Hortonworks Data Platform

Ambari Security Guide

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Hortonworks Data Platform : Ambari Security Guide

The Hortonworks Data Platform, powered by Apache Hadoop, is a massively scalable and 100% open source platform for storing, processing and analyzing large volumes of data. It is designed to deal with data from many sources and formats in a very quick, easy and cost-effective manner. The Hortonworks Data Platform consists of the essential set of Apache Hadoop projects including MapReduce, Hadoop Distributed File System (HDFS), HCatalog, Pig, Hive, HBase, Zookeeper and Ambari. Hortonworks is the major contributor of code and patches to many of these projects. These projects have been integrated and tested as part of the Hortonworks Data Platform release process and installation and configuration tools have also been included.

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1.1. Preparing Kerberos for Hadoop

This section describes how to set up the Kerberos components in your Hadoop cluster.

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1.1.1. Kerberos Overview

Establishing identity with strong authentication is the basis for secure access in Hadoop. Users need to be able to reliably "identify" themselves and then have that identity propagated throughout the Hadoop cluster. Once this is done those users can access resources (such as files or directories) or interact with the cluster (like running MapReduce jobs). As well, Hadoop cluster resources themselves (such as Hosts and Services) need to authenticate with each other to avoid potential malicious systems "posing as" part of the cluster to gain access to data.

To create that secure communication among its various components, Hadoop uses Kerberos. Kerberos is a third party authentication mechanism, in which users and services that users want to access rely on a third party - the Kerberos server - to authenticate each to the other. The Kerberos server itself is known as the *Key Distribution Center*, or KDC. At a high level, it has three parts:

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

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

Because cluster resources (hosts or services) cannot provide a password each time to decrypt the TGT, they use a special file, called a *keytab,* which contains the resource principal's authentication credentials.

The set of hosts, users, and services over which the Kerberos server has control is called a *realm*.

Table 1.1. Kerberos terminology

Term	Description
Key Distribution Center, or KDC	The trusted source for authentication in a Kerberos-enabled environment.
Kerberos KDC Server	The machine, or server, that serves as the Key Distribution Center.
Kerberos Client	Any machine in the cluster that authenticates against the KDC.
Principal	The unique name of a user or service that authenticates against the KDC.
Keytab	A file that includes one or more principals and their keys.
Realm	The Kerberos network that includes a KDC and a number of Clients.

1.1.2. Installing and Configuring the KDC

To use Kerberos with Hadoop you can either use an existing KDC or install a new one just for Hadoop's use. The following gives a very high level description of the installation process. To get more information see RHEL documentation , CentOS documentation, or SLES documentation.

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.

1. To install a new version of the server:

```
[On RHEL, CentOS, or Oracle Linux]
yum install krb5-server krb5-libs krb5-auth-dialog krb5-workstation
```

OR

```
[On SLES]
zypper 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 use a text editor to edit the configuration file, located by default here:

```
/etc/krb5.conf
```

Change the `[realms]` section of this file by replacing the default "kerberos.example.com" setting for the `kdc` and `admin_server` properties with the Fully Qualified Domain Name of the KDC server. In this example below, "kerberos.example.com" has been replaced with "my.kdc.server".

```
[realms]
 EXAMPLE.COM = {
  kdc = my.kdc.server
  admin_server = my.kdc.server
}
```

1.1.3. Creating the Kerberos Database

Use the utility `kdb5_util` to create the Kerberos database.

```
 [on RHEL,CentOS, or Oracle Linux]
/usr/sbin/kdb5_util create -s
```

OR

```
[on SLES]
 kdb5_util create -s
```

1.1.4. Starting the KDC

Start the KDC.

```
[on RHEL, CentOS, or Oracle Linux]
/etc/rc.d/init.d/krb5kdc start
/etc/rc.d/init.d/kadmin start
```

OR

```
[on SLES]
rckrb5kdc start
rckadmind start
```

1.1.5. Installing and Configuring the Kerberos Clients

1. To install the Kerberos clients, on every server in the cluster:

```
 [on RHEL, CentOS, or Oracle Linux]
yum install krb5-workstation
```

OR

```
[on SLES]
 zypper install krb5-client
```

2. Copy the `krb5.conf` file you modified in Installing and Configuring the KDC to all the servers in the cluster.

1.1.6. Creating Service Principals and Keytab Files for Hadoop 1.x

Each service and sub-service in Hadoop must have its own principal. A principal name in a given realm consists of a primary name and an instance name, which in this case is the FQDN of the host that runs that service. As services do not login with a password to acquire their tickets, their principal's authentication credentials are stored in a keytab file, which is extracted from the Kerberos database and stored locally with the service principal on the service component host.

First you must create the principal, using mandatory naming conventions.

Then you must create the keytab file with that principal's information and copy the file to the keytab directory on the appropriate service host.

Note

Principals can be created either on the KDC machine itself or through the network, using an “admin” principal. The following instructions assume you are using the KDC machine and using the `kadmin.local` command line administration utility. Using `kadmin.local` on the KDC machine allows you to create principals without needing to create a separate "admin" principal before you start.

1. Open the `kadmin.local` utility on the KDC machine

```
/usr/sbin/kadmin.local
```

2. Create the service principals:

```
$kadmin.local
addprinc -randkey $primary_name/$fully.qualified.domain.name@EXAMPLE.COM
```

The `-randkey` option is used to generate the password.

Note that in the example each service principal's primary name has appended to it the instance name, the FQDN of the host on which it runs. This provides a unique principal name for services that run on multiple hosts, like DataNodes and TaskTrackers. The addition of the host name serves to distinguish, for example, a request from DataNode A from a request from DataNode B. This is important for two reasons:

- If the Kerberos credentials for one DataNode are compromised, it does not automatically lead to all DataNodes being compromised
- If multiple DataNodes have exactly the same principal and are simultaneously connecting to the NameNode, and if the Kerberos authenticator being sent happens to have same time stamp, then the authentication would be rejected as a replay request.

The principal name must match the values in the table below:

Table 1.2. 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/*$FQDN*
MapReduce	JobTracker	jt/*$FQDN*
MapReduce	TaskTracker	tt/*$FQDN*
Oozie	Oozie Server	oozie/*$FQDN*
Oozie	Oozie HTTP	HTTP/*$FQDN*
Hive	Hive Metastore HiveServer2	hive/*$FQDN*
Hive	WebHCat	HTTP/*$FQDN*
HBase	MasterServer	hbase/*$FQDN*
HBase	RegionServer	hbase/*$FQDN*
ZooKeeper	ZooKeeper	zookeeper/*$FQDN*
Nagios Server	Nagios	nagios/*$FQDN*

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

