:

```
/usr/java/default/bin/keytool -importcert -alias oracle -file ca-cert.pe
m -keystore /var/lib/cloudera-scm-agent/agent-cert/cm-auto-global_trusts
tore.jks -storetype jks -noprompt -storepass [***PASSWORD***]
```

13. Log in to Cloudera Manager as an Administrator.
14. Go to Clusters Hive service Configuration Hive Metastore Server Advanced Configuration Snippet (Safety Valve) for hive-site.xml and click + to add the following:

    - Name: javax.jdo.option.ConnectionURL
    - Value: jdbc:oracle:thin:@tcps://[***BASE_CLUSTER_HOSTNAME***]:2484/ORCLPDB1?javax.net.ssl.trustStore=/var/lib/cloudera-scm-agent/agent-cert/cm-auto-global_truststore.jks&javax.net.ssl.trustStorePassword=[***PASSWORD***]&oracle.net.ssl_server_dn_match=false

15. Change the port to 2484 in the Hive Metastore Database Port field.
16. Click Save Changes.
17. Restart the Hive service.

Enabling mTLS between the HMS database and Cloudera Data Warehouse on premises

In setups where mTLS is used for secure authentication and communication between HMS service and HMS databases, Cloudera Data Warehouse also supports setting up mTLS for this connectivity. The Hive MetaStore (HMS) pod in Cloudera Data Warehouse needs a client certificate and client private key to set up the mTLS authentication.

About this task

Note: Cloudera Data Warehouse does not support password-protected private keys.

Before you begin

- Verify whether mTLS is configured on the Cloudera Base on premises cluster and it is the only means of authentication to the HMS database. Perform this task only if you meet this condition.
- Ensure that the database client certificate and private key files are present on the Cloudera Base on premises cluster.
- You must have an environment available that you want to activate in Cloudera Data Warehouse.

Procedure

1. Log in to the Cloudera Data Warehouse service as DWAdmin.
2. Go to the **Environment(s)** tab and click Activate corresponding to the environment you want to activate in Cloudera Data Warehouse.
3. Browse and upload the database client certificate and database client private key in PEM format.
4. Click ACTIVATE.

SSL-enabled endpoints for Virtual Warehouse clients in Cloudera Data Warehouse on premises

In Cloudera Data Warehouse on premises, all client endpoints have been SSL-enabled. This requires that you configure the SSL certificates for client endpoints.

The client endpoints for web applications and Virtual Warehouse client URLs are SSL-enabled. The following endpoints use the OpenShift/Cloudera Embedded Container Service cluster default certificate:

- Hue
- Impala coordinator
- HiveServer2

Domain name changes

To use the OpenShift/Cloudera Embedded Container Service cluster wildcard certificate, the DNS names have been changed. The environment ID sub domain from the domain name has been removed. This creates a flat DNA structure so the cluster wildcard certificate can be applied to the endpoints.

Generating a truststore for a self-signed certificate

You can query the service certificate and convert it to a JKS truststore using the following steps:

1. Retrieve the certificate:

```
$ openssl s_client -showcerts -connect hs2-my-cwh1.apps.cdw.mycloud.myfi
rm.com:443 -servername
hs2-my-cwh1.apps.cdw.mycloud.myfirm.com </dev/null|openssl x509 -outform
PEM > <MYCERTFILE>.pem
```

2. Convert the PEM file to a truststore. You will be prompted for a password.

```
$ keytool -import -alias hs2-my-cw1.apps.cdw.mycloud.myfirm.com -file
 <MYCERTFILE>.pem -keystore <MYCERT>.jks
```

Opening SSL-enabled connections with Database Catalog clients

The Cloudera Data Warehouse Virtual Warehouse clients like beeline and impala-shell can open SSL-enabled connections as described in this section.

Beeline

A beeline connection can be created using a JDBC connection string. Specifying the username and password with the '-n' and the '-p' options returns an error. The beeline CLI prompts for credentials:

```
$ beeline
beeline> !connect
jdbc:hive2://hs2-my-cwh1.apps.cdw.mycloud.myfirm.com:443/default;transportMo
de=http;httpPath=cliservice;
     ssl=true;retries=3;sslTrustStore=<JKS-PATH>;trustStorePassword
=<***PASSWORD***>
Enter username for jdbc:hive2://hs2-my-cwh1.apps.cdw.mycloud.myfirm.com:443/
default:<MY-USER-NAME
Enter password for jdbc:hive2://hs2-my-cwh1.apps.cdw.mycloud.myfirm.com:443/
default:<********>
```

