Hortonworks Data Platform: Hadoop Security Guide
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1. Hadoop Security Features

For organizations that store sensitive data in the Hadoop ecosystem, such as proprietary or personal data that is subject to regulatory compliance (HIPPA, PCI, DSS, FISAM, etc), security is essential. Many organizations also have to adhere to strict internal security policies.

The Hortonworks Data Platform provides a comprehensive approach to security in the following key areas:

- **Perimeter security**: HDP enables isolation of the Hadoop cluster using a gateway and properly configured firewall rules. HDP supports the following perimeter security:
  - Apache Knox Gateway
  - Gateway clients

- **Authentication**: HDP provides single authentication point for services and users that integrates with existing enterprise identity and access management systems. HDP supports the following authentication services:
  - Kerberos
  - LDAP
  - Local Unix System
  - SSO (at the perimenter through Apache Knox Gateway)

- **Authorization (Access Control)**: HDP provides features that allow system administrators to control access to Hadoop data using role-based authorization. HDP supports the following authorization models:
  - Fine-grained access control for data stored in HDFS
  - Resource-level access control for YARN
  - Coarse-grain service level access control for MapReduce Operations
  - Table and column family level access control for HBase data, and extended ACLs for cell level control with Accumulo.
  - Table level access control for Apache Hive data sets

- **Accounting (Security auditing and monitoring)**: HDP allows you to track Hadoop activity using Native Auditing (audit logs), perimeter security auditing logs on the Knox Gateway, and from a central location, the HDP Security Administration console, including:
  - Access requests
  - Data processing operations
  - Data changes
• **Data Protection**: HDP provides the mechanisms for encrypting data in flight, and requires the use of partner solutions for encrypting data at rest, data discovery, and data masking. HDP supports the following wire encryption methods:

  • SSL for HDP Components
  • RPC encryption
  • Data Transfer Protocol
2. Set up Authentication for Hadoop Cluster Components

**Authentication**: HDP provides single authentication point for services and users that integrates with existing enterprise identity and access management systems. HDP supports the following authentication services:

- Kerberos
- LDAP
- Local Unix System
- SSO (at the perimeter through Apache Knox Gateway)


This section provides information on enabling security for a manually installed version of HDP.

2.1.1. Preparing Kerberos

To create secure communication among its various components, HDP uses Kerberos. Kerberos is a third-party authentication mechanism, in which users and services that users wish to access rely on a the Kerberos server to authenticate each to the other. This mechanism also supports encrypting all traffic between the user and the service. The Kerberos server itself is known as the **Key Distribution Center**, or KDC. At a high level, it has the following parts:

- A database of the users and services (known as **principals**) that it knows about and their respective Kerberos passwords
- An **authentication server** (AS) which performs the initial authentication and issues a **Ticket Granting Ticket** (TGT)
- A **Ticket Granting Server** (TGS) that issues subsequent service tickets based on the initial TGT.

A user principal requests authentication from the AS. The AS returns a TGT that is encrypted using the user principal’s Kerberos password, which is known only to the user principal and the AS. The user principal decrypts the TGT locally using its Kerberos password, and from that point forward, until the ticket expires, the user principal can use the TGT to get service tickets from the TGS.

Because a service principal cannot provide a password each time to decrypt the TGT, it uses a special file, called a **keytab**, which contains its authentication credentials.

The service tickets are what allow the principal to access various services. The set of hosts, users, and services over which the Kerberos server has control is called a **realm**.
Because Kerberos is a time-sensitive protocol, all hosts in the realm must be time-synchronized, for example, by using the Network Time Protocol (NTP). If the local system time of a client differs from that of the KDC by as little as 5 minutes (the default), the client will not be able to authenticate.

### 2.1.2. Installing and Configuring the KDC

To use Kerberos with HDP, either use an existing KDC or install a new one for HDP only. The following gives a very high level description of the installation process. For more information, see [RHEL documentation](#), [CentOS documentation](#), [SLES documentation](#), or [Ubuntu and Debian documentation](#).

1. **Install the KDC server:**
   - On RHEL, CentOS, or Oracle Linux, run:
     ```bash
     yum install krb5-server krb5-libs krb5-auth-dialog krb5-workstation
     ```
   - On SLES, run:
     ```bash
     zypper install krb5 krb5-server krb5-client
     ```
   - On Ubuntu or Debian, run:
     ```bash
     apt-get install krb5 krb5-server krb5-client
     ```

**Note**

The host on which you install the KDC must itself be secure.

When the server is installed you must edit the two main configuration files, located by default here:

2. **Update the KDC configuration by replacing EXAMPLE.COM with your domain and kerberos.example.com with the FQDN of the KDC host; the configuration files are located:**
   - On RHEL, CentOS, or Oracle Linux:
     - `/etc/krb5.conf`
     - `/var/kerberos/krb5kdc/kdc.conf`
   - On SLES:
     - `/etc/krb5.conf`
     - `/var/lib/kerberos/krb5kdc/kdc.conf`
   - On Ubuntu or Debian:
     - `/etc/krb5.conf`
3. Copy the updated `krb5.conf` to every cluster node.

### 2.1.3. Creating the Database and Setting Up the First Administrator

1. Use the utility `kdb5_util` to create the Kerberos database:
   - On RHEL, CentOS, or Oracle Linux:
     ```bash
     /usr/sbin/kdb5_util create -s
     ```
   - On SLES:
     ```bash
     kdb5_util create -s
     ```
   - On Ubuntu or Debian:
     ```bash
     kdb5_util -s create
     ```

   **Note**
   The `-s` option stores the master server key for the database in a *stash* file. If the stash file is not present, you must log into the KDC with the master password (specified during installation) each time it starts. This will automatically regenerate the master server key.

2. Set up the KDC Access Control List (ACL):
   - On RHEL, CentOS, or Oracle Linux add administrators to `/var/kerberos/krb5kdc/kadm5.acl`.
   - On SLES, add administrators to `/var/lib/kerberos/krb5kdc/kadm5.acl`.

   **Note**
   For example, the following line grants full access to the database for users with the `admin` extension:
   ```bash
   */admin@EXAMPLE.COM  *
   ```

3. Restart `kadmin` for the change to take effect.

4. Create the first user principal. This must be done at a terminal window on the KDC machine itself, while you are logged in as root. Notice the `.local`. Normal `kadmin` usage requires that a principal with appropriate access already exist. The `kadmin.local` command can be used even if no principals exist.
   ```bash
   /usr/sbin/kadmin.local -q "addprinc $username/admin"
   ```
Now this user can create additional principals either on the KDC machine or through the network. The following instruction assume you are using the KDC machine.

5. On the KDC, start Kerberos:

- On RHEL, CentOS, or Oracle Linux:

  ```bash
  /sbin/service krb5kdc start
  /sbin/service kadmin start
  ```

- On SLES:

  ```bash
  rckrb5kdc start
  rckadmin start
  ```

- On Ubuntu or Debian:

  ```bash
  /etc/init.d/krb5-kdc start
  /etc/init.d/kadmin start
  ```

2.1.4. Creating Service Principals and Keytab Files for HDP

Each service in HDP must have its own principal. As services do not login with a password to acquire their tickets, their principal’s authentication credentials are stored in a keytab file, which is extracted from the Kerberos database and stored locally with the service principal.

First you must create the principal, using mandatory naming conventions. Then you must create the keytab file with that principal’s information and copy the file to the keytab directory on the appropriate service host.

**Step 1**: Create a service principal using the `kadmin` utility:

```bash
kadmin: addprinc -randkey $principal_name/$service-host-FQDN@$hadoop.realm
```

You must have a principal with administrative permissions to use this command. The `randkey` is used to generate the password.

where

**Note**

In the example each service principal’s name has appended to it the fully qualified domain name of the host on which it is running. This is to provide a unique principal name for services that run on multiple hosts, like DataNodes and TaskTrackers. The addition of the hostname serves to distinguish, for example, a request from DataNode A from a request from DataNode B. This is important for two reasons:

- If the Kerberos credentials for one DataNode are compromised, it does not automatically lead to all DataNodes being compromised

- If multiple DataNodes have exactly the same principal and are simultaneously connecting to the NameNode, and if the Kerberos authenticator being sent
happens to have same timestamp, then the authentication would be rejected as a replay request.

The $principal_name part of the name must match the values in the table below.

![Note]

The NameNode, Secondary NameNode, and Oozie require two principals each.

![Note]

If you are configuring High Availability (HA) for a Quorum-based NameNode, you must also generate a principle ($jn/$FQDN) and keytab ($jn.service.keytab) for each JournalNode. JournalNode also requires the keytab for its HTTP service. If the JournalNode is deployed on the same host as a NameNode, the same keytab file (spnego.service.keytab) can be used for both. In addition, HA requires two NameNodes. Both the active and standby NameNode require their own principle and keytab files. The service principles of the two NameNodes can share the same name, specified with the dfs.namenode.kerberos.principal property in hdfs-site.xml, but the NameNodes still have different fully qualified domain names.

**Table 2.1. Service Principals**

<table>
<thead>
<tr>
<th>Service</th>
<th>Component</th>
<th>Mandatory Principal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDFS</td>
<td>NameNode</td>
<td>nn/$FQDN</td>
</tr>
<tr>
<td>HDFS</td>
<td>NameNode HTTP</td>
<td>HTTP/$FQDN</td>
</tr>
<tr>
<td>HDFS</td>
<td>SecondaryNameNode</td>
<td>$FQDN</td>
</tr>
<tr>
<td>HDFS</td>
<td>SecondaryNameNode HTTP</td>
<td>$FQDN</td>
</tr>
<tr>
<td>HDFS</td>
<td>DataNode</td>
<td>dn/$FQDN</td>
</tr>
<tr>
<td>MR2</td>
<td>History Server</td>
<td>jhs/$FQDN</td>
</tr>
<tr>
<td>MR2</td>
<td>History Server HTTP</td>
<td>$FQDN</td>
</tr>
<tr>
<td>YARN</td>
<td>ResourceManager</td>
<td>rm/$FQDN</td>
</tr>
<tr>
<td>YARN</td>
<td>NodeManager</td>
<td>nm/$FQDN</td>
</tr>
<tr>
<td>Oozie</td>
<td>Oozie Server</td>
<td>oozie/$FQDN</td>
</tr>
<tr>
<td>Oozie</td>
<td>Oozie HTTP</td>
<td>HTTP/$FQDN</td>
</tr>
<tr>
<td>Hive</td>
<td>Hive Metastore</td>
<td>hive/$FQDN</td>
</tr>
<tr>
<td>Hive</td>
<td>HiveServer2</td>
<td></td>
</tr>
<tr>
<td>Hive</td>
<td>WebHCat</td>
<td>HTTP/$FQDN</td>
</tr>
<tr>
<td>HBase</td>
<td>MasterServer</td>
<td>hbase/$FQDN</td>
</tr>
<tr>
<td>HBase</td>
<td>RegionServer</td>
<td>hbase/$FQDN</td>
</tr>
<tr>
<td>Hue</td>
<td>Hue Interface</td>
<td>hue/$FQDN</td>
</tr>
<tr>
<td>ZooKeeper</td>
<td>ZooKeeper</td>
<td>zookeeper$/FQDN</td>
</tr>
<tr>
<td>Nagios Server</td>
<td>Nagios</td>
<td>nagios/$FQDN</td>
</tr>
<tr>
<td>JournalNode Server*</td>
<td>JournalNode</td>
<td>$jn/$FQDN</td>
</tr>
<tr>
<td>Gateway</td>
<td>Knox</td>
<td>Knox/$FQDN</td>
</tr>
</tbody>
</table>

*Only required if you are setting up NameNode HA.

**For example:** To create the principal for a DataNode service, issue this command:
**Step 2:** Extract the related keytab file and place it in the keytab directory (by default /etc/krb5.keytab) of the appropriate respective components:

```
kadmin: xst -k $keytab_file_name $principal_name/fully.qualified.domain.name
```

You must use the mandatory names for the $keytab_file_name variable shown in this table.