```
$kadmin.local
addprinc -randkey dn/$DataNode-Host@EXAMPLE.COM
```

3. In addition you must create four special principals for Ambari's own use.

Note

The names in table below can be customized in the Customize Services step of the Ambari Install Wizard. If this is the case in your installation, the principal names should match the customized names. For example, if the HDFS Service User has been set to `hdfs1`, the respective principal for the Ambari HDFS User should also be created as `hdfs1`.

These principals do not need the FQDN appended to the primary name:

Table 1.3. Ambari Principals

User	Default Principal Name
Ambari User[a]	ambari
Ambari Smoke Test User	ambari-qa
Ambari HDFS User	hdfs
Ambari HBase User	hbase

[a]This principal is used with the JAAS configuration. See Setting Up JAAS for Ambari for more information.

4. Once the principals are created in the database, you can extract the related keytab files for transfer to the appropriate host:

```
$kadmin.local
```

```
xst -norandkey -k $keytab_file_name $primary_name/fully.qualified.domain.
name@EXAMPLE.COM
```

Note

Some older versions of Kerberos do not support the xst `-norandkey` option. You can use the command without the `-norandkey` flag, except in cases where you need to merge two principals with the same name into a single keytab file for a single host. In this case, you can use the two step `kadmin/kutil` procedure. This description assumes MIT Kerberos. If you are using another version, please check your documentation.

a. Extract the keytab file information:

```
$kadmin
xst -k $keytab_file_name-temp1 $primary_name/fully.qualified.
domain.name@EXAMPLE.COM
xst -k $keytab_file_name-temp2 $primary_name/fully.qualified.
domain.name@EXAMPLE.COM
```

b. Merge the keytabs into a single file. :

```
 $kutil
rkt $keytab_file_name-temp1
rkt $keytab_file_name-temp2
wkt $keytab_file_name
clear
```

You must use the mandatory names for the *keytab_file_name* variable shown in this table. Adjust the principal names if necessary.

Table 1.4. 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/*$FQDN*	dn.service.keytab
JobTracker	jt/*$FQDN*	jt.service.keytab
TaskTracker	tt/*$FQDN*	tt.service.keytab
Oozie Server	oozie/*$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/*$FQDN*	hbase.service.keytab
ZooKeeper	zookeeper/*$FQDN*	zk.service.keytab
Nagios Server	nagios/*$FQDN*	nagios.service.keytab
Ambari User[a]	ambari	ambari.keytab
Ambari Smoke Test User	ambari-qa	smokeuser.headless.keytab

Component	Principal Name	Mandatory Keytab File Name
Ambari HDFS User	hdfs	hdfs.headless.keytab
Ambari HBase User	hbase	hbase.headless.keytab

[a]This principal is used with the JAAS configuration. See Setting Up JAAS for Ambari for more information.

For example: To create the keytab files for NameNode HTTP, issue this command:

```
xst -norandkey -k spnego.service.keytab HTTP/<namenode-host>
```

Note

If you have a large cluster, you may want to create a script to automate creating your principals and keytabs. The Ambari Web GUI can help. See Create Principals and Keytabs for more information.

5. When the keytab files have been created, on each host create a directory for them and set appropriate permissions.

```
mkdir -p /etc/security/keytabs/
chown root:hadoop /etc/security/keytabs
chmod 750 /etc/security/keytabs
```

6. Copy the appropriate keytab file to each host. If a host runs more than one component (for example, both TaskTracker and DataNode), copy keytabs for both components. The Ambari Smoke Test User, the Ambari HDFS User, and the Ambari HBase User keytabs should be copied to all hosts.

7. Set appropriate permissions for the keytabs.

Important

If you have customized service user names, replace the default values below with your appropriate service user, group, and keytab names.

a. Optionally, if you have Set up JAAS for Ambari on the Ambari server host:

```
chown ambari:ambari /etc/security/keytabs/ambari.keytab
chmod 400 /etc/security/keytabs/ambari.keytab
```

b. On the HDFS NameNode and SecondaryNameNode hosts:

```
chown hdfs:hadoop /etc/security/keytabs/nn.service.keytab
chmod 400 /etc/security/keytabs/nn.service.keytab
chown root:hadoop /etc/security/keytabs/spnego.service.keytab
chmod 440 /etc/security/keytabs/spnego.service.keytab
```

c. On the HDFS NameNode host, for the Ambari Test Users:

```
chown ambari-qa:hadoop /etc/security/keytabs/smokeuser.headless.keytab
chmod 440 /etc/security/keytabs/smokeuser.headless.keytab
chown hdfs:hadoop /etc/security/keytabs/hdfs.headless.keytab
chmod 440 /etc/security/keytabs/hdfs.headless.keytab
chown hbase:hadoop /etc/security/keytabs/hbase.headless.keytab
chmod 440 /etc/security/keytabs/hbase.headless.keytab
```

d. On each host that runs an HDFS DataNode:

```
chown hdfs:hadoop /etc/security/keytabs/dn.service.keytab
chmod 400 /etc/security/keytabs/dn.service.keytab
```

e. On the host that runs the MapReduce JobTracker:

```
chown mapred:hadoop /etc/security/keytabs/jt.service.keytab
chmod 400 /etc/security/keytabs/jt.service.keytab
```

f. On each host that runs a MapReduce TaskTracker:

```
chown mapred:hadoop /etc/security/keytabs/tt.service.keytab
chmod 400 /etc/security/keytabs/tt.service.keytab
```

g. On the host that runs the Oozie Server:

```
chown oozie:hadoop /etc/security/keytabs/oozie.service.keytab
chmod 400 /etc/security/keytabs/oozie.service.keytab
chown root:hadoop /etc/security/keytabs/spnego.service.keytab
chmod 440 /etc/security/keytabs/spnego.service.keytab
```

h. On the host that runs the Hive Metastore, HiveServer2 and WebHCat:

```
chown hive:hadoop /etc/security/keytabs/hive.service.keytab
chmod 400 /etc/security/keytabs/hive.service.keytab
chown root:hadoop /etc/security/keytabs/spnego.service.keytab
chmod 440 /etc/security/keytabs/spnego.service.keytab
```

i. On hosts that run the HBase MasterServer, RegionServer and ZooKeeper:

```
chown hbase:hadoop /etc/security/keytabs/hbase.service.keytab
chmod 400 /etc/security/keytabs/hbase.service.keytab
chown zookeeper:hadoop /etc/security/keytabs/zk.service.keytab
chmod 400 /etc/security/keytabs/zk.service.keytab
```

j. On the host that runs the Nagios server:

```
chown nagios:nagios /etc/security/keytabs/nagios.service.keytab
chmod 400 /etc/security/keytabs/nagios.service.keytab
```

8. 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/keytabs/nn.service.keytab
```

Do this on each respective service in your cluster.

1.1.7. Creating Service Principals and Keytab Files for Hadoop 2.x

Each service and sub-service in Hadoop must have its own principal. A principal name in a given realm consists of a primary name and an instance name, which in this case is the FQDN of the host that runs that service. As services do not login with a password to acquire their tickets, their principal's authentication credentials are stored in a keytab file, which is extracted from the Kerberos database and stored locally with the service principal on the service component host.

First you must create the principal, using mandatory naming conventions.

Then you must create the keytab file with that principal's information and copy the file to the keytab directory on the appropriate service host.

Note

Principals can be created either on the KDC machine itself or through the network, using an “admin” principal. The following instructions assume you are using the KDC machine and using the `kadmin.local` command line administration utility. Using `kadmin.local` on the KDC machine allows you to create principals without needing to create a separate "admin" principal before you start.

1. Open the `kadmin.local` utility on the KDC machine

```
/usr/sbin/kadmin.local
```

2. Create the service principals:

```
$kadmin.local
addprinc -randkey $primary_name/$fully.qualified.domain.name@EXAMPLE.COM
```

The `-randkey` option is used to generate the password.

Note that in the example each service principal's primary name has appended to it the instance name, the FQDN of the host on which it runs. This provides a unique principal name for services that run on multiple hosts, like DataNodes and NodeManagers. The addition of the host name serves to distinguish, for example, a request from DataNode A from a request from DataNode B. This is important for two reasons:

- If the Kerberos credentials for one DataNode are compromised, it does not automatically lead to all DataNodes being compromised
- If multiple DataNodes have exactly the same principal and are simultaneously connecting to the NameNode, and if the Kerberos authenticator being sent happens to have same timestamps, then the authentication would be rejected as a replay request.

The principal name must match the values in the table below:

Table 1.5. 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`

Service	Component	Mandatory Principal Name
Hive	Hive Metastore HiveServer2	hive/*$FQDN*
Hive	WebHCat	HTTP/*$FQDN*
HBase	MasterServer	hbase/*$FQDN*
HBase	RegionServer	hbase/*$FQDN*
ZooKeeper	ZooKeeper	zookeeper/*$FQDN*
Nagios Server	Nagios	nagios/*$FQDN*
JournalNode Server[a]	JournalNode	jn/*$FQDN*

[a]Only required if you are setting up NameNode HA.

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

```
$kadmin.local
addprinc -randkey dn/$DataNode-Host@EXAMPLE.COM
```

3. In addition you must create four special principals for Ambari's own use.

Note

The names in table below can be customized in the Customize Services step of the Ambari Install Wizard. If this is the case in your installation, the principal names should match the customized names. For example, if the HDFS Service User has been set to `hdfs1`, the respective principal for the Ambari HDFS User should also be created as `hdfs1`.

These principals do not have the FQDN appended to the primary name:

Table 1.6. Ambari Principals

User	Mandatory Principal Name
Ambari User[a]	ambari
Ambari Smoke Test User	ambari-qa
Ambari HDFS User	hdfs
Ambari HBase User	hbase

[a]This principal is used with the JAAS configuration. See Setting up JAAS for Ambari for more information.

4. Once the principals are created in the database, you can extract the related keytab files for transfer to the appropriate host:

```
$kadmin.local
xst -norandkey -k $keytab_file_name $primary_name/fully.qualified.domain.
name@EXAMPLE.COM
```

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

Note

Some older versions of Kerberos do not support the xst `-norandkey` option. You can use the command without the `-norandkey` flag, except in cases where you need to copy a principal from one keytab file to

another keytab file on a host. This might be a requirement if the Hadoop configurations on a host have keytab path properties that point to different keytab locations but have corresponding principal name properties that have the same values.

In situations like this, you can use the two step `kadmin`/`kutil` procedure. This description assumes MIT Kerberos. If you are using another version, please check your documentation.

a. Extract the keytab file information:

```
$kadmin
xst -k $keytab_file_name-temp1 $primary_name/fully.qualified.
domain.name@EXAMPLE.COM
xst -k $keytab_file_name-temp2 $primary_name/fully.qualified.
domain.name@EXAMPLE.COM
```

b. Write the keytab to a file. :

```
 $kutil
kutil: rkt $keytab_file_name-temp1
kutil: rkt $keytab_file_name-temp2
kutil: wkt $keytab_file_name
kutil: clear
```

Table 1.7. 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*	jhs.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/*$FQDN*	hbase.service.keytab
ZooKeeper	zookeeper/*$FQDN*	zk.service.keytab
Nagios Server	nagios/*$FQDN*	nagios.service.keytab
Journal Server[a]	jn/*$FQDN*	jn.service.keytab
Ambari User[b]	ambari	ambari.keytab
Ambari Smoke Test User	ambari-qa	smokeuser.headless.keytab
Ambari HDFS User	hdfs	hdfs.headless.keytab

Component	Principal Name	Mandatory Keytab File Name
Ambari HBase User	hbase	hbase.headless.keytab

[a]Only required if you are setting up NameNode HA.