Important: The value for <*JKS-PATH*> is generated in the above section "Generating a truststore for a self-signed certificate."

impala-shell

The impala-shell CLI opens a TLS/SSL-enabled connection when you use the `--ssl` option. If `--ca_cert` is not set, impala-shell enables TLS/SSL, but does not validate the server certificate. Set the `--ca_cert` CLI option to the local path name that points to the third-party CA certificate, or to a copy of the server certificate in the case you have a self-signed server certificate:

```
$ impala-shell --protocol='hs2-http' -i "coordinator-my-iwh2.apps.cdw.myclou
d.myfirm.com:443" --ssl
```

OpenShift routes

OpenShift routes are used to expose the user-facing services in the Cloudera Data Warehouse on premises deployment. Route objects can perform edge TLS termination using the cluster-deployed certificate for the endpoints. If the cluster certificate must be rotated, the routes can pick up the new certificate automatically. It is not necessary to re-deploy or to manually configure the service in order to pick up the changes.

HDFS encryption in the context of Cloudera Data Warehouse on premises

Cloudera Data Warehouse Data Service and its components such as Hive, Impala, and Hue can read and write encrypted data to HDFS on a Cloudera Base on premises cluster.

How HDFS encryption works with Cloudera Data Warehouse

Encryption and decryption of the data happens in the HDFS client library. The client library is part of the client application such as, Hive, Impala, Spark, or any service that is reading or writing the data. To use this functionality encapsulated in the HDFS client library, the services must have access to the Hadoop Key Management Server (KMS) to retrieve the master key. KMS is a part of the Ranger service that runs in the base cluster. Cloudera recommends that you configure a secure cluster and then establish a secure channel between the encrypted HDFS cluster and the service using TLS.

All authorizations need an authenticated security principal – a user id, if it is a user, or a service account if it is a service.

SQL engines, such as Impala and Hive, and Hue as their front-end user interface need to authenticate the user connecting to them. This is required to authorize the user for various database-level operations, such as SELECT or INSERT, and to pass this user to the HDFS encryption ops to be authorized for those.

Understanding HDFS encryption zones in the context of Cloudera Data Warehouse

Encryption Zone (EZ) is a directory in HDFS whose contents are automatically encrypted during write operations and decrypted during read operations. Cloudera Data Warehouse can access data stored on the base cluster's HDFS, which can be set up with HDFS encryption.

You can configure the base cluster to have one or more HDFS encryption zones, a sub-directory encrypted with a particular master key. You can, then, store Hive and Impala tables in that sub-directory or you can store the entire Hive and Impala Warehouse in an encryption zone, encrypting the tables and metadata. Cloudera Data Warehouse can then access the shared data from a Virtual Warehouse running in that extension.

Important: You can copy data between two encryption zones. Moving data between the encryption zones is neither possible nor recommended. SQL commands such as Impala's LOAD DATA INPATH statement copy the data instead of moving it when the data needs to cross encryption zone boundaries (reencrypting the data as necessary).

Conditions for enabling Impala to read and write encrypted data to HDFS

To access data in an encryption zone, you must set up authorization for various user principals.

To allow Impala to read and write encrypted data stored on HDFS, you must meet the following authorization permissions:

- You must have permissions to perform key operations for creating and accessing keys that encrypt your encryption zone (one key per zone).
- You must have read and write permissions to the HDFS sub-directory, which is your encryption zone.
- You must have permissions to perform various actions in the Hadoop SQL policy area in Ranger. For example, the ability to specify the LOCATION clause for a CREATE TABLE statement is a specific permission you have to grant to a user, which may be necessary if you have an encryption zone outside your warehouse directory and you want to write or read data there.

Encryption keys for the encryption zones are also managed in Ranger on the base cluster, together with their permissions (key ACLs).

You must grant these permissions to the user identities fetched from LDAP to make the base cluster and the Cloudera Data Warehouse cluster refer to the same user identities in Ranger on the base cluster. You must configure the Ranger UserSync so that the base cluster can pull in the LDAP user identities.

You must also configure the Cloudera Management Console to point to the same LDAP instance for authentication so that the base cluster and the Cloudera Data Warehouse clusters are synchronized for user authentication.

If you are using Impala on encrypted source data, then ensure that data written to disk temporarily during processing is encrypted to keep the data confidential even during processing. For more information, see *Configuring Impala Virtual Warehouses to encrypt spilled data inCloudera Data Warehouse on premises*.