### Table 2.2. Service Keytab File Names

<table>
<thead>
<tr>
<th>Component</th>
<th>Principal Name</th>
<th>Mandatory Keytab File Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>NameNode</td>
<td>nn/$FQDN</td>
<td>nn.service.keytab</td>
</tr>
<tr>
<td>NameNode HTTP</td>
<td>HTTP/$FQDN</td>
<td>spnego.service.keytab</td>
</tr>
<tr>
<td>SecondaryNameNode</td>
<td>nn/$FQDN</td>
<td>nn.service.keytab</td>
</tr>
<tr>
<td>SecondaryNameNode HTTP</td>
<td>HTTP/$FQDN</td>
<td>spnego.service.keytab</td>
</tr>
<tr>
<td>DataNode</td>
<td>dn/$FQDN</td>
<td>dn.service.keytab</td>
</tr>
<tr>
<td>MR2 History Server</td>
<td>jhs/$FQDN</td>
<td>nm.service.keytab</td>
</tr>
<tr>
<td>MR2 History Server HTTP</td>
<td>HTTP/$FQDN</td>
<td>spnego.service.keytab</td>
</tr>
<tr>
<td>YARN</td>
<td>rm/$FQDN</td>
<td>rm.service.keytab</td>
</tr>
<tr>
<td>YARN HTTP</td>
<td>HTTP/$FQDN</td>
<td>spnego.service.keytab</td>
</tr>
<tr>
<td>Oozie Server</td>
<td>oozie/$FQDN</td>
<td>oozie.service.keytab</td>
</tr>
<tr>
<td>Oozie HTTP</td>
<td>HTTP/$FQDN</td>
<td>spnego.service.keytab</td>
</tr>
<tr>
<td>Hive Metastore</td>
<td>hive/$FQDN</td>
<td>hive.service.keytab</td>
</tr>
<tr>
<td>HiveServer2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WebHCat</td>
<td>HTTP/$FQDN</td>
<td>spnego.service.keytab</td>
</tr>
<tr>
<td>HBase Master Server</td>
<td>hbase/$FQDN</td>
<td>hbase.service.keytab</td>
</tr>
<tr>
<td>HBase RegionServer</td>
<td>hbase/$FQDN</td>
<td>hbase.service.keytab</td>
</tr>
<tr>
<td>Hue</td>
<td>hue/$FQDN</td>
<td>hue.service.keytab</td>
</tr>
<tr>
<td>ZooKeeper</td>
<td>zookeeper/$FQDN</td>
<td>zk.service.keytab</td>
</tr>
<tr>
<td>Nagios Server</td>
<td>nagios/$FQDN</td>
<td>nagios.service.keytab</td>
</tr>
<tr>
<td>Journal Server*</td>
<td>jn/$FQDN</td>
<td>jn.service.keytab</td>
</tr>
<tr>
<td>Knox Gateway*</td>
<td>Knox/$FQDN</td>
<td>Knox.service.keytab</td>
</tr>
</tbody>
</table>

*Only required if you are setting up NameNode HA.
*bOnly required if you are using a Knox Gateway.

**For example:** To create the keytab files for the NameNode, issue these commands:

```
kadmin: xst -k nn.service.keytab nn/$namenode-host
kadmin: xst -k spnego.service.keytab HTTP/$namenode-host
```

When you have created the keytab files, copy them to the keytab directory of the respective service hosts.

**Step 3:** Verify that the correct keytab files and principals are associated with the correct service using the klist command. For example, on the NameNode:

```
klist -k -t /etc/security/nn.service.keytab
```

Do this on each respective service in your cluster.
2.2. Configuring HDP

This section provides information on configuring HDP for Kerberos.

- Configuration Overview
- Creating Mappings Between Principals and UNIX Usernames
- Creating the Database and Setting Up the First Administrator
- Creating Principals and Keytab Files for HDP

2.2.1. Configuration Overview

Configuring HDP for Kerberos has two parts:

- Creating a mapping between service principals and UNIX usernames.

  Hadoop uses group memberships of users at various places, such as to determine group ownership for files or for access control.

  A user is mapped to the groups it belongs to using an implementation of the GroupMappingServiceProvider interface. The implementation is pluggable and is configured in core-site.xml.

  By default Hadoop uses ShellBasedUnixGroupsMapping, which is an implementation of GroupMappingServiceProvider. It fetches the group membership for a username by executing a UNIX shell command. In secure clusters, since the usernames are actually Kerberos principals, ShellBasedUnixGroupsMapping will work only if the Kerberos principals map to valid UNIX usernames. Hadoop provides a feature that lets administrators specify mapping rules to map a Kerberos principal to a local UNIX username.

- Adding information to three main service configuration files.

  There are several optional entries in the three main service configuration files that must be added to enable security on HDP.

2.2.2. Creating Mappings Between Principals and UNIX Usernames

HDP uses a rule-based system to create mappings between service principals and their related UNIX usernames. The rules are specified in the core-site.xml configuration file as the value to the optional key hadoop.security.auth_to_local.

The default rule is simply named DEFAULT. It translates all principals in your default domain to their first component. For example, myusername@APACHE.ORG and myusername/admin@APACHE.ORG both become myusername, assuming your default domain is APACHE.ORG.
2.2.2.1. Creating Rules

To accommodate more complex translations, you can create a hierarchical set of rules to add to the default. Each rule is divided into three parts: base, filter, and substitution.

2.2.2.1.1. The Base

The base begins with the number of components in the principal name (excluding the realm), followed by a colon, and the pattern for building the username from the sections of the principal name. In the pattern section $0$ translates to the realm, $1$ translates to the first component, and $2$ to the second component.

For example:

\[1:$1@$0\] translates myusername@APACHE.ORG to myusername@APACHE.ORG
\[2:$1\] translates myusername/admin@APACHE.ORG to myusername
\[2:$1%$2\] translates myusername/admin@APACHE.ORG to "myusername%admin"

2.2.2.1.2. The Filter

The filter consists of a regex in a parentheses that must match the generated string for the rule to apply.

For example:

\(.*%admin\) matches any string that ends in %admin
\(.*@SOME.DOMAIN\) matches any string that ends in @SOME.DOMAIN

2.2.2.1.3. The Substitution

The substitution is a `sed` rule that translates a regex into a fixed string.

For example:

\(s/@ACME\./\)// removes the first instance of @SOME.DOMAIN.
\(s/@[A-Z]*\./\)// removes the first instance of @ followed by a name followed by COM.
\(s/X/Y/g\) replaces all of the X in the name with Y

2.2.2.2. Examples

• If your default realm was APACHE.ORG, but you also wanted to take all principals from ACME.COM that had a single component joe@ACME.COM, you would create this rule:

```
RULE: [1:$1@$0] (.@ACME.COM)s/@.//
DEFAULT
```

• To also translate names with a second component, you would use these rules:

```
RULE: [1:$1@$0] (.@ACME.COM)s/@.//
RULE: [2:$1@$0] (.@ACME.COM)s/@.//
DEFAULT
```
• To treat all principals from APACHE.ORG with the extension /admin as admin, your rules would look like this:

```
RULE[2:$1$%$2@$0]({.admin@APACHE.ORG})s/.admin/ DEFAULT
```

### 2.2.3. Adding Security Information to Configuration Files

To enable security on HDP, you must add optional information to various configuration files.

Before you begin, set JSVC_Home in hadoop-env.sh.

• For RHEL/CentOS/Oracle Linux:

```bash
export JSVC_HOME=/usr/libexec/bigtop-utils
```

• For SLES and Ubuntu:

```bash
export JSVC_HOME=/usr/lib/bigtop-utils
```

#### 2.2.3.1. core-site.xml

To the core-site.xml file on every host in your cluster, you must add the following information:

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hadoop.security.authentication</td>
<td>kerberos</td>
<td>Set the authentication type for the cluster. Valid values are: simple or kerberos.</td>
</tr>
</tbody>
</table>
| hadoop.rpc.protection       | authentication; integrity; privacy      | This is an [OPTIONAL] setting. If not set, defaults to authentication. 
authentication = authentication only; the client and server mutually authenticate during connection setup. 
integrity = authentication and integrity; guarantees the integrity of data exchanged between client and server as well as authentication. 
privacy = authentication, integrity, and confidentiality; guarantees that data exchanged between client and server is encrypted and is not readable by a “man in the middle”. |
| hadoop.security.authorization | true                                    | Enable authorization for different protocols. |
| hadoop.security.auth_to_local | The mapping rules. For example: RULE[2:$1$%$0] ([jt]t@.*EXAMPLE.COM)s/./* mapred/ RULE[2:$1$%$0] ([nd]n@.*EXAMPLE.COM)s/./* hdfs/ RULE[2:$1$%$0] (hm@.*EXAMPLE.COM)s/./* hbase/ RULE[2:$1$%$0] (rs@.*EXAMPLE.COM)s/./* hbase/ DEFAULT | The mapping from Kerberos principal names to local OS user names. See Creating Mappings Between Principals and UNIX Usernames for more information. |
The XML for these entries:

```xml
<property>
    <name>hadoop.security.authentication</name>
    <value>kerberos</value>
    <description>Set the authentication for the cluster. Valid values are: simple or kerberos.</description>
</property>

<property>
    <name>hadoop.security.authorization</name>
    <value>true</value>
    <description>Enable authorization for different protocols.</description>
</property>

<property>
    <name>hadoop.security.auth_to_local</name>
    <value>
        RULE:[2:$1@$0](jt@[a-zA-Z0-9.]*EXAMPLE.COM)s/.*/mapred/
        RULE:[2:$1@$0](nd@[a-zA-Z0-9.]*EXAMPLE.COM)s/.*/hdfs/
        RULE:[2:$1@$0](hm@[a-zA-Z0-9.]*EXAMPLE.COM)s/.*/hbase/
        RULE:[2:$1@$0](rs@[a-zA-Z0-9.]*EXAMPLE.COM)s/.*/hbase/
        DEFAULT</value>
    <description>The mapping from kerberos principal names to local OS user names.</description>
</property>
```

When using the Knox Gateway, add the following to the `core-site.xml` file on the master nodes host in your cluster:

**Table 2.4. core-site.xml**

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hadoop.proxyuser.knox.groups</td>
<td>users</td>
<td>Grants proxy privileges for knox user.</td>
</tr>
<tr>
<td>hadoop.proxyuser.knox.hosts</td>
<td>$knox_host_FQDN</td>
<td>Identifies the Knox Gateway host.</td>
</tr>
</tbody>
</table>

When using the Hue, add the following to the `core-site.xml` file on the master nodes host in your cluster:

**Table 2.5. core-site.xml**

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hue.kerberos.principal.shortname</td>
<td></td>
<td>Hue Kerberos principal name.</td>
</tr>
<tr>
<td>hadoop.proxyuser.hue.groups</td>
<td>*</td>
<td>Group to which all the hue users belong. Use the wild card character to select multiple groups, for example cli*.</td>
</tr>
<tr>
<td>hadoop.proxyuser.hue.hosts</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>hadoop.proxyuser.knox.hosts</td>
<td>$hue_host_FQDN</td>
<td>Identifies the Knox Gateway host.</td>
</tr>
</tbody>
</table>
The XML for these entries:

```
<property>
    <name>hadoop.security.authentication</name>
    <value>kerberos</value>
    <description>Set the authentication for the cluster. Valid values are: simple or kerberos.</description>
</property>

<property>
    <name>hadoop.security.authorization</name>
    <value>true</value>
    <description>Enable authorization for different protocols.</description>
</property>

<property>
    <name>hadoop.security.auth_to_local</name>
    <value>
        RULE:[2:$1@$0](jt@.*EXAMPLE.COM)s/.*/mapred/
        RULE:[2:$1@$0](nd@.*EXAMPLE.COM)s/.*/hdfs/
        RULE:[2:$1@$0](hm@.*EXAMPLE.COM)s/.*/hbase/
        RULE:[2:$1@$0](rs@.*EXAMPLE.COM)s/.*/hbase/
        DEFAULT</value>
    <description>The mapping from kerberos principal names to local OS user names.</description>
</property>

<property>
    <name>hadoop.proxyuser.knox.groups</name>
    <value>users</value>
</property>

<property>
    <name>hadoop.proxyuser.knox.hosts</name>
    <value>Knox.EXAMPLE.COM</value>
</property>
```

### 2.2.3.2. hdfs-site.xml

To the `hdfs-site.xml` file on every host in your cluster, you must add the following information:

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>dfs.permissions.enabled</td>
<td>true</td>
<td>If true, permission checking in HDFS is enabled. If false, permission checking is turned off, but all other behavior is unchanged. Switching from one parameter value to the other does not change the mode, owner or group of files or directories.</td>
</tr>
<tr>
<td>dfs.permissions.supergroup</td>
<td>hdfs</td>
<td>The name of the group of super-users.</td>
</tr>
<tr>
<td>dfs.block.access.token.enable</td>
<td>true</td>
<td>If true, access tokens are used as capabilities for accessing DataNodes. If false, no access tokens are checked on accessing DataNodes.</td>
</tr>
<tr>
<td>Property Name</td>
<td>Property Value</td>
<td>Description</td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>dfs.namenode.kerberos.principal</td>
<td>/_HOST@EXAMPLE.COM</td>
<td>Kerberos principal name for the NameNode.</td>
</tr>
<tr>
<td>dfs.secondary.namenode.kerberos.principal</td>
<td>/_HOST@EXAMPLE.COM</td>
<td>Kerberos principal name for the secondary NameNode.</td>
</tr>
<tr>
<td>dfs.web.authentication.kerberos.principal</td>
<td>HTTP/_HOST@EXAMPLE.COM</td>
<td>The HTTP Kerberos principal used by Hadoop-Auth in the HTTP endpoint.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The HTTP Kerberos principal MUST start with 'HTTP/' per Kerberos HTTP SPNEGO specification.</td>
</tr>
<tr>
<td>dfs.web.authentication.keytabs/spnego.service.keytab</td>
<td></td>
<td>The Kerberos keytab file with the credentials for the HTTP Kerberos principal used by Hadoop-Auth in the HTTP endpoint.</td>
</tr>
<tr>
<td>dfs.datanode.kerberos.principal</td>
<td>/_HOST@EXAMPLE.COM</td>
<td>The Kerberos principal that the DataNode runs as. &quot;_HOST&quot; is replaced by the real host name.</td>
</tr>
<tr>
<td>dfs.namenode.keytab.file</td>
<td>/etc/security/keytabs/nn.service.keytab</td>
<td>Combined keytab file containing the NameNode service and host principals.</td>
</tr>
<tr>
<td>dfs.secondary.namenode.keytab</td>
<td>/etc/security/keytabs/nn.service.keytab</td>
<td>Combined keytab file containing the NameNode service and host principals.</td>
</tr>
<tr>
<td>dfs.datanode.keytab.file</td>
<td>/etc/security/keytabs/dn.service.keytab</td>
<td>The filename of the keytab file for the DataNode.</td>
</tr>
<tr>
<td>dfs=https.port</td>
<td>50470</td>
<td>The HTTPS port to which the NameNode binds</td>
</tr>
<tr>
<td>dfs.namenode=https-address</td>
<td>Example: ip-10-111-59-170.ec2.internal:50470</td>
<td>The HTTPS address to which the NameNode binds</td>
</tr>
<tr>
<td>dfs.datanode.data.dir.perm</td>
<td>750</td>
<td>The permissions that must be set on the dfs.data.dir directories. The DataNode will not come up if all existing dfs.data.dir directories do not have this setting. If the directories do not exist, they will be created with this permission</td>
</tr>
<tr>
<td>dfs.cluster.administrators</td>
<td>hdfs</td>
<td>ACL for who all can view the default servlets in the HDFS</td>
</tr>
<tr>
<td>dfs.namenode.kerberos.internal.spnego.principal</td>
<td>${dfs.web.authentication.kerberos.principal}</td>
<td></td>
</tr>
<tr>
<td>dfs.secondary.namenode.kerberos.internal.spnego.principal</td>
<td>${dfs.web.authentication.kerberos.principal}</td>
<td></td>
</tr>
</tbody>
</table>

The XML for these entries:

```xml
<property>
  <name>dfs.permissions</name>
  <value>true</value>
  <description>If "true", enable permission checking in HDFS. If "false", permission checking is turned off, but all other behavior is unchanged. Switching from one parameter value to the other does not change the mode, owner or group of files or directories. </description>
</property>

<property>
  <name>dfs.permissions.supergroup</name>
  <value>hdfs</value>
  <description>The name of the group of
```
<property>
  <name>dfs.namenode.handler.count</name>
  <value>100</value>
  <description>Added to grow Queue size so that more client connections are allowed</description>
</property>

<property>
  <name>ipc.server.max.response.size</name>
  <value>5242880</value>
</property>

<property>
  <name>dfs.block.access.token.enable</name>
  <value>true</value>
  <description>If "true", access tokens are used as capabilities for accessing datanodes. If "false", no access tokens are checked on accessing datanodes.</description>
</property>

<property>
  <name>dfs.namenode.kerberos.principal</name>
  <value>nn/_HOST@EXAMPLE.COM</value>
  <description>Kerberos principal name for the NameNode</description>
</property>

<property>
  <name>dfs.secondary.namenode.kerberos.principal</name>
  <value>nn/_HOST@EXAMPLE.COM</value>
  <description>Kerberos principal name for the secondary NameNode.</description>
</property>

<!--cluster variant-->
<property>
  <name>dfs.secondary.http.address</name>
  <value>ip-10-72-235-178.ec2.internal:50090</value>
  <description>Address of secondary namenode web server</description>
</property>

<property>
  <name>dfs.secondary.https.port</name>
  <value>50490</value>
  <description>The https port where secondary-namenode binds</description>
</property>

<property>
  <name>dfs.web.authentication.kerberos.principal</name>
  <value>HTTP/_HOST@EXAMPLE.COM</value>
  <description>The HTTP Kerberos principal used by Hadoop-Auth in the HTTP endpoint.
The HTTP Kerberos principal MUST start with 'HTTP/' per Kerberos HTTP SPNEGO specification.</description>
</property>
<property>
  <name>dfs.web.authentication.kerberos.keytab</name>
  <value>/etc/security/keytabs/spnego.service.keytab</value>
  <description>The Kerberos keytab file with the credentials for the HTTP Kerberos principal used by Hadoop-Auth in the HTTP endpoint.</description>
</property>

<property>
  <name>dfs.datanode.kerberos.principal</name>
  <value>dn/_HOST@EXAMPLE.COM</value>
  <description>The Kerberos principal that the DataNode runs as. "_HOST" is replaced by the real host name.</description>
</property>

<property>
  <name>dfs.namenode.keytab.file</name>
  <value>/etc/security/keytabs/nn.service.keytab</value>
  <description>Combined keytab file containing the namenode service and host principals.</description>
</property>

<property>
  <name>dfs.secondary.namenode.keytab.file</name>
  <value>/etc/security/keytabs/nn.service.keytab</value>
  <description>Combined keytab file containing the namenode service and host principals.</description>
</property>

<property>
  <name>dfs.datanode.keytab.file</name>
  <value>/etc/security/keytabs/dn.service.keytab</value>
  <description>The filename of the keytab file for the DataNode.</description>
</property>

<property>
  <name>dfs.https.port</name>
  <value>50470</value>
  <description>The https port where namenode binds.</description>
</property>

<property>
  <name>dfs.https.address</name>
  <value>ip-10-111-59-170.ec2.internal:50470</value>
  <description>The https address where namenode binds.</description>
</property>
<property>
   <name>dfs.datanode.data.dir.perm</name>
   <value>750</value>
   <description>The permissions that should be there on dfs.data.dir directories. The datanode will not come up if the permissions are different on existing dfs.data.dir directories. If the directories don't exist, they will be created with this permission.</description>
</property>

<property>
   <name>dfs.access.time.precision</name>
   <value>0</value>
   <description>The access time for HDFS file is precise up to this value. The default value is 1 hour. Setting a value of 0 disables access times for HDFS.</description>
</property>

<property>
   <name>dfs.cluster.administrators</name>
   <value>hdfs</value>
   <description>ACL for who all can view the default servlets in the HDFS</description>
</property>

<property>
   <name>ipc.server.read.threadpool.size</name>
   <value>5</value>
   <description></description>
</property>

<property>
   <name>dfs.namenode.kerberos.internal.spnego.principal</name>
   <value>${dfs.web.authentication.kerberos.principal}</value>
</property>

<property>
   <name>dfs.secondary.namenode.kerberos.internal.spnego.principal</name>
   <value>${dfs.web.authentication.kerberos.principal}</value>
</property>

In addition, you must set the user on all secure DataNodes:

```bash
export HADOOP_SECURE_DN_USER=hdfs
export HADOOP_SECURE_DN_PID_DIR=/grid/0/var/run/hadoop/$HADOOP_SECURE_DN_USER
```

### 2.2.3.3. yarn-site.xml

You must add the following information to the `yarn-site.xml` file on every host in your cluster:

**Table 2.7. yarn-site.xml**

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>yarn.resourcemanager.principal</td>
<td>yarn/localhost@EXAMPLE.COM</td>
<td>The Kerberos principal for the ResourceManager.</td>
</tr>
<tr>
<td>yarn.resourcemanager.keytab</td>
<td>/etc/krb5.keytab</td>
<td>The keytab for the ResourceManager.</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>yarn.nodemanager.principal</td>
<td>yarn/localhost@EXAMPLE.COM</td>
<td>The Kerberos principal for the NodeManager.</td>
</tr>
<tr>
<td>yarn.nodemanager.keytab</td>
<td>/etc/krb5.keytab</td>
<td>The keytab for the NodeManager.</td>
</tr>
<tr>
<td>yarn.nodemanager.container-executor.class</td>
<td>org.apache.hadoop.yarn.server.container-executor</td>
<td>The class that will execute (launch) the containers.</td>
</tr>
<tr>
<td>yarn.nodemanager.linux-container-executor.path</td>
<td>hadoop-3.0.0-SNAPSHOT/bin/container-executor</td>
<td>The path to the Linux container executor.</td>
</tr>
<tr>
<td>yarn.nodemanager.linux-container-executor.group</td>
<td>hadoop</td>
<td>A special group (e.g. hadoop) with executable permissions for the container executor, of which the NodeManager Unix user is the group member and no ordinary application user is. If any application user belongs to this special group, security will be compromised. This special group name should be specified for the configuration property.</td>
</tr>
<tr>
<td>yarn.timeline-service.principal</td>
<td>yarn/localhost@EXAMPLE.COM</td>
<td>The Kerberos principal for the Timeline Server.</td>
</tr>
<tr>
<td>yarn.timeline-service.keytab</td>
<td>/etc/krb5.keytab</td>
<td>The Kerberos keytab for the Timeline Server.</td>
</tr>
<tr>
<td>yarn.resourcemanager.webapp.delegation-token-auth-filter.enabled</td>
<td>true</td>
<td>Flag to enable override of the default Kerberos authentication filter with the RM authentication filter to allow authentication using delegation tokens (fallback to Kerberos if the tokens are missing). Only applicable when the http authentication type is Kerberos.</td>
</tr>
<tr>
<td>yarn.timeline-service.http-kerberos authentication.type</td>
<td></td>
<td>Defines authentication used for the Timeline Server HTTP endpoint. Supported values are: simple</td>
</tr>
<tr>
<td>yarn.timeline-service.http-HTTP/localhost@EXAMPLE.COM authentication.kerberos.principal</td>
<td></td>
<td>The Kerberos principal to be used for the Timeline Server HTTP endpoint.</td>
</tr>
<tr>
<td>yarn.timeline-service.http-HTTP/localhost@EXAMPLE.COM authentication.kerberos.keytab</td>
<td></td>
<td>The Kerberos keytab to be used for the Timeline Server HTTP endpoint.</td>
</tr>
</tbody>
</table>

The XML for these entries:

```xml
<property>
   <name>yarn.resourcemanager.principal</name>
   <value>yarn/localhost@EXAMPLE.COM</value>
</property>

<property>
   <name>yarn.resourcemanager.keytab</name>
   <value>/etc/krb5.keytab</value>
</property>

<property>
   <name>yarn.nodemanager.principal</name>
   <value>yarn/localhost@EXAMPLE.COM</value>
</property>

<property>
   <name>yarn.nodemanager.keytab</name>
   <value>/etc/krb5.keytab</value>
</property>
```
2.2.3.4. mapred-site.xml

To the mapred-site.xml file on every host in your cluster, you must add the following information:

Table 2.8. mapred-site.xml

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
<th>Final</th>
</tr>
</thead>
<tbody>
<tr>
<td>mapreduce.jobtracker.kerberos.principal</td>
<td>jt/_HOST@EXAMPLE.COM</td>
<td>Kerberos principal name for the JobTracker</td>
<td></td>
</tr>
<tr>
<td>Property Name</td>
<td>Property Value</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>mapreduce.tasktracker.kerberos.principal</td>
<td>tt/_HOST@EXAMPLE.COM</td>
<td>Kerberos principal name for the TaskTracker. &quot;_HOST&quot; is replaced by the host name of the task tracker.</td>
<td></td>
</tr>
<tr>
<td>hadoop.job.history.use</td>
<td>none</td>
<td>true</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobtracker.keytab.path/keytabs/jt.service.keytab</td>
<td></td>
<td>The keytab for the JobTracker principal</td>
<td></td>
</tr>
<tr>
<td>mapreduce.tasktracker.keytab.path/keytabs/tt.service.keytab</td>
<td></td>
<td>The keytab for the TaskTracker principal</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobhistory.keytab.path/keytabs/jt.service.keytab</td>
<td></td>
<td>The keytab for the JobHistory principal</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobhistory.keytab.path/keytabs/tt.service.keytab</td>
<td></td>
<td>The keytab for the JobHistory principal</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobhistory.keytab.path/keytabs/jt.service.keytab</td>
<td></td>
<td>The keytab for the JobHistory principal</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobhistory.keytab.path/keytabs/tt.service.keytab</td>
<td></td>
<td>The keytab for the JobHistory principal</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobhistory.keytab.path/keytabs/jt.service.keytab</td>
<td></td>
<td>The keytab for the JobHistory principal</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobtracker.split.metainfo.maxsize</td>
<td>50000000</td>
<td>If the size of the split metainfo file is larger than this value, the JobTracker will fail the job during initialization.</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobhistory.server.embedded</td>
<td>true</td>
<td>Should the Job History server be embedded within the JobTracker process</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobhistory.kerberos.principal</td>
<td>jt/_HOST@EXAMPLE.COM</td>
<td>Kerberos principal name for JobHistory. This must map to the same user as the JT user.</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobtracker.blacklist.fault-timeout-window</td>
<td>Example: 180</td>
<td>3-hour sliding window - the value is specified in minutes.</td>
<td></td>
</tr>
<tr>
<td>mapreduce.jobtracker.blacklist.bucket-width</td>
<td>Example: 15</td>
<td>15-minute bucket size - the value is specified in minutes.</td>
<td></td>
</tr>
<tr>
<td>mapred.queue.names</td>
<td>default</td>
<td>Comma separated list of queues configured for this JobTracker.</td>
<td></td>
</tr>
</tbody>
</table>

The XML for these entries:

```xml
<property>
  <name>mapreduce.jobtracker.kerberos.principal</name>
  <value>jt/_HOST@EXAMPLE.COM</value>
  <description> JT user name key.  </description>
</property>
```
<property>
  <name>mapreduce.tasktracker.kerberos.principal</name>
  <value>tt/_HOST@EXAMPLE.COM</value>
  <description>tt user name key. "_HOST" is replaced by the host name of the task tracker.</description>
</property>

<property>
  <name>hadoop.job.history.user.location</name>
  <value>none</value>
  <final>true</final>
</property>

<property>
  <name>mapreduce.jobtracker.keytab.file</name>
  <value>/etc/security/keytabs/jt.service.keytab</value>
  <description>The keytab for the jobtracker principal.</description>
</property>

<property>
  <name>mapreduce.tasktracker.keytab.file</name>
  <value>/etc/security/keytabs/tt.service.keytab</value>
  <description>The filename of the keytab for the task tracker</description>
</property>

<property>
  <name>mapreduce.jobtracker.staging.root.dir</name>
  <value>/user</value>
  <description>The Path prefix for where the staging directories should be placed. The next level is always the user’s name. It is a path in the default file system.</description>
</property>

<property>
  <name>mapreduce.tasktracker.group</name>
  <value>hadoop</value>
  <description>The group that the task controller uses for accessing the task controller. The mapred user must be a member and users should *not* be members.</description>
</property>

<property>
  <name>mapreduce.jobtracker.split.metainfo.maxsize</name>
  <value>50000000</value>
  <final>true</final>
  <description>If the size of the split metainfo file is larger than this, the JobTracker will fail the job during initialize.</description>
</property>
<property>
    <name>mapreduce.history.server.embedded</name>
    <value>false</value>
    <description>Should job history server be embedded within Job tracker process</description>
    <final>true</final>
</property>

<property>
    <name>mapreduce.history.server.http.address</name>
    <value>ip-10-111-59-170.ec2.internal:51111</value>
    <description>Http address of the history server</description>
    <final>true</final>
</property>

<property>
    <name>mapreduce.jobhistory.kerberos.principal</name>
    <value>jt/_HOST@EXAMPLE.COM</value>
    <description>Job history user name key. (must map to same user as JT user)</description>
</property>

<property>
    <name>mapreduce.jobhistory.keytab.file</name>
    <value>/etc/security/keytabs/jt.service.keytab</value>
    <description>The keytab for the job history server principal.</description>
</property>

<property>
    <name>mapred.jobtracker.blacklist.fault-timeout-window</name>
    <value>180</value>
    <description>3-hour sliding window (value is in minutes)</description>
</property>

<property>
    <name>mapred.jobtracker.blacklist.fault-bucket-width</name>
    <value>15</value>
    <description>15-minute bucket size (value is in minutes)</description>
</property>

<property>
    <name>mapred.queue.names</name>
    <value>default</value>
    <description>Comma separated list of queues configured for this jobtracker.</description>
</property>
2.2.3.5. hbase-site.xml

For HBase to run on a secured cluster, HBase must be able to authenticate itself to HDFS. To the hbase-site.xml file on your HBase server, you must add the following information. There are no default values; the following are all only examples:

Table 2.9. hbase-site.xml

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hbase.master.keytab.file</td>
<td>/etc/security/keytabs/hm.service.keytab</td>
<td>The keytab for the HMaster service principal</td>
</tr>
<tr>
<td>hbase.master.kerberos.principal</td>
<td>hm/_HOST@EXAMPLE.COM</td>
<td>The Kerberos principal name that should be used to run the HMaster process. If _HOST is used as the hostname portion, it will be replaced with the actual hostname of the running instance.</td>
</tr>
<tr>
<td>hbase.regionserver.keytab.file</td>
<td>/etc/security/keytabs/rs.service.keytab</td>
<td>The keytab for the HRegionServer service principal</td>
</tr>
<tr>
<td>hbase.regionserver.kerberos.principal</td>
<td>rs/_HOST@EXAMPLE.COM</td>
<td>The Kerberos principal name that should be used to run the HRegionServer process. If _HOST is used as the hostname portion, it will be replaced with the actual hostname of the running instance.</td>
</tr>
<tr>
<td>hbase.superuser</td>
<td>hbase</td>
<td>Comma-separated List of users or groups that are allowed full privileges, regardless of stored ACLs, across the cluster. Only used when HBase security is enabled.</td>
</tr>
<tr>
<td>hbase.coprocessor.region.classes</td>
<td></td>
<td>Comma-separated list of Coprocessors that are loaded by default on all tables. For any override coprocessor method, these classes will be called in order. After implementing your own Coprocessor, just put it in HBase's classpath and add the fully qualified class name here. A coprocessor can also be loaded on demand by setting HTableDescriptor.</td>
</tr>
<tr>
<td>hbase.coprocessor.master.classes</td>
<td></td>
<td>Comma-separated list of org.apache.hadoop.hbase.coprocessor.MasterObserver coprocessors that are loaded by default on the active HMaster process. For any implemented coprocessor methods, the listed classes will be called in order. After implementing your own MasterObserver, just put it in HBase's classpath and add the fully qualified class name here.</td>
</tr>
</tbody>
</table>

The XML for these entries:

```xml
<property>
  <name>hbase.master.keytab.file</name>
  <value>/etc/security/keytabs/hm.service.keytab</value>
  <description>Full path to the kerberos keytab file to use for logging in the configured HMaster server principal.</description>
</property>
```
<property>
    <name>hbase.master.kerberos.principal</name>
    <value>hm/_HOST@EXAMPLE.COM</value>
    <description>Ex. "hbase/_HOST@EXAMPLE.COM". The kerberos principal name that should be used to run the HMaster process. The principal name should be in the form: user/hostname@DOMAIN. If "_HOST" is used as the hostname portion, it will be replaced with the actual hostname of the running instance.</description>
</property>

<property>
    <name>hbase.regionserver.keytab.file</name>
    <value>/etc/security/keytabs/rs.service.keytab</value>
    <description>Full path to the kerberos keytab file to use for logging in the configured HRegionServer server principal.</description>
</property>

<property>
    <name>hbase.regionserver.kerberos.principal</name>
    <value>rs/_HOST@EXAMPLE.COM</value>
    <description>Ex. "hbase/_HOST@EXAMPLE.COM". The kerberos principal name that should be used to run the HRegionServer process. The principal name should be in the form: user/hostname@DOMAIN. If _HOST is used as the hostname portion, it will be replaced with the actual hostname of the running instance. An entry for this principal must exist in the file specified in hbase.regionserver.keytab.file</description>
</property>

<!--Additional configuration specific to HBase security -->

<property>
    <name>hbase.superuser</name>
    <value>hbase</value>
    <description>List of users or groups (comma-separated), who are allowed full privileges, regardless of stored ACLs, across the cluster. Only used when HBase security is enabled.</description>
</property>

<property>
    <name>hbase.coprocessor.region.classes</name>
    <value></value>
    <description>A comma-separated list of Coprocessors that are loaded by default on all tables. For any override coprocessor method, these classes will be called in order. After implementing your own Coprocessor, just put it in HBase's classpath and add the fully qualified class name here. A coprocessor can also be loaded on demand by setting HTableDescriptor.
</value>
</description>
</property>
2.2.3.6. hive-site.xml

Hive Metastore supports Kerberos authentication for Thrift clients only. HiveServer does not support Kerberos authentication for any clients:

Table 2.10. hive-site.xml

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>hive.metastore.sasl.enabled</td>
<td>true</td>
<td>If true, the Metastore Thrift interface will be secured with SASL and clients must authenticate with Kerberos.</td>
</tr>
<tr>
<td>hive.metastore.kerberos.keytab.file</td>
<td>/etc/security/keytabs/hive.service.keytab</td>
<td>The keytab for the Metastore Thrift service principal</td>
</tr>
<tr>
<td>hive.metastore.kerberos.principal</td>
<td>hive/_HOST@EXAMPLE.COM</td>
<td>The service principal for the Metastore Thrift server. If _HOST is used as the hostname portion, it will be replaced with the actual hostname of the running instance.</td>
</tr>
<tr>
<td>hive.metastore.cache.pinobjtypes</td>
<td>Table, Database, Type, FieldSchema, Ordered</td>
<td>Comma-separated Metastore object types that should be pinned in the cache.</td>
</tr>
</tbody>
</table>

The XML for these entries:

```xml
<property>
  <name>hive.metastore.sasl.enabled</name>
  <value>true</value>
  <description>If true, the metastore thrift interface will be secured with SASL. Clients must authenticate with Kerberos.</description>
</property>

<property>
  <name>hive.metastore.kerberos.keytab.file</name>
  <value>/etc/security/keytabs/hive.service.keytab</value>
  <description>The path to the Kerberos Keytab file containing the metastore thrift server's service principal.</description>
</property>

<property>
  <name>hive.metastore.kerberos.principal</name>
  <value>hive/_HOST@EXAMPLE.COM</value>
  <description>The service principal for the Metastore Thrift server. If _HOST is used as the hostname portion, it will be replaced with the actual hostname of the running instance.</description>
</property>
```
2.2.3.6.1. oozie-site.xml

To the oozie-site.xml file, you must add the following information:

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>oozie.service.AuthorizationService.security.enabled</td>
<td>true</td>
<td>Specifies whether security (user name/admin role) is enabled or not. If it is disabled any user can manage the Oozie system and manage any job.</td>
</tr>
<tr>
<td>oozie.service.HadoopAccessorService.kerberos.enabled</td>
<td>true</td>
<td>Indicates if Oozie is configured to use Kerberos</td>
</tr>
<tr>
<td>local.realm</td>
<td>EXAMPLE.COM</td>
<td>Kerberos Realm used by Oozie and Hadoop. Using local.realm to be aligned with Hadoop configuration.</td>
</tr>
<tr>
<td>oozie.service.HadoopAccessorService.keytab.file</td>
<td>/etc/security/keytabs/oozie.service.keytab</td>
<td>The keytab for the Oozie service principal.</td>
</tr>
<tr>
<td>oozie.service.HadoopAccessorService.kerberos.principal</td>
<td>oozie/_HOST@EXAMPLE.COM</td>
<td>Kerberos principal for Oozie service</td>
</tr>
<tr>
<td>oozie.authentication.type</td>
<td>kerberos</td>
<td></td>
</tr>
<tr>
<td>oozie.authentication.kerberos.principal</td>
<td>HTTP/_HOST@EXAMPLE.COM</td>
<td>Whitelisted job tracker for Oozie service</td>
</tr>
<tr>
<td>oozie.authentication.kerberos.security/keytabs/spnego.service.keytab</td>
<td></td>
<td>Location of the Oozie user keytab file.</td>
</tr>
<tr>
<td>oozie.service.HadoopAccessorService.nameNode.whitelist</td>
<td></td>
<td>The mapping from Kerberos principal names to local OS user names. See Creating Mappings Between Principals and UNIX Usernames for more information.</td>
</tr>
<tr>
<td>oozie.service.HadoopAccessorService.keytab.file</td>
<td>/etc/security/keytabs/spnego.service.keytab</td>
<td></td>
</tr>
<tr>
<td>oozie.service.ProxyUserService.proxyuser.knox.groups</td>
<td>users</td>
<td>Grant proxy privileges to the knox user. Note only required when using a Knox Gateway.</td>
</tr>
<tr>
<td>oozie.service.ProxyUserService.proxyuser.knox.hosts</td>
<td>$knox_host_FQDN</td>
<td>Identifies the Knox Gateway. Note only required when using a Knox Gateway.</td>
</tr>
</tbody>
</table>

2.2.3.6.2. webhcat-site.xml

To the webhcat-site.xml file, you must add the following information:
Table 2.12. `webhcat-site.xml`

<table>
<thead>
<tr>
<th>Property Name</th>
<th>Property Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>templeton.kerberos.principal</td>
<td>HTTP_<a href="mailto:HOST@EXAMPLE.COM">HOST@EXAMPLE.COM</a></td>
<td></td>
</tr>
<tr>
<td>templeton.kerberos.keytab</td>
<td><code>/etc/security/keytabs/spnego.service.keytab</code></td>
<td></td>
</tr>
<tr>
<td>templeton.kerberos.secret</td>
<td><code>secret</code></td>
<td></td>
</tr>
<tr>
<td>hadoop.proxyuser.knox.groups</td>
<td><code>groups</code></td>
<td>Grant proxy privileges to the knox user. Note only required when using a Knox Gateway.</td>
</tr>
<tr>
<td>hadoop.proxyuser.knox.knox_host_FQDN</td>
<td><code>$knox_host_FQDN</code></td>
<td>Identifies the Knox Gateway. Note only required when using a Knox Gateway.</td>
</tr>
</tbody>
</table>

2.3. Configure Secure HBase and ZooKeeper

Use the following instructions to set up secure HBase and ZooKeeper:

1. Configure HBase Master
2. Create JAAS configuration files
3. Start HBase and ZooKeeper services
4. Configure secure client side access for HBase
5. Optional: Configure client-side operation for secure operation - Thrift Gateway
6. Optional: Configure client-side operation for secure operation - REST Gateway
7. Configure HBase for Access Control Lists (ACL)

2.3.1. Configure HBase Master

Edit `$HBASE_CONF_DIR/hbase-site.xml` file on your HBase Master server to add the following information (`$HBASE_CONF_DIR` is the directory to store the HBase configuration files. For example, `/etc/hbase/conf`):

Note

There are no default values. The following are all examples.
<property>
    <name>hbase.master.keytab.file</name>
    <value>/etc/security/keytabs/hbase.service.keytab</value>
    <description>Full path to the kerberos keytab file to use for logging in the configured HMaster server principal.
    </description>
</property>

<property>
    <name>hbase.master.kerberos.principal</name>
    <value>hbase/_HOST@EXAMPLE.COM</value>
    <description>Ex. "hbase/_HOST@EXAMPLE.COM". The kerberos principal name that should be used to run the HMaster process. The principal name should be in the form: user/hostname@DOMAIN. If "_HOST" is used as the hostname portion, it will be replaced with the actual hostname of the running instance.</description>
</property>

<property>
    <name>hbase.regionserver.keytab.file</name>
    <value>/etc/security/keytabs/hbase.service.keytab</value>
    <description>Full path to the kerberos keytab file to use for logging in the configured HRegionServer server principal.</description>
</property>

<property>
    <name>hbase.regionserver.kerberos.principal</name>
    <value>hbase/_HOST@EXAMPLE.COM</value>
    <description>Ex. "hbase/_HOST@EXAMPLE.COM". The kerberos principal name that should be used to run the HRegionServer process. The principal name should be in the form: user/hostname@DOMAIN. If _HOST is used as the hostname portion, it will be replaced with the actual hostname of the running instance. An entry for this principal must exist in the file specified in hbase.regionserver.keytab.file</description>
</property>

<!--Additional configuration specific to HBase security -->

<property>
    <name>hbase.superuser</name>
    <value>hbase</value>
    <description>List of users or groups (comma-separated), who are allowed full privileges, regardless of stored ACLs, across the cluster. Only used when HBase security is enabled.</description>
</property>
For more information on bulk loading in secure mode, see [HBase Secure BulkLoad](#). Note that the `hbase.bulkload.staging.dir` is created by HBase.

### 2.3.2. Create JAAS configuration files

1. Create the following JAAS configuration files on the HBase Master, RegionServer, and HBase client host machines.

   These files must be created under the `$HBASE_CONF_DIR` directory:

   ```bash
   $HBASE_CONF_DIR
   ``

   where `$HBASE_CONF_DIR` is the directory to store the HBase configuration files. For example, `/etc/hbase/conf`. 
On your HBase Master host machine, create the `hbase-server.jaas` file under the `/etc/hbase/conf` directory and add the following content:

```java
Server {
    com.sun.security.auth.module.Krb5LoginModule required
    useKeyTab=true
    storeKey=true
    useTicketCache=false
    keyTab="/etc/security/keytabs/hbase.service.keytab"
    principal="hbase/$HBase.Master.hostname";
};
```

On each of your RegionServer host machine, create the `regionserver.jaas` file under the `/etc/hbase/conf` directory and add the following content:

```java
Server {
    com.sun.security.auth.module.Krb5LoginModule required
    useKeyTab=true
    storeKey=true
    useTicketCache=false
    keyTab="/etc/security/keytabs/hbase.service.keytab"
    principal="hbase/$RegionServer.hostname";
};
```

On HBase client machines, create the `hbase-client.jaas` file under the `/etc/hbase/conf` directory and add the following content:

```java
Client {
    com.sun.security.auth.module.Krb5LoginModule required
    useKeyTab=false
    useTicketCache=true;
};
```

2. Create the following JAAS configuration files on the ZooKeeper Server and client host machines.

These files must be created under the `$ZOOKEEPER_CONF_DIR` directory, where `$ZOOKEEPER_CONF_DIR` is the directory to store the HBase configuration files. For example, `/etc/zookeeper/conf`:

- On ZooKeeper server host machines, create the `zookeeper-server.jaas` file under the `/etc/zookeeper/conf` directory and add the following content:

  ```java
  Server {
      com.sun.security.auth.module.Krb5LoginModule required
      useKeyTab=true
      storeKey=true
      useTicketCache=false
      keyTab="/etc/security/keytabs/zookeeper.service.keytab"
      principal="zookeeper/$ZooKeeper.Server.hostname";
  };
  ```

- On ZooKeeper client host machines, create the `zookeeper-client.jaas` file under the `/etc/zookeeper/conf` directory and add the following content:

  ```java
  Client {
      com.sun.security.auth.module.Krb5LoginModule required
      useKeyTab=false
      useTicketCache=true;
  };
  ```
3. Edit the hbase-env.sh file on your HBase server to add the following information:

```bash
export HBASE_OPTS ="-Djava.security.auth.login.config=$HBASE_CONF_DIR/hbase-client.jaas"
export HBASE_MASTER_OPTS ="-Djava.security.auth.login.config=$HBASE_CONF_DIR/hbase-server.jaas"
export HBASE_REGIONSERVER_OPTS="-Djava.security.auth.login.config=$HBASE_CONF_DIR/regionserver.jaas"
```

where `$HBASE_CONF_DIR` is the HBase configuration directory. For example, `/etc/hbase/conf`.

4. Edit zoo.cfg file on your ZooKeeper server to add the following information:

```bash
authProvider.1=org.apache.zookeeper.server.auth.SASLAuthenticationProvider
jaasLoginRenew=3600000
kerberos.removeHostFromPrincipal=true
kerberos.removeRealmFromPrincipal=true
```

5. Edit zookeeper-env.sh file on your ZooKeeper server to add the following information:

```bash
export SERVER_JVMFLAGS ="-Djava.security.auth.login.config=$ZOOKEEPER_CONF_DIR/zookeeper-server.jaas"
export CLIENT_JVMFLAGS ="-Djava.security.auth.login.config=$ZOOKEEPER_CONF_DIR/zookeeper-client.jaas"
```

where `$ZOOKEEPER_CONF_DIR` is the ZooKeeper configuration directory. For example, `/etc/zookeeper/conf`.

### 2.3.3. Start HBase and ZooKeeper services

Start the HBase and ZooKeeper services using the instructions provided [here](#).

If the configuration is successful, you should see the following in your ZooKeeper server logs:
2.3.4. Configure secure client side access for HBase

HBase configured for secure client access is expected to be running on top of a secure HDFS cluster. HBase must be able to authenticate to HDFS services.

1. Provide a Kerberos principal to the HBase client user using the instructions provided here.

   • **Option I:** Provide Kerberos principal to normal HBase clients.

     For normal HBase clients, Hortonworks recommends setting up a password to the principal.

     • **Set** `maxrenewlife`.

     The client principal’s `maxrenewlife` should be set high enough so that it allows enough time for the HBase client process to complete. Client principals are not renewed automatically.

     For example, if a user runs a long-running HBase client process that takes at most three days, we might create this user’s principal within kadmin with the following command:

     ```
     addprinc -maxrenewlife 3days
     ```

   • **Option II:** Provide Kerberos principal to long running HBase clients.

     a. Set-up a keytab file for the principal and copy the resulting keytab files to where the client daemon will execute.

     Ensure that you make this file readable only to the user account under which the daemon will run.

2. On every HBase client, add the following properties to the `$HBASE_CONF_DIR/hbase-site.xml` file:
2.3.5. Optional: Configure client-side operation for secure operation - Thrift Gateway

Add the following to the $HBASE_CONF_DIR/hbase-site.xml file for every Thrift gateway:

```xml
<property>
   <name>hbase.thrift.keytab.file</name>
   <value>/etc/hbase/conf/hbase.keytab</value>
</property>
<property>
   <name>hbase.thrift.kerberos.principal</name>
   <value>$USER/_HOST@HADOOP.LOCALDOMAIN</value>
</property>
```

Substitute the appropriate credential and keytab for $USER and $KEYTAB respectively.

The Thrift gateway will authenticate with HBase using the supplied credential. No authentication will be performed by the Thrift gateway itself. All client access via the Thrift gateway will use the Thrift gateway's credential and have its privilege.

2.3.6. Optional: Configure client-side operation for secure operation - REST Gateway

Add the following to the $HBASE_CONF_DIR/hbase-site.xml file for every REST gateway:

```xml
<property>
   <name>hbase.security.authentication</name>
   <value>kerberos</value>
</property>
```

Note

The client environment must be logged in to Kerberos from KDC or keytab via the `kinit` command before communication with the HBase cluster is possible. Note that the client will not be able to communicate with the cluster if the `hbase.security.authentication` property in the client- and server-side site files fails to match.
<property>
  <name>hbase.rest.keytab.file</name>
  <value>$KEYTAB</value>
</property>

<property>
  <name>hbase.rest.kerberos.principal</name>
  <value>$USER/_HOST@HADOOP.LOCALDOMAIN</value>
</property>

Substitute the appropriate credential and keytab for $USER and $KEYTAB respectively.

The REST gateway will authenticate with HBase using the supplied credential. No authentication will be performed by the REST gateway itself. All client access via the REST gateway will use the REST gateway's credential and have its privilege.

### 2.3.7. Configure HBase for Access Control Lists (ACL)

Use the following instructions to configure HBase for ACL:

1. Open kinit as HBase user.
   
   a. Create a keytab for principal hbase@REALM and store it in the hbase.headless.keytab file. See instructions provided [here](#) for creating principal and keytab file.
   
   b. Open kinit as HBase user. Execute the following command on your HBase Master:

   ```bash
   kinit -kt hbase.headless.keytab hbase
   ```

2. Start the HBase shell. On the HBase Master host machine, execute the following command:

   ```bash
   hbase shell
   ```

3. Set ACLs using HBase shell:

   ```bash
   grant '$USER', '$permissions'
   ```

   where

   - $USER is any user responsible for create/update/delete operations in HBase.

   **Note**

   You must set the ACLs for all those users who will be responsible for create/update/delete operations in HBase.

   - $permissions is zero or more letters from the set "RWCA": READ('R'), WRITE('W'), CREATE('C'), ADMIN('A').
2.4. Setting up One-Way Trust with Active Directory

In environments where users from Active Directory (AD) need to access Hadoop Services, set up one-way trust between Hadoop Kerberos realm and the AD (Active Directory) domain.

**Warning**

Hortonworks recommends setting up one-way trust after fully configuring and testing your Kerberized Hadoop Cluster.

2.4.1. Configure Kerberos Hadoop Realm on the AD DC

Configure the Hadoop realm on the AD DC server and set up the one-way trust.

1. Add the Hadoop Kerberos realm and KDC host to the DC:

   ```bash
   ksetup /addkdc $hadoop.realm $KDC-host
   ```

2. Establish one-way trust between the AD domain and the Hadoop realm:

   ```bash
   netdom trust $hadoop.realm /Domain:$AD.domain /add /realm /
   passwordt:$trust_password
   ```

3. (Optional) If Windows clients within the AD domain need to access Hadoop Services, and the domain does not have a search route to find the services in Hadoop realm, run the following command to create a hostmap for Hadoop service host:

   ```bash
   ksetup /addhosttorealmmap $hadoop-service-host $hadoop.realm
   ```

   **Note**

   Run the above for each `hadoop-host` that provides services that need to be accessed by Windows clients. For example, Oozie host, WebHCat host, etc.

4. (Optional) define the encryption type:

   ```bash
   ksetup /SetEncTypeAttr $hadoop.realm $encryption_type
   ```

   Set encryption types based on your security requirements. Mismatching encryption types causes problems.

   **Note**

   Run `ksetup /GetEncTypeAttr $krb_realm` to list the available encryption types. Verify that the encryption type is configured for the Hadoop realm in the `krb5.conf`. 
2.4.2. Configure the AD Domain on the KDC and Hadoop Cluster Hosts

Add the AD domain as a realm to the krb5.conf on the Hadoop cluster hosts. Optionally configure encryption types and UDP preferences.

1. Open the krb5.conf file with a text editor and make the following changes:

   a. To libdefaults, add the following properties:

   Sets the Hadoop realm as default:

   ```
   [libdefaults]
   default_domain = $hadoop.realm
   ```

   Set the encryption type:

   ```
   [libdefaults]
   default_tkt_enctypes = $encryption_types
   default_tgs_enctypes = $encryption_types
   permitted_enctypes = $encryption_types
   ```

   where the $encryption_types match the type supported by your environment. For example:

   ```
   default_tkt_enctypes = aes256-cts aes128-cts rc4-hmac arcfour-hmac-md5 des-cbc-md5 des-cbc-crc
   default_tgs_enctypes = aes256-cts aes128-cts rc4-hmac arcfour-hmac-md5 des-cbc-md5 des-cbc-crc
   permitted_enctypes = aes256-cts aes128-cts rc4-hmac arcfour-hmac-md5 des-cbc-md5 des-cbc-crc
   ```

   If TCP is open on the KDC and AD Server:

   ```
   [libdefaults]
   udp_preference_limit = 1
   ```

   b. Add a realm for the AD domain:

   ```
   [realms]
   $AD.DOMAIN = {
   kdc = $AD-host-FQDN
   admin_server = $AD-host-FQDN
   default_domain = $AD-host-FQDN
   }
   ```

   c. Save the krb5.conf the changes to all Hadoop Cluster hosts.

2. Add the trust principal for the AD domain to the Hadoop MIT KDC:

   ```
   kadmin
   kadmin: addprinc krbtgt/$hadoop.realm@$AD.domain
   ```

   This command will prompt you for the trust password, use the same password as the earlier step.
Note

If the encryption type was defined, then use the following command to configure the AD principal:

```
  kadmin:  addprinc -e "$encryption_type" krbtgt/$hadoop.
          realm@$AD.domain
```

2.5. Allowing Impersonation

Superusers.html
3. Data Protection

Encryption is applied to electronic information in order to ensure its privacy and confidentiality. Wire encryption protects data as it moves into and through Hadoop cluster over RPC, HTTP, Data Transfer Protocol (DTP), and JDBC.

The following describes how the data is protected as it is in motion:

- Clients typically communicate directly with the Hadoop cluster and the data can be protected using:
  - **RPC encryption**: Clients interacting directly with the Hadoop cluster through RPC. A client uses RPC to connect to the NameNode (NN) to initiate file read and write operations. RPC connections in Hadoop use Java’s Simple Authentication & Security Layer (SASL), which supports encryption.
  - **Data Transfer Protocol**: The NN gives the client the address of the first DataNode (DN) to read or write the block. The actual data transfer between the client and a DN uses Data Transfer Protocol.

- Users typically communicate with the Hadoop cluster using a Browser or a command line tools, data can be protected using:
  - **HTTPS encryption**: Users typically interact with Hadoop using a browser or component CLI, while applications use REST APIs or Thrift. Encryption over the HTTP protocol is implemented with the support for SSL across a Hadoop cluster and for the individual components such as Ambari.
  - **JDBC**: HiveServer2 implements encryption with Java SASL protocol’s quality of protection (QOP) setting. With this the data moving between a HiveServer2 over jdbc and a jdbc client can be encrypted.

- Additionally within the cluster communication between processes can be protected using:
  - **HTTPS encryption during shuffle**: Starting in HDP 2.0 encryption during shuffle is supported. The data moves between the Mappers and the Reducers over the HTTP protocol, this step is called shuffle. Reducer initiates the connection to the Mapper to ask for data and acts as SSL client.

This chapter provides an overview on encryption over-the-wire in Hadoop. Data can be moved in and out of Hadoop over RPC, HTTP, Data Transfer Protocol, and JDBC. Network traffic over each of these protocols can be encrypted to provide privacy for data movement.

- Section 3.1, “Enable RPC Encryption for the Hadoop Cluster” [39]
- Section 3.2, “Enable Data Transfer Protocol” [39]
- Section 3.3, “Enable SSL on HDP Components” [39]
- Section 3.4, “Connect to SSL Enabled Components” [55]
3.1. Enable RPC Encryption for the Hadoop Cluster

The most common way for a client to interact with a Hadoop cluster is through RPC. A client connects to a NameNode over RPC protocol to read or write a file. RPC connections in Hadoop use the Java Simple Authentication and Security Layer (SASL) which supports encryption. When the `hadoop.rpc.protection` property is set to privacy, the data over RPC is encrypted with symmetric keys.

**Note**

RPC encryption covers not only the channel between a client and a Hadoop cluster but also the inter-cluster communication among Hadoop services.

Enable Encrypted RPC by setting the following properties in `core-site.xml`:

```xml
hadoop.rpc.protection=privacy
```

(Also supported are the ‘authentication’ and ‘integrity’ settings.)

3.2. Enable Data Transfer Protocol

The NameNode gives the client the address of the first DataNode to read or write the block. The actual data transfer between the client and the DataNode is over Hadoop's Data Transfer Protocol. To encrypt this protocol you must set `dfs.encrypt.data.transfer=true` on the NameNode and all DataNodes. The actual algorithm used for encryption can be customized with `dfs.encrypt.data.transfer.algorithm` set to either "3des" or "rc4". If nothing is set, then the default on the system is used (usually 3DES.) While 3DES is more cryptographically secure, RC4 is substantially faster.

Enable Encrypted DTP by setting the following properties in `hdfs-site.xml`:

```xml
dfs.encrypt.data.transfer=true
dfs.encrypt.data.transfer.algorithm=3des
```

(‘rc4’ is also supported.)

**Note**

Secondary Namenode is not supported with the HTTPS port. It can only be accessed by “http://<SNN>:50090”. WebHDFS, hsftp, and shortcircuitread are not supported with SSL enabled.

3.3. Enable SSL on HDP Components

The following table links to step-by-step instructions to enable SSL in the HDP environment:

<table>
<thead>
<tr>
<th>HDP Component</th>
<th>Notes/Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hadoop</td>
<td>Section 3.1, “Enable RPC Encryption for the Hadoop Cluster” [39] Section 3.3.3, “Enable SSL for WebHDFS, MapReduce Shuffle, and YARN” [49]</td>
</tr>
</tbody>
</table>
This section contains the following topics:

• Section 3.3.1, “Understanding Hadoop SSL Keystore Factory” [40]
• Section 3.3.2, “Manage SSL Certificates” [42]
• Section 3.3.3, “Enable SSL for WebHDFS, MapReduce Shuffle, and YARN” [49]
• Section 3.3.4, “Enable SSL on Ozzie” [52]
• Section 3.3.5, “Enable SSL on WebHBase and the HBase REST API” [53]
• Section 3.3.6, “Enable SSL on HiveServer2” [54]

3.3.1. Understanding Hadoop SSL Keystore Factory

The Hadoop SSL Keystore Factory manages SSL for Hadoop core services that communicate with other cluster services over HTTP, that is MapReduce, YARN, and HDFS. While components that have services that are typically not distributed or only receive HTTP connections directly from clients use the built-in Java JDK SSL tools, such as HBase, and Oozie.

The following table shows the Hadoop cluster services that use HTTP and support SSL for wire encryption.

<table>
<thead>
<tr>
<th>Component</th>
<th>Service</th>
<th>SSL Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>HDFS</td>
<td>WebHDFS</td>
<td>Hadoop SSL Keystore Factory</td>
</tr>
</tbody>
</table>
When enabling support for SSL, it is important to know which SSL Management method is used by the Hadoop service. Services that are co-located on a host must have the server certificate and keys, and in some cases the client truststore, configured in both the Hadoop SSL Keystore Factory and JDK locations. When using CA signed certificates, configure the Hadoop SSL Keystore Factory to use the Java keystore and truststore locations.

The following describes the major differences between certificates managed by JDK and the Hadoop SSL Keystore Factory:

- **Hadoop SSL Keystore Management Factory:**
  
  - Supports only JKS formatted keys
  
  - Supports toggling the shuffle between HTTP and HTTPS.
  
  - Supports two way certificate and name validation.
  
  - Uses a common location for both the keystore and truststore that is available to other Hadoop core services.
  
  - Allows you to manage SSL in a centralized location and propagate changes to all cluster nodes.
  
  - Automatically reloads the keystore and truststore without restarting services.
  
- **SSL Management with JDK:**
  
  - Allows either HTTP or HTTPS.
  
  - Uses hardcoded locations for truststores and keystores that may vary between hosts. And generally requires you to generate key pairs and import certificates on each host.
  
  - Requires the service to be restarted to reload the keystores and truststores.
  
  - Requires certificates to be installed in the client CA truststore.
3.3.2. Manage SSL Certificates

When setting up SSL in production environments, Hortonworks recommends using Certificate Authority (CA) certificates that are signed by a well-known, trusted third-party. In development and other non-production environments, you may want to use certificates signed by an internal CA or self-signed certificate.

Java-based Hadoop components such as HDFS, MapReduce, YARN, etc support JKS format, while Python based services such as Hue uses PEM format.

The basic process for enabling SSL support includes:

• Create a signed certificate as follows:
  • From a third-party CA (recommended for production environments)
  • Creating and signing the certificate using an internal CA
  • Creating a self-signed certificate (not recommended, use only in small cluster for demonstration)

• Installing the certificate on the host
• Generating a public/private key pair
• Securing the private key
• Importing the certificate into the client truststore
• Enabling SSL for Hadoop Component
• Restarting the services

This section contains the following topics:

• Section 3.3.2.1, “Generate a Certificate Signing Request (Third-party)” [43]
• Section 3.3.2.2, “Sign with Internal CA (OpenSSL)” [45]
• Section 3.3.2.3, “Create and Import Self-Signed Certificate” [46]
• Section 3.3.2.4, “Use a CA Signed Certificate” [47]
• Section 3.3.1, “Understanding Hadoop SSL Keystore Factory” [40]

Note

These instructions are based on information found in the Oracle keytool reference, see keytool - Key and Certificate Management Tool and the OpenSSL How to Documentation, refer to the SSL utilities for details.
3.3.2.1. Generate a Certificate Signing Request (Third-party)

To obtain a certificate signed by a third-party CA, generate a certificate signing request for each Hadoop Cluster host node as follows:

**Note**

A certificate signing request is typically not required when signing the certificate using an internal CA.

1. Using the service user account (shown below as $service_user), such as hive, hbase, oozie, hdfs, etc, generate the host key:

   ```
   su -l $service_user -C "keytool –keystore keystore.jks –genkey –alias $host"
   Enter keystore password: javacaps
   What is your first and last name? [Unknown]: name
   What is the name of your organizational unit? [Unknown]: department
   What is the name of your organization? [Unknown]: companyname
   What is the name of your City or Locality? [Unknown]: city
   What is the name of your State or Province? [Unknown]: state
   What is the two-letter country code for this unit? [Unknown]: XX
   Is <CN=name, OU=department, O=companyname, L=city, ST=state, C=XX> correct? [no]: yes
   ```

   Enter key password for <host> (RETURN if same as keystore password):

   The keystore file is created in the user's home directory. Access to the keystore requires the password and alias.

2. Verify that key was generated:

   ```
   su -l hdfs -c "keytool -list -v -keystore keystore.jks"
   ```

3. Create the Certificate Signing Request (CSR).

   ```
   su -l hdfs -c "keytool –keystore $keystorename –certreq –alias $host –keyalg rsa –file $host.csr"
   ```

   The CSR is created in the user's home directory.

4. Verify that the file was created:

   ```
   su -l hdfs -c "ls ~/
cache  keystore.jks  $host.csr"
   ```

5. Send the CSR to the CA. Follow the instructions sent to you by the CA to properly install the keys and certificate.
Note

Request generation instructions may vary depending on the third-party CAs, follow the instructions provided by them.

Example for HDFS user creating a signing request on host nn:

```
su -l hdfs -c "keytool -keystore keystore -genkey -alias nn"
Enter keystore password:
Re-enter new password:
What is your first and last name?
[Unknown]: Hortonworks
What is the name of your organizational unit?
[Unknown]: Engineering
What is the name of your organization?
[Unknown]: Hortonworks
What is the name of your City or Locality?
[Unknown]: Palo Alto
What is the name of your State or Province?
[Unknown]: California
What is the two-letter country code for this unit?
[Unknown]: US
Is CN=Hortonworks, OU=Engineering, O=Hortonworks, L=Palo Alto, ST=California, C=US correct?
[no]: yes
Enter key password for <nn>
(RETURN if same as keystore password):
```

```
su -l hdfs -c "keytool -list -v -keystore keystore.jks"
Enter keystore password:

Keystore type: JKS
Keystore provider: SUN

Your keystore contains 1 entry

Alias name: nn
Creation date: Aug 25, 2014
Entry type: PrivateKeyEntry
Certificate chain length: 1
Certificate[1]:
Owner: CN=Hortonworks, OU=Engineering, O=Hortonworks, L=Palo Alto, ST=California, C=US
Issuer: CN=Hortonworks, OU=Engineering, O=Hortonworks, L=Palo Alto, ST=California, C=US
Serial number: 53fb6404
Certificate fingerprints:
Signature algorithm name: SHA1withDSA
Version: 3
```

***********************************************************************
3.3.2.2. Sign with Internal CA (OpenSSL)

OpenSSL allows you sign certificates. Considerations for internally signed certificates include:

- The encryption algorithms may be less secure than a well-known, trusted third-party
- Unknown CAs require that certificate to be installed in the corresponding client truststores

Note

When accessing the service from a client application such as HiveCLI, cURL, etc, the CA must resolve on the client side or the connection attempt may fail. Users accessing the service through a browser will be able to add an exception if the certificate cannot be verified in their local truststore.

To install OpenSSL and set up an internal CA:

1. Install OpenSSL, for example on CentOS run:
   ```
   yum install openssl
   ```

2. Generate a CA signing key and certificate:
   ```
   openssl genrsa -out ca.key 8192; openssl req -new -x509 -extensions v3_ca -key ca.key -out ca.crt -days 365
   ```

3. Set up the CA directory structure:
   ```
   mkdir -m 0700 /root/CA /root/CA/certs /root/CA/crl /root/CA/newcerts /root/CA/private
   ```

4. Move the CA key to `/root/CA/private` and the CA certificate to `/root/CA/certs`.
   ```
   mv ca.key /root/CA/private; mv ca.crt /root/CA/certs
   ```

5. Add required files:
   ```
   touch /root/CA/index.txt; echo 1000 >> /root/CA/serial
   ```

6. Set permissions on the ca.key:
   ```
   chmod 0400 /root/CA/private/ca.key
   ```

7. Open the OpenSSL configuration file:
   ```
   vi /etc/pki/tls/openssl.cnf
   ```

8. Change the directory paths to match your environment:
   ```
   [ CA_default ]
   ```
9. Save the changes and restart OpenSSL:

Example of setting up OpenSSL internal CA:

```
openssl genrsa -out ca.key 8192; openssl req -new -x509 -extensions v3_ca -key ca.key -out ca.crt -days 365
```

Generating RSA private key, 8192 bit long modulus
..............................................................................
.........++
e is 65537 (0x10001)
You are about to be asked to enter information that will be incorporated into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN. There are quite a few fields but you can leave some blank For some fields there will be a default value, If you enter ".", the field will be left blank.
-----
Country Name (2 letter code) [XX]:US
State or Province Name (full name) [XX]:California
Locality Name (eg, city) [Default City]:Palo Alto
Organization Name (eg, company) [Default Company Ltd]:Hortonworks
Organizational Unit Name (eg, section) []:
Common Name (eg, your name or your server's hostname) []:nn
Email Address []:it@hortonworks.com

mkdir -m 0700 /root/CA /root/CA/certs /root/CA/crl /root/CA/newcerts /root/CA/private
ls /root/CA/certs crl newcerts private
```

3.3.2.3. Create and Import Self-Signed Certificate

In small Hadoop Clusters, such as a cluster for demonstration, you can use self-signed certificates for SSL. Using self-signed certificates is less secure, for some services, such as Knox, to work with SSL the key must be imported into the Java CA store.
1. Create a self-signed certificate:

```
cd $SERVER_KEY_LOCATION; keytool -genkey -alias $hostname -keyalg RSA -keysize 1024 -dname CN=Hortonworks,OU=hw,O=hw,L=paloalto,ST=ca,C=us -keypass $SERVER_KEYPASS_PASSWORD -keystore $KEYSTORE_FILE -storepass $SERVER_STOREPASS_PASSWORD
```

2. Export the certificate to a file.

```
cd $SERVER_KEY_LOCATION; keytool -export -alias $hostname -keystore $KEYSTORE_FILE -rfc -file $CERTIFICATE_NAME -storepass $TRUSTSTORE_PASSWORD
```

3. On each host, run the following command to export a certreq file from the host's keystore:

```
keytool -keystore keystore -alias `hostname -s` -certreq -file $host.cert -storepass $hoststorekey -keypass $hostkey
```

4. For example, to create self-signed certificates for the Hadoop SSL Keystore Factory on the local host run:

```
mkdir -p /etc/security/serverKeys; mkdir -p /etc/security/clientKeys
cd /etc/security/serverKeys; keytool -genkey -alias $hostname -keyalg RSA -keysize 1024 -dname "CN=Hortonworks,OU=hw,O=hw,L=paloalto,ST=ca,C=us" -keypass changeit -keystore keystore.jks -storepass changeit
cd /etc/security/serverKeys; keytool -export -alias $hostname -keystore keystore.jks -rfc -file $hostname.jks -storepass changeit
```

Import the certificates:

```
keytool -keystore $hostkeystore -storepass $hoststorekey -alias `hostname -s` -import -file $host.signed -keypass $hostkey
```

Push the keystore and truststore files back out to the other nodes in the cluster (along with the Hadoop configuration files and SSL Server and Client configurations), the first time you will need to restart affected cluster services. After, you can push only the keystore and truststore files and they are automatically reloaded.

### 3.3.2.4. Use a CA Signed Certificate

1. Run the following command to create a self-signing rootCA and import the rootCA into client truststore:

```
openssl genrsa -out $clusterCA.key 2048
openssl req -x509 -new -key $clusterCA.key -days 300 -out $clusterCA.keytool -importcert -alias $clusterCA -file $clusterCA.key -keystore $clustertruststore -storepass $clustertruststorekey
```

Note

Ensure that the ssl-client.xml on every host configure to use this `$clustertrust` store. When configuring with Hive point to this file, and for all other services install the certificate in the Java truststore.

2. For each host, sign certreq file with the rootCA:
openssl x509 -req -CA $clusterCA.pem -CAkey $clusterCA.key -in $host.cert -out $host.signed -days 300 -CAcreateserial

3. On each host, import both rootCA and the signed cert back in:

keytool -keystore $hostkeystore -storepass $hoststorekey -alias $clusterCA -import -file cluster1CA.pem
keytool -keystore $hostkeystore -storepass $hoststorekey -alias `hostname -s` -import -file $host.signed -keypass $hostkey

3.3.2.5. Install Certificates in the Hadoop SSL Keystore Factory

The MapReduce, YARN, and HDFS use the Hadoop SSL Keystore Factory to manage SSL Certificates. This factory uses a common directory for server keystore and client truststore. The Hadoop SSL Keystore Factory allows you to use CA certificates or self-signed certificates managed in their own stores.

1. Create a directory for the server and client stores.

   mkdir -p $SERVER_KEY_LOCATION ; mkdir -p $CLIENT_KEY_LOCATION

2. Import the server certicate from each node into the HTTP Factory truststore.

   cd $SERVER_KEY_LOCATION ; keytool -import -noprompt -alias $remote-hostname -file $remote-hostname.jks -keystore $TRUSTSTORE_FILE -storepass $SERVER_TRUSTSTORE_PASSWORD

3. Create a single truststore file containing the public key from all certificates, by importing the public key for each CA or from each self-signed certificate pair:

   keytool -import -noprompt -alias $host -file $CERTIFICATE_NAME -keystore $ALL_JKS -storepass $CLIENT_TRUSTSTORE_PASSWORD

4. Copy the keystore and truststores to every node in the cluster.

5. Validate the common truststore file on all hosts.

   keytool -list -v -keystore $ALL_JKS -storepass $CLIENT_TRUSTSTORE_PASSWORD

6. Set permissions and ownership on the keys:

   chgrp -R $YARN_USER:hadoop $SERVER_KEY_LOCATION
   chmod 755 $SERVER_KEY_LOCATION
   chmod 755 $CLIENT_KEY_LOCATION
   chmod 440 $KEYSTORE_FILE
   chmod 440 $TRUSTSTORE_FILE
   chmod 440 $CERTIFICATE_NAME
   chmod 444 $ALL_JKS

   Note

   The complete path of the $SERVER_KEY_LOCATION and the CLIENT_KEY_LOCATION from the root directory/etc must be owned by the $YARN_USER user and the hadoop group.
3.3.3. Enable SSL for WebHDFS, MapReduce Shuffle, and YARN

This section explains how to set up SSL for WebHDFS, YARN and MapReduce. Before you begin ensure that the SSL certificate is properly configured, including the keystore and truststore that will be used by WebHDFS, MapReduce, and YARN. HDP supports the following SSL modes:

- One-way SSL: SSL client validates the server identity only.

