Hortonworks Data Platform

Hadoop Security Guide

(Dec 21, 2015)

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Hortonworks Data Platform : Hadoop Security Guide

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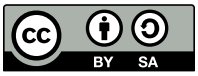

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1. Hadoop Security Features

Central security administration is provided through the the Apache Ranger console, which delivers a 'single pane of glass' for the security administrator. The console ensures consistent security policy coverage across the entire Hadoop stack.

Centralized security administration in a Hadoop environment has four aspects:

- Authentication

  Effected by Kerberos in native Apache Hadoop, and secured by the Apache Knox Gateway via the HTTP/REST API.

- Authorization

  Fine-grained access control provides flexibility in defining policies...

  - on the folder and file level, via HDFS
  - on the database, table and column level, via Hive
  - on the table, column family and column level, via HBase

- Audit

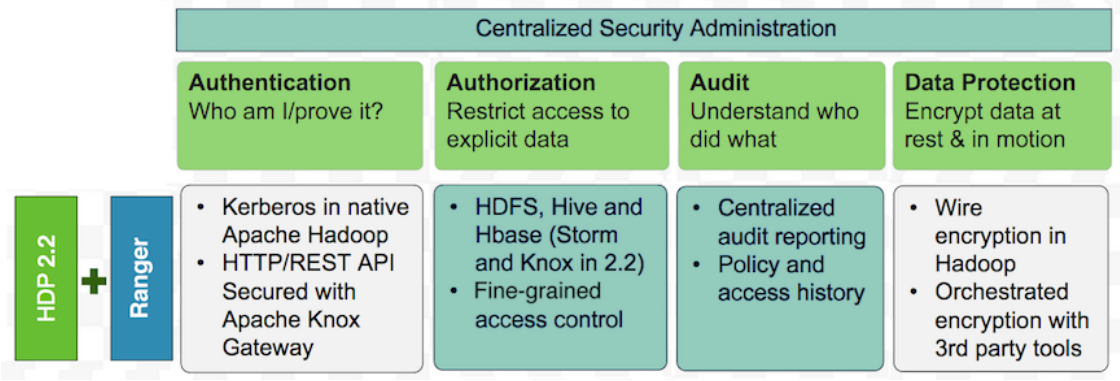
  Controls access into the system via extensive user access auditing in HDFS, Hive and HBase at...

  - IP address
  - Resource/resource type
  - Timestamp
  - Access granted or denied

- Data Protection

  Provided by wire encryption, volume encryption and (via HDFS TDE and Hortonworks partners) file/column encryption

Ranger security administration spans the four aspects of security:



This Security Guide focuses on the following topics:

- Kerberos security
- Wire encryption data protection

For information about configuring and using other aspects of HDP security, see:

- Knox Gateway Administration Guide
- Ranger User Guide
- Installing Ranger Over Ambari
- Configuring Kafka for Kerberos Over Ambari
- Configuring Storm for Kerberos Over Ambari
- Ranger KMS Administration Guide
- Component installation documentation for your cluster (Ambari or non-Ambari)

2. Setting Up Security for Manual Installs

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

- Preparing Kerberos
- Configuring HDP
- Configuring Secure HBase and ZooKeeper
- Configuring Hue
- Setting up One-Way Trust with Active Directory
- Configuring Proxy Users

2.1. Preparing Kerberos

This subsection provides information on setting up Kerberos for an HDP installation.

2.1.1. Kerberos Overview

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 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 three parts:

- A database of users and services (known as *principals*) 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 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*.

Note

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:

     ```
     yum install krb5-server krb5-libs krb5-auth-dialog krb5-workstation
     ```

   - On SLES, run:

     ```
     zypper install krb5 krb5-server krb5-client
     ```

   - On Ubuntu or Debian, run:

     ```
     apt-get install krb5 krb5-server krb5-client
     ```

   Note

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

2. When the server is installed you must edit the two main configuration files.

   Update the KDC configuration by replacing EXAMPLE.COM with your domain and kerberos.example.com with the FQDN of the KDC host. Configuration files are in the following locations:

   - 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
     /var/kerberos/krb5kdc/kdc.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:

     ```
     /usr/sbin/kdb5_util create -s
     ```

   - On SLES:

     ```
     kdb5_util create -s
     ```

   - On Ubuntu or Debian:

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

3. Start **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:

   ```
   /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 assumes that you are using the KDC machine.

5. On the KDC, start Kerberos:

   - On RHEL, CentOS, or Oracle Linux:

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

- On SLES:

```
rckrb5kdc start
rckadmind start
```

- On Ubuntu or Debian:

```
/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. Because 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 create the principal, using mandatory naming conventions. Then create the keytab file with that principal's information, and copy the file to the keytab directory on the appropriate service host.

1. To create a service principal you will use the kadmin utility. This is a command-line driven utility into which you enter Kerberos commands to manipulate the central database. To start kadmin, enter:

   ```
   'kadmin $USER/admin@REALM'
   ```

   To create a service principal, enter the following:

   ```
   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.

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

   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:

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

   b. 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.

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

If you are configuring High Availability (HA) for a Quorom-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 NameNodes 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

Service	Component	Mandatory Principal Name
HDFS	NameNode	nn/*$FQDN*
HDFS	NameNode HTTP	HTTP/*$FQDN*
HDFS	SecondaryNameNode	nn/*$FQDN*
HDFS	SecondaryNameNode HTTP	HTTP/*$FQDN*
HDFS	DataNode	dn/*$FQDN*
MR2	History Server	jhs/*$FQDN*
MR2	History Server HTTP	HTTP/*$FQDN*
YARN	ResourceManager	rm/*$FQDN*
YARN	NodeManager	nm/*$FQDN*
Oozie	Oozie Server	oozie/*$FQDN*
Oozie	Oozie HTTP	HTTP/*$FQDN*
Hive	Hive Metastore HiveServer2	hive/*$FQDN*
Hive	WebHCat	HTTP/*$FQDN*
HBase	MasterServer	hbase/*$FQDN*
HBase	RegionServer	hbase/*$FQDN*
Storm	Nimbus server DRPC daemon	nimbus/*$FQDN* **
Storm	Storm UI daemon Storm Logviewer daemon Nodes running process controller (such as Supervisor)	storm/*$FQDN* **
Kafka	KafkaServer	kafka/*$FQDN*
Hue	Hue Interface	hue/*$FQDN*
ZooKeeper	ZooKeeper	zookeeper/*$FQDN*
JournalNode Server*	JournalNode	jn/*$FQDN*
Gateway	Knox	knox/*$FQDN*

* Only required if you are setting up NameNode HA.

** For more information, see Configure Kerberos Authentication for Storm.

For example: To create the principal for a DataNode service, issue this command:

```
kadmin: addprinc -randkey dn/$datanode-host@$hadoop.realm
```

2. Extract the related keytab file and place it in the keytab directory of the appropriate respective components. The default directory is `/etc/krb5.keytab`.

```
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 the following table.