Note: The Cloudera Data Warehouse cache is not encrypted. You must use a third-party disk encryption solution to encrypt data that is cached. Encrypting and decrypting data can degrade performance.

Related Information

HDFS Transparent Encryption (Cloudera documentation)

Transparent Encryption in HDFS (Apache documentation)

HDFS encryption: Rename and Trash considerations

HDFS encryption: Distcp considerations

Creating Encryption Zones

Transparent Encryption Recommendations for Impala

Transparent Encryption Recommendations for Hive

Transparent Encryption Recommendations for Hue

Configuring Impala Virtual Warehouses to encrypt spilled data in Cloudera Data Warehouse on premises

Enabling browsing files on Kerberized HDFS from Hue in Cloudera Data Warehouse on premises

Because SPNEGO is disabled in Cloudera Data Warehouse on premises, by default, you cannot browse files on Kerberized HDFS cluster using the Hue File Browser. To enable access, you must set the security_enabled property to true in the Hue Advanced Configurations (hue-safety-valve) in Cloudera Data Warehouse.

Procedure

1. Log in to the Cloudera Data Warehouse service as DWAdmin.
2. Select a Virtual Warehouse on which you want to enable access to the Kerberized HDFS cluster from Hue and click ⋮ Edit .

   The **Virtual Warehouse Details** page is displayed.
3. Go to Configurations Hue , select hue-safety -valve from the Configuration files drop-down list, and add the following lines:

```
[hadoop]
[[hdfs_clusters]]
[[[default]]]
security_enabled=true
```

4. Click Apply Changes.

Configuring Impala Virtual Warehouses to encrypt spilled data in Cloudera Data Warehouse on premises

If you have encrypted HDFS on the Cloudera Base on premises cluster, then Cloudera recommends that you configure an Impala Virtual Warehouse to write temporary data to disk during query processing in an encrypted format using the AES-256-CFB encryption for complete security.

About this task

In Cloudera on premises, the temporary data is spilled to the local storage, the location of which is hard coded by the system.

Important: Impala does not selectively encrypt data based on whether the source data is already encrypted in HDFS. This results in at most 15 percent performance degradation when data is spilled.

Procedure

1. Log in to the Cloudera Data Warehouse service as an administrator.
2. Go to Impala Virtual Warehouse ⋮ Edit CONFIGURATIONS Impala coordinator and select flagfile from the Configuration files drop-down list.
3. Set the value of the disk_spill_encryption property to true.
4. Click APPLY.
5. Go to the Impala executor tab and select flagfile from the Configuration files drop-down list.
6. Set the value of the disk_spill_encryption property to true.
7. Click APPLY.
8. Restart the Impala Virtual Warehouse.

Ranger authorization for Trino Virtual Warehouses

Authorization for Trino is supported through Apache Ranger by default and you can create or update Ranger policies for specific resources and assign permissions to Trino users, groups, or roles. When a user submits a query to Trino, the system verifies the defined policies to ensure that the user has the necessary permissions to run queries.

Note: Trino is in Technical Preview and is not ready for production deployments. Cloudera recommends trying this feature in test or development environments and encourages you to provide feedback on your experiences.

Authorization is the process that checks user permissions to perform select operations, such as creating, reading, and writing data, as well as editing table metadata.

Trino supports the following Ranger features:

- Resource-based authorization policies
- Resource-based column masking
- Row-level filtering

Trino authorization service (cm_trino)

Ranger authorization for all the Trino supported connectors is offered through the cm_trino resource-based service.

For each resource specified in a Hive policy, an "allow" policy must also be configured in the cm_trino service to enable successful access control verification. You must be aware that there are two services where Hive authorization policies are defined and therefore you will notice two sets of audit logs; one from the cm_trino service and another from the HadoopSQL service (cm_hive). However, the cm_trino service allows for more restrictive permission as compared to HadoopSQL.

Access Request Audit

Audit log entries are created for requests, detailing the request information and the authorization outcome (allow or deny). These logs can be viewed through the Audits service in the Ranger Admin Web UI.

Related Information

Trino System Access Control

Apache Ranger Access Control and Auditing

Adding a user to Ranger service policies

Learn how to add a logged-in user or resource owner, who is not already part of the required groups, to the relevant Ranger policies.

Procedure

1. In Cloudera Manager, click Clusters Ranger Ranger Admin Web UI , enter your username and password, and then click Sign In.