- Mutual authentication (2WAY SSL): Both the server and clients validate each others identity. 2WAY SSL can cause performance delays and is difficult to set up and maintain.

**Note**

In order to access SSL enabled HDP Services through the Knox Gateway, additional configuration on the Knox Gateway is required, see Apache Knox Gateway Adminsitrator Guide, Gateway Security, Configure Wire Encryption.

To enable one-way SSL set the following properties and restart all services:

1. Set the following property values (or add the properties if required) in `core-site.xml`:
   - hadoop.ssl.require.client.cert=false
   - hadoop.ssl.hostname.verifier=DEFAULT
   - hadoop.ssl.keystores.factory.class=org.apache.hadoop.security.ssl.FileBasedKeyStoresFactory
   - hadoop.ssl.server.conf=ssl-server.xml
   - hadoop.ssl.client.conf=ssl-client.xml

   **Note**

   Specify the hadoop.ssl.server.conf and hadoop.ssl.client.conf values as the relative or absolute path to Hadoop SSL Keystore Factory configuration files. If you specify only the file name, put the files in the same directory as the core-site.xml.

2. Set the following properties (or add the properties if required) in `hdfs-site.xml`:
   - dfs.http.policy=$Policy
   - dfs.client.https.need-auth=true (optional for mutual client/server certificate validation)
   - dfs.datanode.https.address=$hostname:50475
   - dfs.namenode.https-address=$hostname:50470

   where $Policy is either:
• **HTTP\_ONLY**: Service is provided only on HTTP
• **HTTPS\_ONLY**: Service is provided only on HTTPS
• **HTTP\_AND\_HTTPS**: Service is provided both on HTTP and HTTPS

3. Set the following properties in `mapred-site.xml`:

```xml
mapreduce.jobhistory.http.policy=HTTPS\_ONLY
mapreduce.jobhistory.webapp.https.address=<JHS>:<JHS\_HTTPS\_PORT>
```

4. Set the following properties in `yarn-site.xml`:

```xml
yarn.http.policy=HTTPS\_ONLY
yarn.log.server.url=https://<JHS>:<JHS\_HTTPS\_PORT>/jobhistory/logs
yarn.resourcemanager.webapp.https.address=<RM>:<RM\_HTTPS\_PORT>
yarn.nodemanager.webapp.https.address=0.0.0.0:<NM\_HTTPS\_PORT>
```

5. Create a `ssl-server.xml` file for the Hadoop SSL Keystore Factory:
   
a. Copy the example SSL Server configuration file and modify the settings for your environment:

   ```bash
   cp /etc/hadoop/conf/ssl-server.xml.example /etc/hadoop/conf/ssl-server.xml
   ```

   b. Configure the server ssl properties:

   **Table 3.3. Configuration Properties in ssl-server.xml**

<table>
<thead>
<tr>
<th>Property</th>
<th>Default Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ssl.server.keystore.type</td>
<td>JKS</td>
<td>The type of the keystore, JKS = Java Keystore, the de-facto standard in Java</td>
</tr>
<tr>
<td>ssl.server.keystore.location</td>
<td>None</td>
<td>The location of the keystore file</td>
</tr>
<tr>
<td>ssl.server.keystore.password</td>
<td>None</td>
<td>The password to open the keystore file</td>
</tr>
<tr>
<td>ssl.server.truststore.type</td>
<td>JKS</td>
<td>The type of the trust store</td>
</tr>
<tr>
<td>ssl.server.truststore.location</td>
<td>None</td>
<td>The location of the truststore file</td>
</tr>
<tr>
<td>ssl.server.truststore.password</td>
<td>None</td>
<td>The password to open the truststore file</td>
</tr>
</tbody>
</table>

   For example:

   ```xml
   <property>
   <name>ssl.server.truststore.location</name>
   <value>/etc/security/serverKeys/truststore.jks</value>
   <description>Truststore to be used by NN and DN. Must be specified.</description>
   </property>

   <property>
   <name>ssl.server.truststore.password</name>
   <value>changeit</value>
   <description>Optional. Default value is "".</description>
   </property>
   ```
6. Create a ssl-client.xml file for the Hadoop SSL Keystore Factory:

   a. Copy the client truststore example file:

   ```
   cp /etc/hadoop/conf/ssl-server.xml.example /etc/hadoop/conf/ssl-server.xml
   ```

   b. Configure the client trust store values:

   ```
   ssl.client.truststore.location=/etc/security/clientKeys/all.jks
   ssl.client.truststore.password=clientTrustStorePassword
   ssl.client.truststore.type=jks
   ```

7. Copy the configuration files (core-site.xml, hdfs-site.xml, mapred-site.xml, yarn-site.xml, ssl-server.xml, and ssl-client.xml), including the ssl-server
and ssl-client store files if the Hadoop SSL Keystore Factory uses its own keystore and truststore files, to all nodes in the cluster.

8. Restart services on all nodes in the cluster.

### 3.3.4. Enable SSL on Oozie

The default SSL configuration makes all Oozie URLs use HTTPS except for the JobTracker callback URLs. This simplifies the configuration because no changes are required outside of Oozie. Oozie inherently does not trust the callbacks, they are used as hints.

**Note**

Before you begin ensure that the SSL certificate has been generated and properly configured. By default Oozie uses the user default keystore. In order to access SSL enabled HDP Services through the Knox Gateway, additional configuration on the Knox Gateway is required, see Apache Knox Gateway Administrator Guide, Gateway Security, Configure Wire Encryption.

1. If Oozie server is running, stop Oozie.

2. Change the Oozie environment variables for HTTPS if required:

   - `OOZIE_HTTPS_PORT` set to Oozie HTTPS port. The default value is 11443.

   - `OOZIE_HTTPS_KEYSTORE_FILE` set to the keystore file that contains the certificate information. Default value `${HOME}/.keystore`, that is the home directory of the Oozie user.

   - `OOZIE_HTTPS_KEYSTORE_PASS` set to the password of the keystore file. Default value `password`.

   **Note**

   The see Oozie Environment Setup for more details.

3. Run the following command to enable SSL on Oozie:

   ```bash
   su -l oozie -c "oozie-setup.sh prepare-war -secure"
   ```

4. Start the Oozie server.

   **Note**

   To revert back to un-secured HTTP, run the following command:

   ```bash
   su -l oozie -c "oozie-setup.sh prepare-war"
   ```

### 3.3.4.1. Configure Oozie HCatalogJob Properties

Integrate Oozie Hcatalog by adding following property to `oozie-hcatalog job.properties`. For example if you are using Ambari, set the properties as:

```
hadoop.rpc.protection=privacy
```
3.3.5. Enable SSL on WebHBase and the HBase REST API

Perform the following task to enable SSL on WebHBase and HBase REST API.

1. Verify that the HBase REST API is running, on the HBase Master run:

   ```
   curl http://localhost:60080/
   ```

   If the rest daemon is not running on that port, run the following command to start it:

   ```
   sudo /usr/lib/hbase/bin/hbase-daemon.sh start rest -p 60080
   ```

2. Create and install an SSL certificate for HBase, for example to use a self-signed certificate:

   a. Create an HBase keystore:

      ```
      su -l hbase -c "keytool -genkey -alias hbase -keyalg RSA -keysize 1024 -keystore hbase.jks"
      ```

   b. Export the certificate:

      ```
      su -l hbase -c "keytool -exportcert -alias hbase -file certificate.cert -keystore hbase.jks"
      ```

   c. Add certificate to the Java keystore:

      • If you are not root run:

        ```
        sudo keytool -import -alias hbase -file certificate.cert -keystore /usr/jdk64/jdk1.7.0_45/jre/lib/security/cacerts
        ```

      • If you are root:

        ```
        keytool -import -alias hbase -file certificate.cert -keystore /usr/jdk64/jdk1.7.0_45/jre/lib/security/cacerts
        ```

3. Add the following properties to the `hbase-site.xml` configuration file on each node in your HBase cluster:

   ```
   <property>
     <name>hbase.rest.ssl.enabled</name>
     <value>true</value>
   </property>

   <property>
     <name>hbase.rest.ssl.keystore.store</name>
     <value>hbase.jks</value>
   </property>
   ```
4. Restart all HBase nodes in the cluster.

**Note**

When using a self-signed certificate, manually add the certificate to the JVM truststore on all HBase clients.

### 3.3.6. Enable SSL on HiveServer2

When using HiveServer2 without Kerberos authentication, you can enable SSL.

**Note**

In order to access SSL enabled HDP Services through the Knox Gateway, additional configuration on the Knox Gateway is required, see Apache Knox Gateway Administrator Guide, Gateway Security, Configure Wire Encryption.

Perform the following steps on the HiveServer2:

1. Run the following command to create a keystore for hiveserver2:

   ```bash
   keytool -genkey -alias hbase -keyalg RSA -keysize 1024 -keystore hbase.jks
   ```

2. Edit the `hive-site.xml`, set the following properties to enable SSL:

   ```xml
   <property>
     <name>hive.server2.enable.SSL</name>
     <value>true</value>
     <description></description>
   </property>
   
   <property>
     <name>hive.server2.keystore.path</name>
     <value>$keystore-file-path</value>
     <description></description>
   </property>
   
   <property>
     <name>hive.server2.keystore.password</name>
     <value>$keystore-file-password</value>
     <description></description>
   </property>
   
   3. On the client-side, specify SSL settings for Beeline or JDBC client as follows:
jdbc:hive2://$host:$port/$database;ssl=true;sslTrustStore=$path-to-truststore;trustStorePassword=$password

3.4. Connect to SSL Enabled Components

This section explains how to connect to SSL enabled HDP Components:

- Section 3.4.1, “Connect to SSL Enabled HiveServer2 using JDBC” [55]
- Section 3.4.2, “Connect to SSL Enabled Oozie Server” [55]

Note

In order to access SSL enabled HDP Services through the Knox Gateway, additional configuration on the Knox Gateway is required, see Apache Knox Gateway Administrator Guide, Gateway Security, Configure Wire Encryption.

3.4.1. Connect to SSL Enabled HiveServer2 using JDBC

HiveServer2 implemented encryption with the Java SASL protocol's quality of protection (QOP) setting that allows data moving between a HiveServer2 over JDBC and a JDBC client to be encrypted.

From the JDBC client specify `sasl.sop` as part of the JDBC-Hive connection string, for example `jdbc:hive://hostname/dbname;sasl.qop=auth-int`. For more information on connecting to Hive, see Data Integration Services with HDP, Using Apache Hive: Hive ODBC and JDBC Drivers.

Tip

See HIVE-4911 for more details on this enhancement.

3.4.2. Connect to SSL Enabled Oozie Server

On every Oozie client system, follow the instructions for the type of certificate used in your environment.

3.4.2.1. Use a Self-signed Certificate from Oozie Java Clients

When using a self-signed certificate, you must first install the certificate before the Oozie client can connect to the server.

1. Install the certificate in the keychain:
   a. Copy or download the .cert file onto the client machine.
   b. Run the following command (as root) to import the certificate into the JRE's keystore:

   ```
   sudo keytool -import -alias tomcat -file path/to/certificate.cert -keystore $JRE_cacerts
   ```
Where $JRE_cacerts$ is the path to the JRE's certs file. It's location may differ depending on the Operating System, but its typically called cacerts and located at $JAVA_HOME/lib/security/cacerts. It can be under a different directory in $JAVA_HOME$. The default password is changeit.

Java programs, including the Oozie client, can now connect to the Oozie Server using the self-signed certificate.

2. In the connection strings change HTTP to HTTPS, for example, replace
oozie.server.hostname:11443/oozie.

Java does not automatically redirect HTTP addresses to HTTPS.

3.4.2.2. Connect to Oozie from Java Clients

In the connection strings change HTTP to HTTPS and adjust the port, for example, replace
oozie.server.hostname:11443/oozie.

Java does not automatically redirect HTTP addresses to HTTPS.

3.4.2.3. Connect to Oozie from a Web Browser


When using a Self-Signed Certificate, your browser warns you that it can't verify the certificate. Add the certificate as an exception.