Table 2.2. Service Keytab File Names

Component	Principal Name	Mandatory Keytab File Name
NameNode	nn/*$FQDN*	nn.service.keytab
NameNode HTTP	HTTP/*$FQDN*	spnego.service.keytab
SecondaryNameNode	nn/*$FQDN*	nn.service.keytab
SecondaryNameNode HTTP	HTTP/*$FQDN*	spnego.service.keytab
DataNode	dn/*$FQDN*	dn.service.keytab
MR2 History Server	jhs/*$FQDN*	nm.service.keytab
MR2 History Server HTTP	HTTP/*$FQDN*	spnego.service.keytab
YARN	rm/*$FQDN*	rm.service.keytab
YARN	nm/*$FQDN*	nm.service.keytab
Oozie Server	oozie/*$FQDN*	oozie.service.keytab
Oozie HTTP	HTTP/*$FQDN*	spnego.service.keytab
Hive Metastore HiveServer2	hive/*$FQDN*	hive.service.keytab
WebHCat	HTTP/*$FQDN*	spnego.service.keytab
HBase Master Server	hbase/*$FQDN*	hbase.service.keytab
HBase RegionServer	hbase/*$FQDN*	hbase.service.keytab
Storm	storm/*$FQDN*	storm.service.keytab
Kafka	kafka/*$FQDN*	kafka.service.keytab
Hue	hue/*$FQDN*	hue.service.keytab
ZooKeeper	zookeeper/*$FQDN*	zk.service.keytab
Journal Server*	jn/*$FQDN*	jn.service.keytab
Knox Gateway**	knox/*$FQDN*	knox.service.keytab

* Only required if you are setting up NameNode HA.

** Only 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.

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 for Kerberos

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.

This section provides information on configuring HDP for Kerberos.

- Creating Mappings Between Principals and UNIX Usernames
- Adding Security Information to Configuration Files
- Configuring Secure HBase and ZooKeeper
- Configuring Hue

Note

You must adhere to the existing upper and lower case naming conventions in the configuration file templates.

2.2.1. 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.

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.

- **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
```

- **The Filter**

  The filter consists of a regular expression (regex) in a parentheses. It 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
```

- **The Substitution**

  The substitution is a sed rule that translates a regex into a fixed string. For example:

```
s/@ACME\.COM// removes the first instance of @ACME.DOMAIN
s/@[A-Z]*\.COM// remove the first instance of @ followed by a name followed
 by COM.
s/X/Y/g replace all of X's in the name with Y
```

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, the following rule would do this:

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

- To translate names with a second component, you could 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:

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

- For SLES and Ubuntu:

```
export JSVC_HOME=/usr/hdp/current/bigtop-utils
```

2.2.3.1. core-site.xml

Add the following information to the `core-site.xml` file on *every* host in your cluster:

Table 2.3. General core-site.xml, Knox, and Hue

Property Name	Property Value	Description
hadoop.security.authentication	kerberos	Set the authentication type for the cluster. Valid values are: simple or kerberos.
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.

Following is 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]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
    </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 Master Node Settings – Knox Gateway

Property Name	Property Value	Description
hadoop.proxyuser.knox.groups	users	Grants proxy privileges for Knox user.
hadoop.proxyuser.knox.hosts	$knox_host_FQDN	Identifies the Knox Gateway host.

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

Table 2.5. core-site.xml Master Node Settings – Hue

Property Name	Property Value	Description
hue.kerberos.principal.shortname	hue	Group to which all the Hue users belong. Use the wild card character to select multiple groups, for example cli*.
hadoop.proxyuser.hue.groups	*	Group to which all the Hue users belong. Use the wild card character to select multiple groups, for example cli*.
hadoop.proxyuser.hue.hosts	*	
hadoop.proxyuser.knox.hosts	$hue_host_FQDN	Identifies the Knox Gateway host.

Following is the XML for both Knox and Hue settings:

```
<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]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
     </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>
```

2.2.3.1.1. HTTP Cookie Persistence

During HTTP authentication, a cookie is dropped. This is a persistent cookie that is valid across browser sessions. For clusters that require enhanced security, it is desirable to have a session cookie that gets deleted when the user closes the browser session.

You can use the following `core-site.xml` property to specify cookie persistence across browser sessions.

```
<property>
   <name>hadoop.http.authentication.cookie.persistent</name>
   <value>true</value>
</property>
```

The default value for this property is `false`.

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 2.6. hdfs-site.xml File Property Settings

Property Name	Property Value	Description
dfs.permissions.enabled	true	If true, permission checking in HDFS is enabled. If false, permission checking is turned off, but all other behavioris unchanged. Switching from one parameter value to the other does not

Property Name	Property Value	Description
		change the mode, owner or group of files or directories.
dfs.permissions.supergroup	hdfs	The name of the group of super-users.
dfs.block.access.token.enable	true	If true, access tokens are used as capabilities for accessing DataNodes. If false, no access tokens are checked on accessing DataNodes.
dfs.namenode.kerberos.principal	nn/_HOST@EXAMPLE.COM	Kerberos principal name for the NameNode.
dfs.secondary.namenode.kerberos.principal	nn/_HOST@EXAMPLE.COM	Kerberos principal name for the secondary NameNode.
dfs.web.authentication.kerberos.principal	HTTP/_HOST@EXAMPLE.COM	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.
dfs.web.authentication.kerberos.keytab	/etc/security/keytabs/spnego.service.keytab	The Kerberos keytab file with the credentials for the HTTP Kerberos principal used by Hadoop-Auth in the HTTP endpoint.
dfs.datanode.kerberos.principal	dn/_HOST@EXAMPLE.COM	The Kerberos principal that the DataNode runs as. "_HOST" is replaced by the real host name.
dfs.namenode.keytab.file	/etc/security/keytabs/nn.service.keytab	Combined keytab file containing the NameNode service and host principals.
dfs.secondary.namenode.keytab.file	/etc/security/keytabs/nn.service.keytab	Combined keytab file containing the NameNode service and host principals. <question?>
dfs.datanode.keytab.file	/etc/security/keytabs/dn.service.keytab	The filename of the keytab file for the DataNode.
dfs.https.port	50470	The HTTPS port to which the NameNode binds.
dfs.namenode.https-address	Example: ip-10-111-59-170.ec2.internal:50470	The HTTPS address to which the NameNode binds.
dfs.datanode.data.dir.perm	750	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.
dfs.cluster.administrators	hdfs	ACL for who all can view the default servlets in the HDFS.
dfs.namenode.kerberos.internal.spnego.principal	${dfs.web.authentication.kerberos.principal}	
dfs.secondary.namenode.kerberos.internal.spnego.principal	${dfs.web.authentication.kerberos.principal}	

Following is the XML for these entries:

```
<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
     super-users.</description>
</property>

<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>

<property>
     <!--cluster variant -->
     <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 upto 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:

```
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 Property Settings

Property	Value	Description
yarn.resourcemanager.principal	yarn/localhost@EXAMPLE.COM	The Kerberos principal for the ResourceManager.
yarn.resourcemanager.keytab	/etc/krb5.keytab	The keytab for the ResourceManager.
yarn.nodemanager.principal	yarn/localhost@EXAMPLE.COM	The Kerberos principal for the NodeManager.
yarn.nodemanager.keytab	/etc/krb5.keytab	The keytab for the NodeManager.
yarn.nodemanager.container-executor.class	org.apache.hadoop.yarn.server.nodemanager.LinuxContainer Executor	The class that will execute (launch) the containers.
yarn.nodemanager.linux-container-executor.path	hadoop-3.0.0-SNAPSHOT/bin/container-executor	The path to the Linux container executor.
yarn.nodemanager.linux-container-executor.group	hadoop	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.
yarn.timeline-service.principal	yarn/localhost@EXAMPLE.COM	The Kerberos principal for the Timeline Server.
yarn.timeline-service.keytab	/etc/krb5.keytab	The Kerberos keytab for the Timeline Server.
yarn.resourcemanager.webapp.delegation-token-auth-filter.enabled	true	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.
yarn.timeline-service.http-authentication.type	kerberos	Defines authentication used for the Timeline Server HTTP endpoint. Supported values are: simple | kerberos | $AUTHENTICATION_HANDLER _CLASSNAME
yarn.timeline-service.http-authentication.kerberos.principal	HTTP/localhost@EXAMPLE.COM	The Kerberos principal to be used for the Timeline Server HTTP endpoint.
yarn.timeline-service.http-authentication.kerberos.keytab	authentication.kerberos.keytab /etc/krb5.keytab	The Kerberos keytab to be used for the Timeline Server HTTP endpoint.

Following is the XML for these entries:

```
<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>

<property>
     <name>yarn.nodemanager.container-executor.class</name>
     <value>org.apache.hadoop.yarn.server.nodemanager.LinuxContainerExecutor</
value>
</property>

<property>
     <name>yarn.nodemanager.linux-container-executor.path</name>
     <value>hadoop-3.0.0-SNAPSHOT/bin/container-executor</value>
</property>

<property>
     <name>yarn.nodemanager.linux-container-executor.group</name>
     <value>hadoop</value>
</property>

<property>
     <name>yarn.timeline-service.principal</name>
     <value>yarn/localhost@EXAMPLE.COM</value>
</property>

<property>
     <name>yarn.timeline-service.keytab</name>
     <value>/etc/krb5.keytab</value>
</property>

<property>
     <name>yarn.resourcemanager.webapp.delegation-token-auth-filter.enabled</
name>
     <value>true</value>
</property>

<property>
     <name>yarn.timeline-service.http-authentication.type</name>
     <value>kerberos</value>
</property>

<property>
     <name>yarn.timeline-service.http-authentication.kerberos.principal</name>
     <value>HTTP/localhost@EXAMPLE.COM</value>
</property>

<property>
     <name>yarn.timeline-service.http-authentication.kerberos.keytab</name>
     <value>/etc/krb5.keytab</value>
</property>
```

2.2.3.4. mapred-site.xml

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

Table 2.8. mapred-site.xml Property Settings

Property Name	Property Value	Description
mapreduce.jobhistory.keytab	/etc/security/keytabs/jhs.service.keytab	Kerberos keytab file for the MapReduce JobHistory Server.
mapreduce.jobhistory.principal	jhs/_HOST@TODO-KERBEROS-DOMAIN	Kerberos principal name for the MapReduce JobHistory Server.
mapreduce.jobhistory.webapp.address	TODO-JOBHISTORYNODE-HOSTNAME:19888	MapReduce JobHistory Server Web UI host:port
mapreduce.jobhistory.webapp.https.address	TODO-JOBHISTORYNODE-HOSTNAME:19889	MapReduce JobHistory Server HTTPS Web UI host:port
mapreduce.jobhistory.webapp.spnego-keytab-file	/etc/security/keytabs/spnego.service.keytab	Kerberos keytab file for the spnego service.
mapreduce.jobhistory.webapp.spnego-principal	HTTP/_HOST@TODO-KERBEROS-DOMAIN	Kerberos principal name for the spnego service.

Following is the XML for these entries:

```
<property>
     <name>mapreduce.jobhistory.keytab</name>
     <value>/etc/security/keytabs/jhs.service.keytab</value>
</property>

<property>
     <name>mapreduce.jobhistory.principal</name>
     <value>jhs/_HOST@TODO-KERBEROS-DOMAIN</value>
</property>

<property>
     <name>mapreduce.jobhistory.webapp.address</name>
     <value>TODO-JOBHISTORYNODE-HOSTNAME:19888</value>
</property>

<property>
     <name>mapreduce.jobhistory.webapp.https.address</name>
     <value>TODO-JOBHISTORYNODE-HOSTNAME:19889</value>
</property>

<property>
     <name>mapreduce.jobhistory.webapp.spnego-keytab-file</name>
     <value>/etc/security/keytabs/spnego.service.keytab</value>
</property>

<property>
     <name>mapreduce.jobhistory.webapp.spnego-principal</name>
     <value>HTTP/_HOST@TODO-KERBEROS-DOMAIN</value>
</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. Add the following information to the `hbase-site.xml` file on your HBase server. There are no default values; the following are only examples:

Table 2.9. hbase-site.xml Property Settings – HBase Server

Property Name	Property Value	Description
hbase.master.keytab.file	/etc/security/keytabs/hm.service.keytab	The keytab for the HMaster service principal.
hbase.master.kerberos.principal	hm/_HOST@EXAMPLE.COM	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.
hbase.regionserver.keytab.file	/etc/security/keytabs/rs.service.keytab	The keytab for the HRegionServer service principal.
hbase.regionserver.kerberos.principal	rs/_HOST@EXAMPLE.COM	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.
hbase.superuser	hbase	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.
hbase.coprocessor.region.classes		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.
hbase.coprocessor.master.classes		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.

Following is the XML for these entries:

```
<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.
    </description>
</property>

<property>
    <name>hbase.coprocessor.master.classes</name>
    <value></value>
    <description>A 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.
    </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.

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

Table 2.10. hive-site.xml Property Settings

Property Name	Property Value	Description
hive.metastore.sasl.enabled	true	If true, the Metastore Thrift interface will be secured with SASL and clients must authenticate with Kerberos.
hive.metastore.kerberos.keytab.file	/etc/security/keytabs/hive.service.keytab	The keytab for the Metastore Thrift service principal.
hive.metastore.kerberos.principal	hive/_HOST@EXAMPLE.COM	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.
hive.metastore.cache.pinobjtypes	Table,Database,Type, FieldSchema,Order	Comma-separated Metastore object types that should be pinned in the cache.

Following is the XML for these entries:

```
<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. The
    special string _HOST will be replaced automatically with the correct
    hostname.</description>
</property>

<property>
    <name>hive.metastore.cache.pinobjtypes</name>
```

```
    <value>Table,Database,Type,FieldSchema,Order</value>
    <description>List of comma separated metastore object types that should
 be pinned in
    the cache
    </description>
</property>
```

2.2.3.7. oozie-site.xml

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

Table 2.11. oozie-site.xml Property Settings

Property Name	Property Value	Description
oozie.service.AuthorizationService.security.enabled	true	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.
oozie.service.HadoopAccessorService.kerberos.enabled	true	Indicates if Oozie is configured to use Kerberos.
local.realm	EXAMPLE.COM	Kerberos Realm used by Oozie and Hadoop. Using local.realm to be aligned with Hadoop configuration.
oozie.service.HadoopAccessorService.keytab.file	/etc/security/keytabs/oozie.service.keytab	The keytab for the Oozie service principal.
oozie.service.HadoopAccessorService.kerberos.principaloozie/_HOSTl@EXAMPLE.COM	oozie/_HOSTl@EXAMPLE.COM	Kerberos principal for Oozie service.
oozie.authentication.type	kerberos	
oozie.authentication.kerberos.principal	HTTP/_HOST@EXAMPLE.COM	Whitelisted job tracker for Oozie service.
oozie.authentication.kerberos.keytab	/etc/security/keytabs/spnego.service.keytab	Location of the Oozie user keytab file.
oozie.service.HadoopAccessorService.nameNode.whitelist		
oozie.authentication.kerberos.name.rules	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.
oozie.service.ProxyUserService.proxyuser.knox.groups	users	Grant proxy privileges to the Knox user. Note only required when using a Knox Gateway.
oozie.service.ProxyUserService.proxyuser.knox.hosts	$knox_host_FQDN	Identifies the Knox Gateway. Note only required when using a Knox Gateway.