   The **Ranger Service Manager** page for Cloudera services is displayed.
2. From the **Service Manager** page, click the cm_trino service.
3. In the **TRINO Policies** page of the cm_trino service, click edit against the following policies and include the logged-in user or resource owner in the **Allow Conditions**:
   - all – trinouser
   - all – catalog, schema, table
   - all – catalog, schema
   - all – sysinfo
   - all – catalog, schema, procedure
   - all – catalog, schema, schemafunction
   - all - function
   - all - queryid
   - all - role
   - all – catalog, schema, table, column
   - all – catalog
   - all – catalog, sessionproperty
   - all – systemproperty
4. Click Save to apply the changes.
5. Return to the **Service Manager** page and click the Hadoop SQL service to modify the default policies.
6. In the **HIVE policies** page of the Hadoop SQL service, edit each of the following default Hive policies to include the logged-in user or resource owner in the **Allow Conditions**:
   - all - global
   - all - database, table, column
   - all - database, table
   - all - storage-type, storage-url
   - all - database
   - all - hiveservice
   - all - database, udf
   - all - url

7. Click Save to apply the changes.
8. Return to the **Service Manager** page and click the cm_hdfs service to modify the default policies.
9. In the **HDFS Policies** page of the cm_hdfs service, edit the following default policy to include the logged-in user or resource owner in the **Allow Conditions**:

   all - path
10. Click Save to apply the changes.

Results

The logged-in user or resource owner now has the necessary permissions for the HDFS, Hadoop SQL, and Trino services.

Using resource-based authorization policies for Trino

The Apache Ranger access policy model consists of two major components: the specification of the resources a policy is applied to, such as Catalog, Schema, tables, columns, and so on; and the specification of access conditions for specific users and groups.

About this task

The following table lists the allowed permissions and the actions that they support in Trino:

Permission	Action
Select	Provides read access to an object (table, view, and materialized view)
Insert	Provides the ability to insert records into a table
Update	Provides the permission to modify column values in existing rows of a table
Delete	Provides the ability to remove records from a table
Create	Provides the permission to create an object (schema, table, view, and materialized view)
Alter	Provides the ability to: • Rename a schema • Rename a table or column • Add or drop a column • Set session property
Drop	Provides the permission to drop an object (schema, table, view, and materialized view) **Note:** For Hive connectors, the DROP SCHEMA statement with the CASCADE option also checks the table permissions before dropping the schema.
Use	Update the session to use the specified catalog and schema
Grant	Assign privileges to users on an object
Revoke	Deny privileges to users on an object
Show	Provides the ability to: • List the existing objects (catalogs, schemas, tables and views) • Show the SQL statement that creates a schema, table, or view
Excute	Provides the permission to run a SQL statement

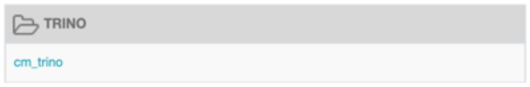
Important: Currently, the Grant and Revoke permissions do not modify Ranger policy definitions.

Perform the following steps to set up the required authorization policies for Trino:

Procedure

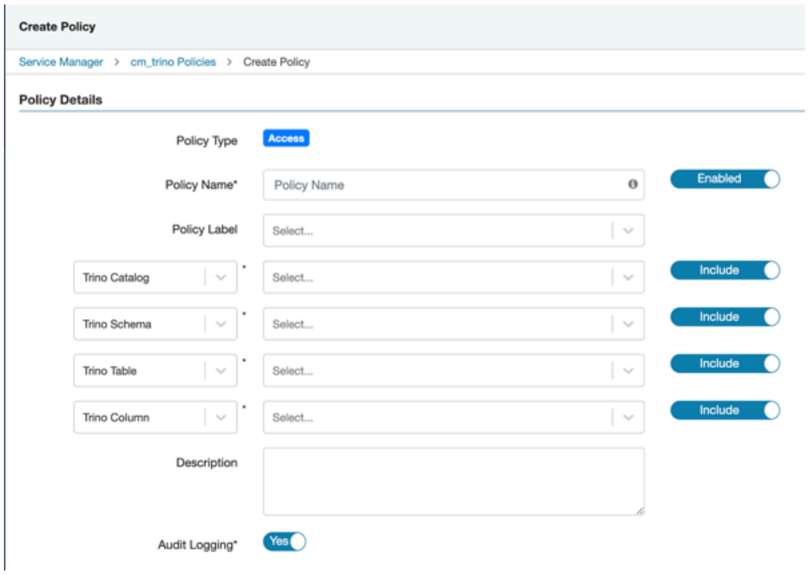
1. In Cloudera Manager, click Clusters Ranger Ranger Admin Web UI , enter your username and password, and then click Sign In.