[b]This principal is used with the JAAS configuration. See Setting up JAAS for Ambari for more information.

For example: To create the keytab files for NameNode HTTP, issue this command:

```
$kadmin.local
xst -norandkey -k spnego.service.keytab HTTP/<namenode-host>
```

Note

If you have a large cluster, you may want to create a script to automate creating your principals and keytabs. To help with that, you can download a CSV-formatted file of all the required principal names and keytab files from the Ambari Web GUI. Select **Admin** view->**Security**->**Enable Security**-> and run the **Enable Security Wizard**, using the default values. At the bottom of the third page, **Create Principals and Keytabs**, click **Download CSV**.

5. When the keytab files have been created, on each host create a directory for them and set appropriate permissions.

```
mkdir -p /etc/security/keytabs/
chown root:hadoop /etc/security/keytabs
chmod 750 /etc/security/keytabs
```

6. Copy the appropriate keytab file to each host. If a host runs more than one component (for example, both NodeManager and DataNode), copy keytabs for both components. The Ambari Smoke Test User, the Ambari HDFS User, and the Ambari HBase User keytabs should be copied to the all hosts on the cluster.

Important

If you have customized service user names, replace the default values below with your appropriate service user, group, and keytab names.

7. Set appropriate permissions for the keytabs.

   a. Optionally, if you have Set up JAAS on the Ambari server host:

```
chown ambari:ambari /etc/security/keytabs/ambari.keytab
chmod 400 /etc/security/keytabs/ambari.keytab
```

   b. On the HDFS NameNode and SecondaryNameNode hosts:

```
chown hdfs:hadoop /etc/security/keytabs/nn.service.keytab
chmod 400 /etc/security/keytabs/nn.service.keytab
chown root:hadoop /etc/security/keytabs/spnego.service.keytab
chmod 440 /etc/security/keytabs/spnego.service.keytab
```

   c. On the HDFS NameNode host, for the Ambari Test Users:

```
chown ambari-qa:hadoop /etc/security/keytabs/smokeuser.headless.keytab
chmod 440 /etc/security/keytabs/smokeuser.headless.keytab
chown hdfs:hadoop /etc/security/keytabs/hdfs.headless.keytab
chmod 440 /etc/security/keytabs/hdfs.headless.keytab
```

```
chown hbase:hadoop /etc/security/keytabs/hbase.headless.keytab
chmod 440 /etc/security/keytabs/hbase.headless.keytab
```

d. On each host that runs an HDFS DataNode:

```
chown hdfs:hadoop /etc/security/keytabs/dn.service.keytab
chmod 400 /etc/security/keytabs/dn.service.keytab
```

e. On the host that runs the MR2 History Server:

```
chown  mapred:hadoop /etc/security/keytabs/jhs.service.keytab
chmod 400 /etc/security/keytabs/jhs.service.keytab
chown root:hadoop /etc/security/keytabs/spnego.service.keytab
chmod 440 /etc/security/keytabs/spnego.service.keytab
```

f. On the host that runs the YARN ResourceManager:

```
chown yarn:hadoop /etc/security/keytabs/rm.service.keytab
chmod 400 /etc/security/keytabs/rm.service.keytab
```

g. On each host that runs a YARN NodeManager:

```
chown yarn:hadoop /etc/security/keytabs/nm.service.keytab
chmod 400 /etc/security/keytabs/nm.service.keytab
```

h. On the host that runs the Oozie Server:

```
chown oozie:hadoop /etc/security/keytabs/oozie.service.keytab
chmod 400 /etc/security/keytabs/oozie.service.keytab
chown root:hadoop /etc/security/keytabs/spnego.service.keytab
chmod 440 /etc/security/keytabs/spnego.service.keytab
```

i. On the host that runs the Hive Metastore, HiveServer2 and WebHCat:

```
chown hive:hadoop /etc/security/keytabs/hive.service.keytab
chmod 400 /etc/security/keytabs/hive.service.keytab
chown root:hadoop /etc/security/keytabs/spnego.service.keytab
chmod 440 /etc/security/keytabs/spnego.service.keytab
```

j. On hosts that run the HBase MasterServer, RegionServer and ZooKeeper:

```
chown hbase:hadoop /etc/security/keytabs/hbase.service.keytab
chmod 400 /etc/security/keytabs/hbase.service.keytab
chown zookeeper:hadoop /etc/security/keytabs/zk.service.keytab
chmod 400 /etc/security/keytabs/zk.service.keytab
```

k. On the host that runs the Nagios server:

```
chown nagios:nagios /etc/security/keytabs/nagios.service.keytab
chmod 400 /etc/security/keytabs/nagios.service.keytab
```

l. On each host that runs a JournalNode, if you are setting up NameNode HA:

```
chown hdfs:hadoop /etc/security/keytabs/jn.service.keytab
chmod 400 /etc/security/keytabs/jn.service.keytab
```

8. 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/keytabs/nn.service.keytab
```

Do this on each respective service in your cluster.

1.2. Setting Up Hadoop Users

This section provides information on setting up Hadoop users for Kerberos.

- Overview
- Creating Mappings Between Principals and UNIX Usernames

1.2.1. Overview

Hadoop uses users' group memberships at various places for things like determining group ownership for files or for access control. To configure Hadoop for use with Kerberos and Ambari you must create a mapping between service principals and these UNIX user names.

A user is mapped to the groups it belongs to using an implementation of the `GroupMappingServiceProviderinterface`. 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 user name by executing a UNIX shell command. In secure clusters, since the user names are actually Kerberos principals, `ShellBasedUnixGroupsMapping` will work only if the Kerberos principals map to valid UNIX user names. Hadoop provides a feature that lets administrators specify mapping rules to map a Kerberos principal to a local UNIX user name .

1.2.2. Creating Mappings Between Principals and UNIX User names

Hadoop uses a rule-based system to create mappings between service principals and their related UNIX user names. 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.

Use the following instructions to configure the mappings between principals and UNIX user names:

1. Creating Rules
2. Examples

1.2.2.1. Creating Rules

- Simple Rules

To make a simple map between principal names and UNIX users, you create a straightforward substitution rule. For example, to map the ResourceManager(rm) and NodeManager(nm) principals in the EXAMPLE.COM realm to the UNIX *$YARN_USER* user and the NameNode(nn) and DataNode(dn) principals to the UNIX *$HDFS_USER* user, you would make this the value for the `hadoop.security.auth_to_local` key in `core-site.xml`.