2.2.3.8. webhcat-site.xml

To the `webhcat-site.xml` file, add the following information:

Table 2.12. webhcat-site.xml Property Settings

Property Name	Property Value	Description
templeton.kerberos.principal	HTTP/_HOST@EXAMPLE.COM	

Property Name	Property Value	Description
templeton.kerberos.keytab	/etc/security/keytabs/ spnego.service.keytab	
templeton.kerberos.secret	secret	
hadoop.proxyuser.knox.groups	users	Grant proxy privileges to the Knox user. Note only required when using a Knox Gateway.
hadoop.proxyuser.knox.hosts	$knox_host_FQDN	Identifies the Knox Gateway. Note only required when using a Knox Gateway.

2.2.3.9. limits.conf

Adjust the Maximum Number of Open Files and Processes

In a secure cluster, if the DataNodes are started as the root user, JSVC downgrades the processing using setuid to hdfs. However, the ulimit is based on the ulimit of the root user, and the default ulimit values assigned to the root user for the maximum number of open files and processes may be too low for a secure cluster. This can result in a "Too Many Open Files" exception when the DataNodes are started.

Therefore, when configuring a secure cluster you should increase the following root ulimit values:

- nofile: The maximum number of open files. Recommended value: 32768
- nproc: The maximum number of processes. Recommended value: 65536

To set system-wide ulimits to these values, log in as root and add the following lines to the the `/etc/security/limits.conf` file on *every* host in your cluster:

```
* - nofile 32768
* - nproc 65536
```

To set only the root user ulimits to these values, log in as root and add the following lines to the the `/etc/security/limits.conf` file.

```
root - nofile 32768
root - nproc 65536
```

You can use the ulimit -a command to view the current settings:

```
[root@node-1 /]# ulimit -a
core file size (blocks, -c) 0
data seg size (kbytes, -d) unlimited
scheduling priority (-e) 0
file size (blocks, -f) unlimited
pending signals (-i) 14874
max locked memory (kbytes, -l) 64
max memory size (kbytes, -m) unlimited
open files (-n) 1024
pipe size (512 bytes, -p) 8
POSIX message queues (bytes, -q) 819200
real-time priority (-r) 0
stack size (kbytes, -s) 10240
cpu time (seconds, -t) unlimited
```

```
max user processes (-u) 14874
virtual memory (kbytes, -v) unlimited
file locks (-x) unlimited
```

You can also use the ulimit command to dynamically set these limits until the next reboot. This method sets a temporary value that will revert to the settings in the `/etc/security/limits.conf` file after the next reboot, but it is useful for experimenting with limit settings. For example:

```
[root@node-1 /]# ulimit -n 32768
```

The updated value can then be displayed:

```
[root@node-1 /]# ulimit -n
32768
```

2.2.4. Configuring 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)

2.2.4.1. 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
 thatshould be used to run the HRegionServer process.
The principal name should be in the form: user/hostname@DOMAIN.
If _HOSTis used as the hostname portion, it will be replaced with the actual
 hostname of the runninginstance.
An entry for this principal must existin 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>org.apache.hadoop.hbase.security.token.TokenProvider,org.
apache.hadoop.hbase.security.access.SecureBulkLoadEndpoint,org.apache.hadoop.
hbase.security.access.AccessController </value>
        <description>A comma-separated list of Coprocessors that are loaded by
 default on all tables.
        </description>
</property>
```

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

</property>
```

```
<property>
        <name>hbase.rpc.engine</name>
        <value>org.apache.hadoop.hbase.ipc.SecureRpcEngine</value>

</property>
```

```
<property>
        <name>hbase.security.authorization</name>
        <value>true</value>
        <description>Enables HBase authorization. Set the value of this
 property to false to disable HBase authorization.
        </description>

</property>
```

```
<property>
        <name>hbase.coprocessor.master.classes</name>
        <value>org.apache.hadoop.hbase.security.access.AccessController</
value>

</property>
```

```
<property>
        <name>hbase.bulkload.staging.dir</name>
        <value>/apps/hbase/staging</value>
        <description>Directory in the default filesystem, owned by the hbase
 user, and has permissions(-rwx--x--x, 711) </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.

2.2.4.2. 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:

   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:

     ```
     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:

```
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:

```
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:

```
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:

```
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:

```
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:

```
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:

```
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`.

2.2.4.3. Start HBase and ZooKeeper services

Start the HBase and ZooKeeper services using the instructions provided in the HDP Reference Manual, Starting HDP Services.

If the configuration is successful, you should see the following in your ZooKeeper server logs:

```
11/12/05 22:43:39 INFO zookeeper.Login: successfully logged in.
11/12/05 22:43:39 INFO server.NIOServerCnxnFactory: binding to port 0.0.0.0/0.
0.0.0:2181
11/12/05 22:43:39 INFO zookeeper.Login: TGT refresh thread started.
11/12/05 22:43:39 INFO zookeeper.Login: TGT valid starting at:        Mon Dec
 05 22:43:39 UTC 2011
11/12/05 22:43:39 INFO zookeeper.Login: TGT expires:                  Tue Dec
 06 22:43:39 UTC 2011
11/12/05 22:43:39 INFO zookeeper.Login: TGT refresh sleeping until: Tue Dec 06
 18:36:42 UTC 2011
..
11/12/05 22:43:59 INFO auth.SaslServerCallbackHandler:
  Successfully authenticated client: authenticationID=hbase/ip-10-166-175-249.
us-west-1.compute.internal@HADOOP.LOCALDOMAIN;
  authorizationID=hbase/ip-10-166-175-249.us-west-1.compute.internal@HADOOP.
LOCALDOMAIN.
11/12/05 22:43:59 INFO auth.SaslServerCallbackHandler: Setting authorizedID:
 hbase
11/12/05 22:43:59 INFO server.ZooKeeperServer: adding SASL authorization for
 authorizationID: hbase
```

2.2.4.4. 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:

```
<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.rpc.engine</name>
        <value>org.apache.hadoop.hbase.ipc.SecureRpcEngine</value>

</property>
```

2.2.4.5. 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:

```
<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.

2.2.4.6. 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:

```
<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.