   The **Ranger Service Manager** page for Cloudera services is displayed.
2. Click the cm_trino resource-based service to create or modify a Trino policy.

   TRINO

   cm_trino
3. In the **Trino Policies** page, under the **Access** tab, click Add New Policy to create a new Trino policy.
   The **Create Policy** modal displays controls for creating details for a new policy.

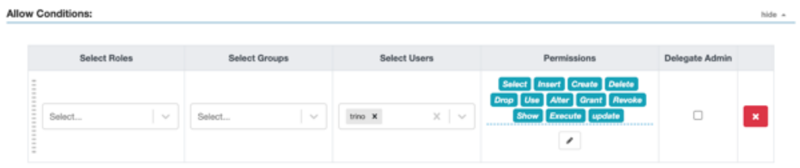
   

   Create Policy

   Service Manager > cm_trino Policies > Create Policy

   Policy Details

Policy Type	Access	
Policy Name*	Policy Name	Enabled
Policy Label	Select...	
Trino Catalog *	Select...	Include
Trino Schema *	Select...	Include
Trino Table *	Select...	Include
Trino Column *	Select...	Include
Description		
Audit Logging*	Yes	
4. Enter a name for the policy and choose the Trino catalog, schema, tables, and columns that you want to give access to.
5. In the **Allow Conditions** pane, add the "trino" user, and then click + to choose the necessary permissions.

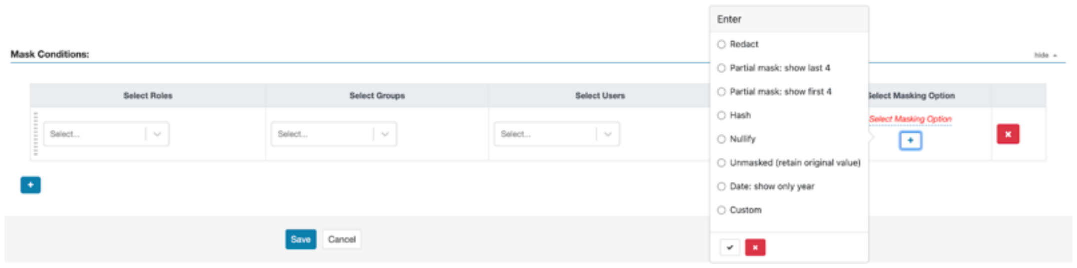
   Allow Conditions:

Select Roles	Select Groups	Select Users	Permissions	Delegate Admin	
Select...	Select...	trino	Select Insert Create Delete Drop Use Alter Grant Revoke Show Execute update	☐	✕
6. Click Save to save the policy.

Using resource-based column masking for Trino

You can use Apache Ranger dynamic resource-based column masking capabilities to protect sensitive data. You can set policies that mask or anonymize sensitive data columns (such as PII, PCI, and PHI) dynamically from the Trino query output. For example, you can mask sensitive data within a column to show only the first or last four characters.

You can create a masking policy from the **Masking** tab in the **Trino Policies** page. You can then set filters for specific users, groups, roles, and choose the masking options.



The following masking options are supported:

Mask Option	Description
Redact	Replace lowercase with 'x', uppercase with 'X', and digits with '0'
Partial mask: show last 4	Show last 4 characters; replace rest with 'x'
Partial mask: show first 4	Show first 4 characters; replace rest with 'x'
Hash	Hash the value
Nullify	Replace with NULL
Date: show only year	Show only the year
Custom	Specify a custom masked value or expression

Using row-level filtering for Trino

Row-level filtering policies are similar to other Ranger access policies. Apache Ranger row-level filtering policy allows to set access policies for rows when reading from a table.

You can use Apache Ranger row-level filtering policies to set access policies for rows when reading from a table. You can set filters for specific users, groups, and conditions. For example, only employees from the sales department may access sales transaction records, payments, and related data.

You can create a row-level filter policy from the **Row Level Filter** tab in the **Trino Policies** page. You can then set filters for specific users, groups, roles, and specify a filter expression. The filter expression must be a valid WHERE clause for the table or view, such as employeeId='123abc'.

Note: You can add multiple filters and the filters are evaluated in the order listed in the policy. The filter at the top of the Row Filter Conditions list is applied first, then the second, then the third, and so on.