```
RULE:[2:$1@$0]([jt]t@.*EXAMPLE.COM)s/.*/$YARN_USER /
RULE:[2:$1@$0]([nd]n@.*EXAMPLE.COM)s/.*/ $HDFS_USER/
DEFAULT
```

- Complex Rules

  To accommodate more complex translations, you 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 user name 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 regex in a parentheses that must match the generated string for the rule to apply.

    For example:

    `(.*%admin)`matches any string that ends in `%admin`

    `(.*@SOME.DOMAIN)` matches any string that ends in `@SOME.DOMAIN`

  - **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 `@SOME.DOMAIN`.

    `s/@[A-Z]*\.COM//` removes the first instance of `@` followed by a name followed by `COM`.

    `s/X/Y/g` replaces all of the `X` in the name with `Y`

1.2.2.2. Examples

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

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

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

```
RULE:[1:$1@$0](.*@ACME\.COM)s/@.*//
RULE:[2:$1@$0](.*@ACME\.COM)s/@.*//
DEFAULT
```

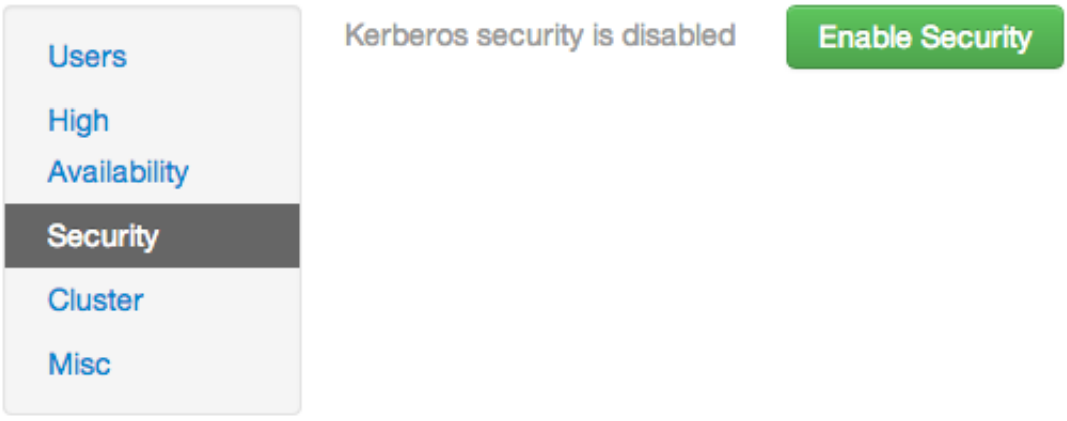
- To treat all principals from APACHE.ORG with the extension /admin as admin, your rules would look like this:

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

1.3. Setting up Ambari for Kerberos

To turn on Kerberos-based security in the Ambari Web GUI you must:

1. Have already set up Kerberos for your cluster. For more information, see Preparing Kerberos for Hadoop.
2. Go to the **Admin** tab.
3. Select **Security**.
4. Click **Enable Security** and follow the **Enable Security Wizard**.



   a. **Get Started**: This step just reminds you that you need to set up Kerberos before you start.

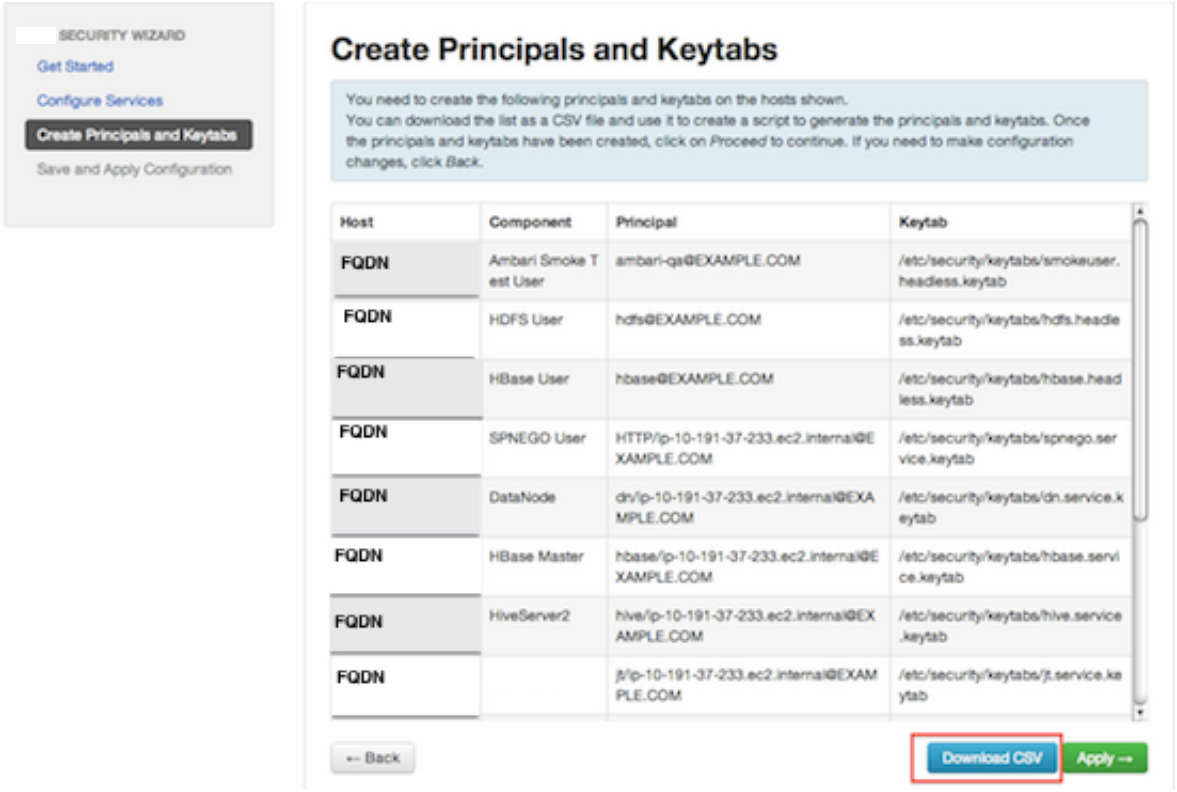
   b. **Configure Services**: This step asks you for your Kerberos information: principals and paths to keytabs, path to your Kerberos tools, realm names and so on. For

more information about a specific field, hover over it, and a pop-up window with a definition displays.

c. **Create Principals and Keytabs**: Use this step to check that all your information is correct. Click **Back** to make any changes. Click **Apply** when you are satisfied with the assignments.

Note

If you have a large cluster, you may want to go to the **Create Principals and Keytabs** step first. Step through the wizard accepting the defaults to get to the appropriate page. On the page, use the **Download CSV** button to get a list of all the necessary principals and keytabs in CSV form, which can be used to set up a script. The list includes hostname, principal description, principal name, keytab user, keytab group, keytab permissions, absolute keytab path, and keytab filename.



d. **Save and Apply Configuration**: This step displays a bar showing the progress of integrating the Kerberos information into your Ambari Server.

1.3.1. Setting up JAAS for Ambari

If you want to set up Java Authentication and Authorization Services (JAAS) configurations for Ambari to provide independent, secure access to native Hadoop GUIs such as the NameName UI, use the Apache community documentation topic Create the JAAS Configuration Files to set up your configurations. Then, do the following:

1. Log into the Ambari server host.

Important

Ambari Server should not be running when you do this. Edit configuration files before you start Ambari Server the first time or, stop the Ambari Server, edit the files, then re-start Ambari Server.

2. Run the following, specific setup-security command and answer the prompts:

```
ambari-server setup-security
```

   a. Select 5 for **Setup Ambari kerberos JAAS configuration**.

   b. Enter the Kerberos principal name for the Ambari server you set up here.

   c. Enter the path to the keytab for the Ambari principal.

   d. Restart Ambari Server:

```
ambari-server restart
```

1.3.2. Deploying JCE Policy Archives on the Ambari Server

On a secure cluster having no internet access, you must deploy the Java Cryptography Extension (JCE) security policy .jar files on the Ambari Server, before setting up your Ambari server with a custom JDK.

When you enable security, Ambari distributes the JCE .jars to all appropriate hosts in your cluster.

To obtain and deploy the JCE .jar files appropriate for the JDK version in your cluster on your Ambari-server host,

1. Download the archive from one of the following locations

   For JDK 1.6: http://www.oracle.com/technetwork/java/javase/downloads/jce-6-download-429243.html

   For JDK 1.7: http://www.oracle.com/technetwork/java/javase/downloads/jce-7-download-432124.html

2. Save the archive in a temporary location.

3. Copy the archive to `/var/lib/ambari-server/resources` on the Ambari server.

2. Advanced Security Options for Ambari

This section describes several security options for an Ambari-monitored-and-managed Hadoop cluster.

- Setting Up LDAP or Active Directory Authentication
- Encrypt Database and LDAP Passwords
- Set Up Security for Ambari
- Set Up Two-Way SSL Betwen Ambari Server and Ambari Agents

2.1. Optional: Set Up LDAP or Active Directory Authentication

By default Ambari uses an internal database as the user store for authentication and authorization. If you want to add LDAP or Active Directory (AD) external authentication in addition for Ambari Web, you need to collect the following information and run a special setup command. Ambari Server must not be running when you execute this command.

Important

Ambari Server should not be running when you do this: either make the edits before you start Ambari Server the first time or bring the server down to make the edits.

2.1.1. Setting Up LDAP Authentication

The following table details the properties and values you need to know to set up LDAP authentication.

Note

If you are going to set `bindAnonymously` to false (the default), you need to make sure you have an LDAP Manager name and password set up. If you are going to use SSL, you need to make sure you have already set up your certificate and keys.

Table 2.1. Ambari Server LDAP Properties

Property	Values	Description
authentication.ldap.primaryUrl	server:port	The hostname and port for the LDAP or AD server. Example: my.ldap.server:389
authentication.ldap.secondaryUrl	server:port	The hostname and port for the secondary LDAP or AD server. Example: my.secondary.ldap.server:389 This is an optional value.

Property	Values	Description
authentication.ldap.useSSL	true or false	If true, use SSL when connecting to the LDAP or AD server.
authentication.ldap. usernameAttribute	[LDAP attribute]	The attribute for username Example: uid
authentication.ldap.baseDn	[Distinguished Name]	The root Distinguished Name to search in the directory for users. Example: ou=people,dc=hadoop,dc=apache, dc=org
authentication.ldap. bindAnonymously	true or false	If true, bind to the LDAP or AD server anonymously
authentication.ldap.managerDn	[Full Distinguished Name]	If Bind anonymous is set to false, the Distinguished Name (“DN”) for the manager. Example: uid=hdfs,ou=people,dc=hadoop, dc=apache,dc=org
authentication.ldap. managerPassword	[password]	If Bind anonymous is set to false, the password for the manager

2.1.1.1. Configure Ambari to use LDAP Server

If the LDAPS server certificate is signed by a trusted Certificate Authority, there is no need to import the certificate into Ambari so this section does not apply to you. If the LDAPS server certificate is self-signed, or is signed by an unrecognized certificate authority such as an internal certificate authority, you must import the certificate and create a keystore file. The following example creates a keystore file at /keys/ldaps-keystore.jks, but you can create it anywhere in the file system:

1. On the Ambari server:
2. mkdir /keys
3. $JAVA_HOME/bin/keytool -import -trustcacerts -alias root -file $PATH_TO_YOUR_LDAPS_CERT -keystore /keys/ldaps-keystore.jks
4. Set a password when prompted. You will use this during ambari-server setup-ldap.

Run the LDAP setup command and answer the prompts with the information you collected above:

```
ambari-server setup-ldap
```

1. At the **Primary URL*** prompt, enter the server URL and port you collected above. Prompts marked with an asterisk are required values.
2. At the **Secondary URL** prompt, enter the secondary server URL and port. This is optional value.
3. At the **Use SSL*** prompt, enter your selection. **If using LDAPS**, enter **true**.
4. At the **User name attribute*** prompt, enter your selection. The default value is `uid`.

5. At the **Base DN*** prompt, enter your selection.
6. At the **Bind anonymously*** prompt, enter your selection.
7. At the **Manager DN*** prompt, enter your selection if you have set `bind.Anonymously` to false.
8. At the **Enter the Manager Password*** , enter the password for your LDAP manager.
9. If you set **Use SSL*** = true in step 3, the following prompt appears: **Do you want to provide custom TrustStore for Ambari?**

   Consider the following options and respond as appropriate.

   - **More secure option:** If using a self-signed certificate that you do not want imported to the existing JDK keystore, enter **y**.

     For example, you want this certificate used only by Ambari, not by any other applications run by JDK on the same host.

     If you choose this option, additional prompts appear. Respond to the additional prompts as follows:

     a. At the **TrustStore type** prompt, enter **jks**.

     b. At the **Path to TrustStore file** prompt, enter **/keys/ldaps-keystore.jks** (or the actual path to your keystore file).

     c. At the **Password for TrustStore** prompt, enter the password that you defined for the keystore.

   - **Less secure option:** If using a self-signed certificate that you want to import and store in the existing, default JDK keystore, enter **n**.

     a. Convert the SSL certificate to X.509 format, if necessary, by executing the following command:

     ```
     openssl x509 -in slapd.pem -out slapd.crt
     ```

     Where `slapd.crt` is the path to the X.509 certificate.

     b. Import the SSL certificate to the existing keystore, for example the default jre certificates storage, using the following instruction:

     ```
     /usr/jdk64/jdk1.7.0_45/bin/keytool -import -trustcacerts -file slapd.
     crt -keystore
     /usr/jdk64/jdk1.7.0_45/jre/lib/security/cacerts
     ```

     Where Ambari is set up to use JDK 1.7. Therefore, the certificate must be imported in the JDK 7 keystore.

10. Review your settings and if they are correct, select y.
11. Start or restart the Server

```
ambari-server restart
```

Initially the users you have enabled all have Ambari User privileges. Ambari Users can read metrics, view service status and configuration, and browse job information. For these new users to be able to start or stop services, modify configurations, and run smoke tests, they need to be Admins. To make this change, use Ambari Web **Admin** -> **Users** -> **Edit**.

2.2. Optional: Encrypt Database and LDAP Passwords

By default the passwords to access the Ambari database and the LDAP server are stored in a plain text configuration file. To have those passwords encrypted, you need to run a special setup command.

Important

Ambari Server should not be running when you do this: either make the edits before you start Ambari Server the first time or bring the server down to make the edits.

1. On the Ambari Server, run the special setup command and answer the prompts:

   ```
   ambari-server setup-security
   ```

   a. Select 4 for **Encrypt passwords stored in ambari.properties file**.

   b. Provide a master key for encrypting the passwords. You are prompted to enter the key twice for accuracy.

   ### Important

   If your passwords are encrypted, you need access to the master key to start Ambari Server.

   c. You have three options for maintaining the master key:

   - At the **Persist** prompt, select y. This stores the key in a file on the server.
   - Create an environment variable AMBARI_SECURITY_MASTER_KEY and set it to the key.
   - Provide the key manually at the prompt on server start up.

   d. Start or restart the Server

   ```
   ambari-server restart
   ```

2.2.1. Reset Encryption

There may be situations in which you want to:

- Remove encryption entirely

- Change the current master key, either because the key has been forgotten or because you want to change the current key as a part of a security routine.

Important

Ambari Server should not be running when you do this.

2.2.1.1. Remove Encryption Entirely

To reset Ambari database and LDAP passwords to a completely unencrypted state:

1. On the Ambari host, open `/etc/ambari-server/conf/ambari.properties` with a text editor and set this property

```
security.passwords.encryption.enabled=false
```

2. Delete `/var/lib/ambari-server/keys/credentials.jceks`
3. Delete `/var/lib/ambari-server/keys/master`
4. You must now reset the database password and, if necessary, the LDAP password. Run `ambari-server setup` and `ambari-server setup-ldap` again.

2.2.1.2. Change the Current Master Key

To change the master key:

- **If** you know the current master key or if the current master key has been persisted:
  1. Re-run the encryption setup command and follow the prompts.

```
ambari-server setup-security
```

     a. Select 4 for **Encrypt passwords stored in ambari.properties file**.
     b. Enter the current master key when prompted if necessary (if it is not persisted or set as an environment variable).
     c. At the **Do you want to reset Master Key** prompt, enter **yes**.
     d. At the prompt, enter the new master key and confirm.

- **If** you do **not** know the current master key:
  1. Remove encryption entirely, as described here.
  2. Re-run `ambari-server setup-security` as described here.
  3. Start or restart the Ambari Server.

```
ambari-server restart
```

2.3. Optional: Set Up Security for Ambari

There are four ways you can increase the security settings for your Ambari server installation.

Note

If you plan to configure your cluster for Kerberos, you may use the **Setup Ambari kerberos JAAS configuration** option, which is described in Setting up Kerberos for Use with Ambari.

- Set Up HTTPS for Ambari Server
- Set Up HTTPS for Ganglia
- Set Up HTTPS for Nagios
- Encrypt Database and LDAP Passwords

2.3.1. Set Up HTTPS for Ambari Server

If you want to limit access to the Ambari Server to HTTPS connections, you need to provide a certificate. While it is possible to use a self-signed certificate for initial trials, they are not suitable for production environments. After your certificate is in place, you must run a special setup command.

Important

Ambari Server should not be running when you do this. Either make these changes before you start Ambari the first time, or bring the server down before running the setup command.

1. Log into the Ambari Server host.
2. Locate your certificate. If you want to create a temporary self-signed certificate, use this as an example:

```
openssl genrsa -out $wserver.key 2048
openssl req -new -key $wserver.key -out $wserver.csr
openssl x509 -req -days 365 -in $wserver.csr -signkey $wserver.key -out
 $wserver.crt
```

Where `$wserver` is the Ambari Server host name.

Important

The certificate you use must be PEM-encoded, not DER-encoded. If you attempt to use a DER-encoded certificate, you see this error:

```
unable to load certificate
140109766494024:error:0906D06C:PEM routines:PEM_read_bio:no start
 line:pem_lib.c
:698:Expecting: TRUSTED CERTIFICATE
```

You can convert a DER-encoded certificate to a PEM-encoded certificate using the following command:

```
openssl x509 -in cert.crt -inform der -outform pem -out cert.pem
```

where `cert.crt` is the DER-encoded certificate and `cert.pem` is the resulting PEM-encoded certificate.

3. Run the special setup command and answer the prompts

```
ambari-server setup-security
```

   a. Select 1 for **Enable HTTPS for Ambari server**.

   b. Respond y to **Do you want to configure HTTPS**?

   c. Select the port you want to use for SSL. Default is 8443.

   d. Provide the path to your certificate and your private key. For example, put your certificate and private key in `/etc/ambari-server/certs` with root as the owner or the non-root user you designated during Ambari Server setup for the ambari-server daemon.

   e. Provide the password for the private key.

   f. Start or restart the Server

```
ambari-server restart
```

2.3.2. Set Up HTTPS for Ganglia

If you want Ganglia to use HTTPS instead of the default HTTP to communicate with Ambari Server, use the following instructions.

Important

The servers should not be running when you do this: either make the edits before you start Ambari Server the first time or bring the servers down to make the edits.

1. Set up the Ganglia server.

   a. Log into the Ganglia server host.

   b. Create a self-signed certificate on the Ganglia server host. For example:

```
openssl genrsa -out $gserver.key 2048
openssl req -new -key $gserver.key -out $gserver.csr
openssl x509 -req -days 365 -in $gserver.csr -signkey $gserver.key -out
 $gserver.crt
```

   Where `$gserver` is the Ganglia server host name.

   c. Install SSL on the Ganglia server host.

```
yum install mod_ssl
```

   d. Edit the SSL configuration file on the Ganglia server host.

      i. Using a text editor, open:

```
/etc/httpd/conf.d/ssl.conf
```

ii. Add lines setting the certificate and key file names to the files you created above [25]. For example:

```
SSLCertificateFile     $gserver.crt
SSLCertificateKeyFile   $gserver.key
```

e. Disable HTTP access (optional)

i. Using a text editor, open:

```
/etc/httpd/conf/httpd.conf
```

ii. Comment out the port 80 listener:

```
# Listen 80
```

f. Restart the `httpd` service on the Ganglia server host.

```
service httpd restart
```

2. Set up and restart the Ambari Server.

a. Log into the Ambari Server.

b. Run the special setup command and answer the prompts.

```
ambari-server setup-security
```

i. Select 2 for **Enable HTTPS for Ganglia service**.

ii. Respond y to **Do you want to configure HTTPS for Ganglia service.**

iii. Enter your TrustStore type. Your options are `jks`, `jceks`, or `pks12`.

iv. Enter the path to your TrustStore file.

v. Enter the password for your TrustStore and then re-enter to confirm. The password must be at least 6 characters long.

vi. Enter the path to the Ganglia server certificate file.

c. Start or restart the Server

```
ambari-server restart
```

2.3.3. Set Up HTTPS for Nagios

If you want Nagios to use HTTPS instead of HTTP (the default), use the following instructions.

Important

The servers should not be running when you do this: either make the edits before you start Ambari Server the first time or bring the servers down to make the edits.

1. Set up the Nagios server.

   a. Log into the Nagios server host.

   b. Create a self-signed certificate on the Nagios server host. For example:

   ```
   openssl genrsa -out $nserver.key 2048
   openssl req -new -key $nserver.key -out $nserver.csr
   openssl x509 -req -days 365 -in $nserver.csr -signkey $nserver.key -out
    $nserver.crt
   ```

   Where `$nserver` is the Nagios server host name.

   c. Install SSL on the Nagios server host.

   ```
   yum install mod_ssl
   ```

   d. Edit the SSL configuration file on the Nagios server host.

      i. Using a text editor, open:

      ```
      /etc/httpd/conf.d/ssl.conf
      ```

      ii. Add lines setting the certificate and key file names to the files you created previously [27]. For example:

      ```
      SSLCertificateFile      $nserver.crt
      SSLCertificateKeyFile  $nserver.key
      ```

   e. Disable HTTP access (optional)

      i. Using a text editor, open:

      ```
      /etc/httpd/conf/httpd.conf
      ```

      ii. Comment out the port 80 listener:

      ```
      # Listen 80
      ```

   f. Restart the `httpd` service on the Nagios server host.

   ```
   service httpd restart
   ```

2. Set up and restart the Ambari Server.

   a. Log into the Ambari Server.

   b. Run the special setup command and answer the prompts.

   ```
   ambari-server setup-security
   ```

      i. Select 2 for **Enable HTTPS for Nagios service**.

      ii. Respond y to **Do you want to configure HTTPS for Nagios?** .

      iii. Enter your TrustStore type. Your options are `jks`, `jceks`, or `pks12`.

      iv. Enter the path to your TrustStore file.

v. Enter the password for your TrustStore and then re-enter to confirm. The password must be at least 6 characters long.

vi. Enter the path to the Nagios server certificate file.

c. Start or restart the Server

```
ambari-server restart
```

2.4. Optional: Set Up Two-Way SSL Between Ambari Server and Ambari Agents

Two-way SSL provides a way to encrypt communication between Ambari Server and Ambari Agents. By default Ambari ships with Two-way SSL disabled. To enable Two-way SSL:

Important

Ambari Server should not be running when you do this: either make the edits before you start Ambari Server the first time or bring the server down to make the edits.

1. On the Ambari Server host, open `/etc/ambari-server/conf/ambari.properties` with a text editor.
2. Add the following property:

```
security.server.two_way_ssl = true
```

3. Start or restart the Ambari Server.

```
ambari-server restart
```

The Agent certificates are downloaded automatically during Agent Registration.