2.2.4.7. 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:

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

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

   ```
   hbase shell
   ```

3. Set ACLs using HBase shell:

```
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').

2.2.5. Configuring Hue

To enable Hue to work with a HDP cluster configured for Kerberos, make the following changes to Hue and Kerberos.

1. Configure Kerberos as described in Setting Up Security for Manual Installs.
2. Create a principal for the Hue Server.

```
addprinc -randkey hue/$FQDN@EXAMPLE.COM
```

where $FQDN is the hostname of the Hue Server and EXAMPLE.COM is the Hadoop realm.

3. Generate a keytab for the Hue principal.

```
xst -k hue.service.keytab hue/$FQDN@EXAMPLE.COM
```

4. Place the keytab file on the Hue Server. Set the permissions and ownership of the keytab file.

```
/etc/security/keytabs/hue.service.keytab
chown hue:hadoop /etc/security/keytabs/hue.service.keytab
chmod 600 /etc/security/keytabs/hue.service.keytab
```

5. Confirm the keytab is accessible by testing kinit.

```
su - hue kinit -k -t /etc/security/keytabs/hue.service.keytab hue/
$FQDN@EXAMPLE.COM
```

6. Add the following to the [kerberos] section in the `/etc/hue/conf/hue.ini` configuration file.

```
[[kerberos]]
# Path to Hue's Kerberos keytab file
hue_keytab=/etc/security/keytabs/hue.service.keytab
# Kerberos principal name for Hue
hue_principal=hue/$FQDN@EXAMPLE.COM
```

7. Set the path to the kinit based on the OS.

```
# Path to kinit
```

```
# For RHEL/CentOS 6.x, kinit_path is /usr/bin/kinit
kinit_path=/usr/kerberos/bin/kinit
```

8. Set security_enabled=true for every component in hue.ini.

```
[[hdfs_clusters]], [[yarn_clusters]], [[liboozie]], [[hcatalog]]
```

9. Save the hue.ini file.

10. Restart Hue:

```
# /etc/init.d/hue start
```

2.3. 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.

Important

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

2.3.1. 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:

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

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

```
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:

```
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:

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

Set encryption types based on your security requirements. Mismatched encryption types cause 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.

2.3.2. 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:
   - To libdefaults, add the following properties.
     - Set 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
       ```

   - Add a realm for the AD domain:

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

   - Save the krb5.conf 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
```

When defining encryption, be sure to also enter the encryption type (e.g., 'normal')

2.4. Configuring Proxy Users

For information about configuring a superuser account that can submit jobs or access HDFS on behalf of another user, see the following information on the Apache site:

Proxy user - Superusers Acting on Behalf of Other Users.

3. Data Protection: Wire Encryption

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

- *Clients* typically communicate directly with the Hadoop cluster. Data can be protected using RPC encryption or Data Transfer Protocol:
  - **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 as follows:
  - **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-cluster communication between processes can be protected using HTTPS encryption during MapReduce shuffle:
  - **HTTPS encryption during shuffle**: When 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; it acts as an SSL client.

This chapter provides information about configuring and connecting to wire-encrypted components.

For information about configuring HDFS data-at-rest encryption, see HDFS "Data at Rest" Encryption.

3.1. Enabling RPC Encryption

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`.

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

(Also supported are the 'authentication' and 'integrity' settings.)

3.2. Enabling 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.encryt.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`:

```
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 via `http://<SNN>:50090`. WebHDFS, hsftp, and shortcircuitread are not supported when SSL is enabled.

3.3. Enabling SSL: Understanding the Hadoop SSL Keystore Factory

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

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

Table 3.1. Components that Support SSL

Component	Service	SSL Management
HDFS	WebHDFS	Hadoop SSL Keystore Factory
MapReduce	Shuffle	Hadoop SSL Keystore Factory
	TaskTracker	Hadoop SSL Keystore Factory
Yarn	Resource Manager	Hadoop SSL Keystore Factory

Component	Service	SSL Management
	JobHistory	Hadoop SSL Keystore Factory
Oozie		Configured in oozie-site.xml
HBase	REST API	Configured in hbase-site.xml
Hive	HiveServer2	Configured in hive-site.xml
Kafka		JDK: User and default
Solr		JDK: User and default
Accumulo		JDK: User and default
Falcon	REST API	JDK: User and default
Knox	Hadoop cluster (REST client)	JDK: default only
	Knox Gateway server	JDK: User and default
HDP Security Administration	Server/Agent	JDK: User and default

When enabling support for SSL, it is important to know which SSL Management method is being used by the Hadoop service. Services that are co-located on a host must configure the server certificate and keys, and in some cases the client truststore, in 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 list describes major differences between certificates managed by the Hadoop SSL Keystore Management Factory and certificates managed by JDK:

- 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 central 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. Typically, this 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.

Note

For more information on JDK SSL Management, see "Using SSL" in Monitoring and Managing Using JMX Technology.

3.4. Creating and Managing SSL Certificates

This section contains the following topics:

- Obtaining a certificate from a third-party Certificate Authority (CA)
- Creating an internal CA (OpenSSL)
- Installing Certificates in the Hadoop SSL Keystore Factory (HDFS, MapReduce, and YARN)
- Using an internal CA (OpenSSL)

Note

For more information about the `keytool` utility, see the Oracle keytool reference: keytool - Key and Certificate Management Tool.

For more information about OpenSSL, see OpenSSL Documentation.

Note

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

3.4.1. Obtain a Certificate from a Trusted Third-Party Certification Authority (CA)

A third-party Certification Authority (CA) accepts certificate requests from entities, authenticates applications, issues certificates, and maintains status information about certificates. Associated cryptography guarantees that a signed certificate is computationally difficult to forge. Thus, as long as the CA is a genuine and trusted authority, clients have high assurance that they are connecting to the machines that they are attempting to connect with.

To obtain a certificate signed by a third-party CA, generate and submit a Certificate Signing Request (CSR) for each cluster node:

1. From the service user account associated with the component (such as `hive`, `hbase`, `oozie`, or `hdfs`, shown below as `<service_user>`), generate the host key:

```
su -l <service_user> -C "keytool -keystore <client-keystore> -genkey -alias
 <host>"
```

2. At the prompts, enter the information required by the CSR.

Note

Request generation information and requirements vary depending on the certificate authority. Check with your CA for details.

Example using default keystore `keystore.jks`:

```
su -l hdfs -c "keytool -keystore keystore.jks -genkey -alias n3"
```

```
Enter keystore password: ********
What is your first and last name?
[Unknown]:  hortonworks.com
What is the name of your organizational unit?
[Unknown]:  Development
What is the name of your organization?
[Unknown]:  Hortonworks
What is the name of your City or Locality?
[Unknown]:  SantaClara
What is the name of your State or Province?
[Unknown]:  CA
What is the two-letter country code for this unit?
[Unknown]:  US
Is <CN=hortonworks.com, OU=Development, O=Hortonworks, L=SantaClara, ST=CA,
C=US correct?
[no]:  yes

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

By default, `keystore` uses JKS format for the keystore and truststore. The keystore file is created in the user's home directory. Access to the keystore requires the password and alias.

3. Verify that the key was generated; for example:

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

4. Create the CSR file:

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

This command generates a certificate signing request that can be sent to a CA. The file `<host>.csr` contains the CSR.

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

5. Confirm that the `keystore.jks` and `<host>.csr` files exist by running the following command and making sure that the files are listed in the output:

```
su -l hdfs -c "ls ~/"
```

6. Submit the CSR to your Certificate Authority.

7. To import and install keys and certificates, follow the instructions sent to you by the CA.

3.4.2. Create and Set Up an Internal CA (OpenSSL)

OpenSSL provides tools to allow you to create your own private certificate authority.

Considerations:

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

Note

When accessing the service from a client application such as HiveCLI or cURL, 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.

Prerequisite: Install `openssl`. For example, on CentOS run `yum install openssl`.

To create and set up a CA:

1. Generate the key and certificate for a component process.

   The first step in deploying HTTPS for a component process (for example, Kafka broker) is to generate the key and certificate for each node in the cluster. You can use the Java `keytool` utility to accomplish this task. Start with a temporary keystore, so that you can export and sign it later with the CA.

   Use the following `keytool` command to create the key and certificate:

   ```
   $ keytool -keystore <keystore-file> -alias localhost -validity <validity> -
   genkey
   ```

   where:

   `<keystore-file>` is the keystore file that stores the certificate. The keystore file contains the private key of the certificate; therefore, it needs to be kept safely.

   `<validity>` is the length of time (in days) that the certificate will be valid.

   Make sure that the common name (CN) matches the fully qualified domain name (FQDN) of the server. The client compares the CN with the DNS domain name to ensure that it is indeed connecting to the desired server, not a malicious server.

2. Create the Certificate Authority (CA)

   After step 1, each machine in the cluster has a public-private key pair and a certificate that identifies the machine. The certificate is unsigned, however, which means that an attacker can create such a certificate to pretend to be any machine.

   To prevent forged certificates, it is very important to sign the certificates for each machine in the cluster.

   A CA is responsible for signing certificates, and associated cryptography guarantees that a signed certificate is computationally difficult to forge. Thus, as long as the CA is a genuine and trusted authority, the clients have high assurance that they are connecting to the machines that they are attempting to connect with.

   Here is a sample `openssl` command to generate a CA:

   ```
   openssl req -new -x509 -keyout ca-key -out ca-cert -days 365
   ```

   The generated CA is simply a public-private key pair and certificate, intended to sign other certificates.

3. Add the generated CA to the *server's* truststore:

```
keytool -keystore server.truststore.jks -alias CARoot -import -file ca-cert
```

4. Add the generated CA to the *client's* truststore, so that clients know that they can trust this CA:

```
keytool -keystore client.truststore.jks -alias CARoot -import -file ca-cert
```

   In contrast to the keystore in step 1 that stores each machine's own identity, the truststore of a client stores all of the certificates that the client should trust. Importing a certificate into one's truststore also means trusting all certificates that are signed by that certificate.

   Trusting the CA means trusting all certificates that it has issued. This attribute is called a "chain of trust," and is particularly useful when deploying SSL on a large cluster. You can sign all certificates in the cluster with a single CA, and have all machines share the same truststore that trusts the CA. That way all machines can authenticate all other machines.

5. Sign all certificates generated in Step 1 with the CA generated in Step 2:

   a. Export the certificate from the keystore:

```
keytool -keystore server.keystore.jks -alias localhost -certreq -file
 cert-file
```

   b. Sign the certificate with the CA:

```
openssl x509 -req -CA ca-cert -CAkey ca-key -in cert-file -out cert-
signed -days <validity> -CAcreateserial -passin pass:<ca-password>
```

6. Import the CA certificate and the signed certificate into the keystore. For example:

```
$ keytool -keystore server.keystore.jks -alias CARoot -import -file ca-cert
$ keytool -keystore server.keystore.jks -alias localhost -import -file cert-
signed
```

   The parameters are defined as follows:

Parameter	Description
`keystore`	The location of the keystore
`ca-cert`	The certificate of the CA
`ca-key`	The private key of the CA
`ca-password`	The passphrase of the CA
`cert-file`	The exported, unsigned certificate of the server
`cert-signed`	The signed certificate of the server

All of the preceding steps can be placed into a bash script.

In the following example, note that one of the commands assumes a password of `test1234`. Specify your own password before running the script.

```
#!/bin/bash

#Step 1
keytool -keystore server.keystore.jks -alias localhost -validity 365 -genkey
```

```
#Step 2
openssl req -new -x509 -keyout ca-key -out ca-cert -days 365
keytool -keystore server.truststore.jks -alias CARoot -import -file ca-cert
keytool -keystore client.truststore.jks -alias CARoot -import -file ca-cert

#Step 3
keytool -keystore server.keystore.jks -alias localhost -certreq -file cert-
file
openssl x509 -req -CA ca-cert -CAkey ca-key -in cert-file -out cert-signed -
days 365 -CAcreateserial -passin pass:test1234
keytool -keystore server.keystore.jks -alias CARoot -import -file ca-cert
keytool -keystore server.keystore.jks -alias localhost -import -file cert-
signed
```

To finish the setup process:

1. Set up the CA directory structure:

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

2. 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
   ```

3. Add required files:

   ```
   touch /root/CA/index.txt; echo 1000 >> /root/CA/serial
   ```

4. Set permissions on the `ca.key`:

   ```
   chmod 0400 /root/ca/private/ca.key
   ```

5. Open the OpenSSL configuration file:

   ```
   vi /etc/pki/tls/openssl.cnf
   ```

6. Change the directory paths to match your environment:

   ```
   [ CA_default ]

   dir             = /root/CA                  # Where everything is kept
   certs           = /root/CA/certs            # Where the issued certs are
    kept
   crl_dir         = /root/CA/crl              # Where the issued crl are kept
   database        = /root/CA/index.txt        # database index file.
   #unique_subject = no                        # Set to 'no' to allow creation
    of
                                               # several certificates with same
    subject.
   new_certs_dir   = /root/CA/newcerts         # default place for new certs.

   certificate     = /root/CA/cacert.pem       # The CA certificate
   serial          = /root/CA/serial           # The current serial number
   crlnumber       = /root/CA/crlnumber        # the current crl number
                                               # must be commented out to leave
    a V1 CRL
   crl             = $dir/crl.pem               # The current CRL
   private_key     = /root/CA/private/cakey.pem # The private key
   ```

```
RANDFILE        = /root/CA/private/.rand     # private random number file

x509_extensions = usr_cert              # The extensions to add to the cert
```

7. Save the changes and restart OpenSSL.

Example of setting up an 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) []:California
Locality Name (eg, city) [Default City]:SantaClara
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
```

3.4.3. Installing Certificates in the Hadoop SSL Keystore Factory (HDFS, MapReduce, and YARN)

HDFS, MapReduce, and YARN 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 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 certificate 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>
chgrp -R <YARN_USER>:hadoop <CLIENT_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 and the `hadoop` group.

3.4.4. Using a CA-Signed Certificate

To use a CA-signed certificate:

1. Run the following command to create a self-signing rootCA and import the rootCA into the client truststore. This is a private key; it should be kept private. The following command creates a 2048-bit key:

```
openssl genrsa -out <clusterCA>.key 2048
```

2. Self-sign the rootCA. The following command signs for 300 days. It will start an interactive script that requests name and location information.

```
openssl req -x509 -new -key <clusterCA>.key -days 300 -out <clusterCA>
```

3. Import the rootCA into the client truststore:

```
keytool -importcert -alias <clusterCA> -file $clusterCA -keystore
 <clustertruststore> -storepass <clustertruststorekey>
```

Note

Make sure that the `ssl-client.xml` file on every host is configured to use this `$clustertrust` store.

When configuring with Hive point to this file; when configuring other services install the certificate in the Java truststore.

4. For each host, sign the certreq file with the rootCA:

```
openssl x509 -req -CA $clusterCA.pem -CAkey <clusterCA>.key -in <host>.cert
 -out $host.signed -days 300 -CAcreateserial
```

5. On each host, import the 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>
```

3.5. Enabling SSL for HDP Components

The following table contains links to instructions for enabling SSL on specific HDP components.

Note

These instructions assume that you have already created keys and signed certificates for each component of interest, across your cluster. (See Section 3.3, "Enabling SSL: Understanding the Hadoop SSL Keystore Factory" [38] for more information.)

Table 3.2. Configure SSL Data Protection for HDP Components

HDP Component	Notes/Link
Hadoop, MapReduce, YARN	Section 3.1, "Enabling RPC Encryption" [37]; Section 3.5.1, "Enable SSL for WebHDFS, MapReduce Shuffle, and YARN" [47]
Oozie	Section 3.5.2, "Enable SSL on Oozie" [50]
HBase	Section 3.5.3, "Enable SSL on WebHBase and the HBase REST API" [51]
Hive (HiveServer2)	Section 3.5.4, "Enable SSL on HiveServer2" [53]
Kafka	Section 3.5.5, "Enable SSL for Kafka Clients" [53]
Ambari Server	Ambari Security Guide, Advanced Security Options, Optional: Set Up SSL for Ambari
Falcon	Enabled by default (see Installing the Falcon Package)
Sqoop	Clients of Hive and HBase, see Data Integration Services with HDP, Apache Sqoop Connectors
Knox Gateway	Knox Administrator Guide, Gateway Security, Configure Wire Encryption
Flume	Apache Flume User Guide, Flume Sources
Accumulo	Apache Foundation Blog, Apache Accumulo: Generating Keystores for configuring Accumulo with SSL
Phoenix	Non-Ambari Cluster Installation, Installing Apache Phoenix: Configuring Phoenix for Security and Apache Phoenix, Flume Plug-in
HUE	Non-Ambari Cluster Installation, Installing Hue, Configure Hue

3.5.1. Enable SSL for WebHDFS, MapReduce Shuffle, and YARN

This section explains how to set up SSL for WebHDFS, YARN and MapReduce. Before you begin, make sure 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): The server and clients validate each others' identities. 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 Administrator 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.FileBasedK

   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`:

   ```
   mapreduce.jobhistory.http.policy=HTTPS_ONLY
   ```

```
mapreduce.jobhistory.webapp.https.address=<JHS>:<JHS_HTTPS_PORT>
```

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

   ```
   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

Property	Default Value	Description
`ssl.server.keystore.type`	JKS	The type of the keystore, JKS = Java Keystore, the de-facto standard in Java
`ssl.server.keystore.location`	None	The location of the keystore file
`ssl.server.keystore.password`	None	The password to open the keystore file
`ssl.server.truststore.type`	JKS	The type of the trust store
`ssl.server.truststore.location`	None	The location of the truststore file
`ssl server.truststore.password`	None	The password to open the truststore

   For example:

   ```
   <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>

   <property>
     <name>ssl.server.truststore.type</name>
     <value>jks</value>
     <description>Optional. The keystore file format, default value is
    "jks".</description>
   </property>

   <property>
     <name>ssl.server.truststore.reload.interval</name>
   ```

```
  <value>10000</value>
  <description>Truststore reload check interval, in milliseconds.
  Default value is 10000 (10 seconds).</description>
</property>

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

<property>
  <name>ssl.server.keystore.password</name>
  <value>changeit</value>
  <description>Must be specified.</description>
</property>

<property>
  <name>ssl.server.keystore.keypassword</name>
  <value>changeit</value>
  <description>Must be specified.</description>
</property>

<property>
  <name>ssl.server.keystore.type</name>
  <value>jks</value>
  <description>Optional. The keystore file format, default value is
 "jks".</description>
</property>
```

6. Create an `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 it's own keystore and truststore files, to all nodes in the cluster.

8. Restart services on all nodes in the cluster.

3.5.2. 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

See Oozie Environment Setup for more details.

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

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

4. Start the Oozie server.

Note

To revert back to unsecured HTTP, run the following command:

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

3.5.2.1. 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
```

Note

This property is in addition to any properties you must set for secure clusters.

3.5.3. Enable SSL on WebHBase and the HBase REST API

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

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.

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>/path/to/keystore</value>
   </property>

   <property>
       <name>hbase.rest.ssl.keystore.password</name>
       <value>keystore-password</value>
   </property>

   <property>
       <name>hbase.rest.ssl.keystore.keypassword</name>
   ```

```
    <value>key-password</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.

3.5.4. 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::

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

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

```
<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>
```

3.5.5. Enable SSL for Kafka Clients

Kafka allows clients to connect over SSL. By default SSL is disabled, but it can be enabled as needed.

Before you begin, be sure to generate the key, SSL certificate, keystore, and truststore that will be used by Kafka.

3.5.5.1. Configuring the Kafka Broker

The Kafka Broker supports listening on multiple ports and IP addresses. To enable this feature, specify one or more comma-separated values in the `listeners` property in `server.properties`.

Both PLAINTEXT and SSL ports are required if SSL is not enabled for inter-broker communication (see the following subsection for information about enabling inter-broker communication):

```
listeners=PLAINTEXT://host.name:port,SSL://host.name:port
```

The following SSL configuration settings are needed on the broker side:

```
ssl.keystore.location = /var/private/ssl/kafka.server.keystore.jks
ssl.keystore.password = test1234
ssl.key.password = test1234
ssl.truststore.location = /var/private/ssl/kafka.server.truststore.jks
ssl.truststore.password = test1234
```

The following optional settings are available:

Property	Description	Value(s)
`ssl.client.auth`	Specify whether client authentication is required, requested, or not required. `none`: no client authentication. `required`: client authentication is required. `requested`: client authentication is requested, but a client without certs can still connect. **Note**: If you set `ssl.client.auth` to `requested` or `required`, then you must provide a truststore for the Kafka broker. The truststore should contain all CA certificates that are used to sign clients' keys.	`none`
`ssl.cipher.suites`	Specify one or more cipher suites: named combinations of authentication, encryption, MAC and key exchange algorithms used to negotiate the security settings for a network connection using the TLS or SSL network protocol.	
`ssl.enabled.protocols`	Specify the SSL protocols that you will accept from clients. Note: SSL is deprecated; its use in production is not recommended.	`TLSv1.2,TLSv1.1,TLSv1`
`ssl.keystore.type`	Specify the SSL keystore type.	`JKS`
`ssl.truststore.type`	Specify the SSL truststore type.	`JKS`

Enabling SSL for Inter-Broker Communication

To enable SSL for inter-broker communication, add the following setting to the broker properties file (default is PLAINTEXT):

```
security.inter.broker.protocol = SSL
```

Enabling Additional Cipher Suites

To enable any cipher suites other than the defaults that come with JVM (see Java Cryptography documentation), you will need to install JCE Unlimited Strength Policy files (download link).

Validating the Configuration

After you start the broker, you should see the following information in the `server.log` file:

```
with addresses: PLAINTEXT -> EndPoint(192.168.64.1,9092,PLAINTEXT),SSL ->
 EndPoint(192.168.64.1,9093,SSL)
```

To make sure that the server keystore and truststore are set up properly, run the following command:

```
openssl s_client -debug -connect localhost:9093 -tls1
```

(Note: TLSv1 should be listed under `ssl.enabled.protocols`)

In the `openssl` output you should see the server certificate; for example:

```
Server certificate
-----BEGIN CERTIFICATE-----
MIID+DCCAuACCQCx2Rz1tXx3NTANBgkqhkiG9w0BAQsFADB6MQswCQYDVQQGEwJV
UzELMAkGA1UECAwCQ0ExFDASBgNVBAcMC1NhbnRhIENsYXJhMQwwCgYDVQQKDANv
cmcxDDAKBgNVBAsMA29yZzEOMAwGA1UEAwwFa2FmYWsxHDAaBgkqhkiG9w0BCQEW
DXRlc3RAdGVzdC5jb20wHhcNMTUwNzMwMDQyOTMwWhcNMTYwNzI5MDQyOTMwWjBt
MQswCQYDVQQGEwJVUzELMAkGA1UECBMCQ0ExFDASBgNVBAcTC1NhbnRhIENsYXJh
MQwwCgYDVQQKEwNvcmcxDDAKBgNVBAsTA29yZzEfMB0GA1UEAxMWU3JpaGFyc2hh
IENoaW50YWxhcGFuaTCCAbcwggEsBgcqhkjOOAQBMIIBHwKBgQD9f1OBHXUSKVLf
Spwu7OTn9hG3UjzvRADDHj+AtlEmaUVdQCJR+1k9jVj6v8X1ujD2y5tVbNeBO4Ad
NG/yZmC3a5lQpaSfn+gEexAiwk+7qdf+t8Yb+DtX58aophUPBPuD9tPFHsMCNVQT
WhaRMvZ1864rYdcq7/IiAxmd0UgBxwIVAJdgUI8VIwvMspK5gqLrhAvwWBz1AoGB
APfhoIXWmz3ey7yrXDa4V7l5lK+7+jrqgvlXTAs9B4JnUVlXjrrUWU/mcQcQgYC0
SRZxI+hMKBYTt88JMozIpuE8FnqLVHyNKOCjrh4rs6Z1kW6jfwv6ITVi8ftiegEk
O8yk8b6oUZCJqIPf4VrlnwaSi2ZegHtVJWQBTDv+z0kqA4GEAAKBgB+Pdz0306bq
TpUAdb2FERMPLFsx06H0x+TULivcp7HbS5yrkV9bXZmv/FD98x76QxXrOq1WpQhY
YDeGDjH+XQkJ6ZxBVBZNJDIpCnfQpfzXAvryQ+cm8oXUsKidtHf4pLMYViXX6BWX
Oc2hX4rG+lC8/NXW+1zVvCr9To9fngzjMA0GCSqGSIb3DQEBCwUAA4IBAQBfyVse
RJ+ugiNlWg5trZscqH0tlocbnek4UuV/xis2eAu9l4EFOM5kRt5GmkGZRcM/zHF8
BRJwXbf0fytMQKSPFk8R4/NGDOlzoK+F7uXeJ0S2u/T29xk0u2i4tjvleq6OCphE
i9vdjM0E0Whf9SHRhOXirOYFX3cL775XwKdzKKRkk+AszFR+mRu90rdoaepQtgGh
9Kfwr4+6AU/dPtdGuomtBQqMxCzlrLd8EYhVVQ97wHIZ3sPvlM5PIhOJ/YHSBJIC
75eo/4acDxZ+j3sR5kcFulzYwFLgDYBaKH/w3mYCgTALeB1zUkX53NVizIvhUd69
XJO4lDSDtGOlfort
-----END CERTIFICATE-----
subject=/C=US/ST=CA/L=Santa Clara/O=org/OU=org/CN=JBrown
issuer=/C=US/ST=CA/L=Santa Clara/O=org/OU=org/CN=kafak/emailAddress=test@test.
com
```

If the certificate does not display, or if there are any other error messages, then your keystore is not set up properly.

3.5.5.2. Configuring Kafka Producer and Kafka Consumer

SSL is supported for new Kafka Producers and Consumer processes; the older API is not supported. Configuration settings for SSL are the same for producers and consumers.

If client authentication is not needed in the broker, then the following is a minimal configuration example:

```
security.protocol = SSL
ssl.truststore.location = /var/private/ssl/kafka.client.truststore.jks
ssl.truststore.password = test1234
```

If client authentication is required, first create a keystore (described earlier in this chapter). Next, specify the following settings:

```
ssl.keystore.location = /var/private/ssl/kafka.client.keystore.jks
ssl.keystore.password = test1234
ssl.key.password = test1234
```

One or more of the following optional settings might also be needed, depending on your requirements and the broker configuration:

Property	Description	Value(s)
`ssl.provider`	The name of the security provider used for SSL connections. Default value is the default security provider of the JVM.	
`ssl.cipher.suites`	Specify one or more cipher suites: named combinations of authentication, encryption, MAC and key exchange algorithms used to negotiate the security settings for a network connection using the TLS or SSL network protocol.	
`ssl.enabled.protocols`	List at least one of the protocols configured on the broker side.	`TLSv1.2,TLSv1.1,TLSv1`
`ssl.keystore.type`	Specify the SSL keystore type.	`JKS`
`ssl.truststore.type`	Specify the SSL truststore type.	`JKS`

The following two examples launch console-producer and console-consumer processes:

```
kafka-console-producer.sh --broker-list localhost:9093 --topic test --
producer.config client-ssl.properties

kafka-console-consumer.sh --bootstrap-server localhost:9093 --topic test --
new-consumer --consumer.config client-ssl.properties
```

3.6. Connecting to SSL-Enabled Components

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

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.

3.6.1. 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, Moving Data into Hive: Hive ODBC and JDBC Drivers.

Tip

See HIVE-4911 for more details on this enhancement.

3.6.2. Connect to SSL Enabled Oozie Server

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

3.6.2.1. 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 `http://oozie.server.hostname:11000/oozie` with `https://oozie.server.hostname:11443/oozie`.

   Java does not automatically redirect HTTP addresses to HTTPS.

3.6.2.2. Connect to Oozie from Java Clients

In the connection strings change HTTP to HTTPS and adjust the port, for example, replace `http://oozie.server.hostname:11000/oozie` with `https://oozie.server.hostname:11443/oozie`.

Java does not automatically redirect HTTP addresses to HTTPS.

3.6.2.3. Connect to Oozie from a Web Browser

Use `https://oozie.server.hostname:11443/oozie` though most browsers should automatically redirect you if you use `http://oozie.server.hostname:11000/oozie`.

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