Hortonworks Data Platform: Apache Zeppelin Component Guide
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1. Overview

Apache Zeppelin is a web-based notebook that supports interactive data exploration, visualization, and collaboration. Zeppelin supports a growing list of programming languages and interfaces, including Python, Scala, Hive, SparkSQL, shell, AngularJS, and markdown.

Apache Zeppelin is useful for working interactively with long workflows: developing, organizing, and running analytic code; and visualizing results.
2. Installing Apache Zeppelin

This chapter describes how to install Zeppelin on an Ambari-managed cluster.

To install Zeppelin on an HDP cluster not managed by Ambari, see Installing and Configuring Apache Zeppelin in the Command Line Installation Guide.

To configure Zeppelin security features, see Configuring Zeppelin Security.

2.1. Requirements for Installing Zeppelin

Install Zeppelin on a node where Spark clients are already installed and running. This typically means that Zeppelin will be installed on a gateway or edge node.

Zeppelin requires the following software versions:

- or later.
- Apache Spark version 1.6. (Zeppelin does not currently support Spark 2.0, which is available as a technical preview with .)
- Java 8 on the node where Zeppelin is installed.

The optional Livy server provides security features and user impersonation support for Zeppelin users. Livy is installed as part of Spark:

- For an Ambari-managed cluster, see Installing Spark Using Ambari.
  After installing Spark, Livy, and Zeppelin, refer to Configuring Zeppelin for post-installation steps.
- For a cluster not managed by Ambari, see Installing and Configuring Livy in the Command Line Installation Guide.

2.2. Installing Zeppelin Using Ambari

This section describes how to install Zeppelin using Ambari.

The Ambari installation wizard sets default values for Zeppelin configuration settings. At first you should accept the default settings. Later, when you are more familiar with Zeppelin, consider customizing Zeppelin configuration settings.

To install Zeppelin using Ambari, add the Zeppelin service:

1. In the "Actions" menu at the bottom left of the Ambari dashboard, select "Add Service". This starts the Add Service wizard, which displays the "Choose Services" page.

2. On the Choose Services page, select the Zeppelin service.

3. Click "Next" to continue.

4. On the Assign Masters page, review the node assignment for Zeppelin, and modify as needed:
5. Click "Next" to continue.

6. On the Customize Services page, review default values and click "Next" to continue.

7. On the Review page, confirm the node selected to run the Zeppelin service:
8. Click "Deploy" to complete the installation process.

To validate your Zeppelin installation, open the Zeppelin Web UI in a browser window. Use the port number configured for Zeppelin (9995 by default); for example:

http://<zeppelin-host>:9995

To check the Zeppelin version number, type the following command on the command line:

/usr/hdp/current/zeppelin-server/bin/zeppelin-daemon.sh --version

Zeppelin stores configuration settings in the /etc/zeppelin/conf directory. Note, however, that if your cluster is managed by Ambari you should not modify configuration settings directly. Instead, use the Ambari web UI.

Zeppelin stores log files in /var/log/zeppelin on the node where Zeppelin is installed.
3. Configuring Zeppelin

This chapter describes how to configure the following optional features:

- Configuring Livy on an Ambari-managed cluster. (For a cluster not managed by Ambari, see Installing and Configuring Livy in the Command Line Installation Guide.)

- Configuring Zeppelin to access Hive using identity propagation, on Kerberos-enabled clusters.

3.1. Configuring Livy on an Ambari-Managed Cluster

Livy is a proxy service for Apache Spark. On HDP 2.5, Livy offers two main capabilities:

- Zeppelin users can launch a Spark session on a cluster, submit code, and retrieve job results, all over a secure connection.

- When Zeppelin runs with authentication enabled, Livy propagates user information when a session is created. Livy user impersonation offers an extended multi-tenant experience, allowing users to share RDDs and cluster resources. Multiple users can access their own private data and session, and collaborate on a notebook.

**Note**

Livy can be accessed through the `%livy` interpreter in Zeppelin notebooks, but direct use of Livy REST APIs is not supported.

Livy supports Kerberos, but does not require it.

The following graphic shows process communication among Zeppelin, Livy, and Spark:

![Zeppelin, Livy, Spark communication diagram]

On an Ambari-managed cluster, Livy is available as an option when you install Spark. After installing Livy, complete the following configuration steps.

1. *(Optional, for Kerberos-enabled clusters)* Ensure that access is enabled only for groups and hosts where Livy runs.

2. Specify the Livy host URL:
a. Navigate to the Interpreter configuration page in the Zeppelin Web UI.

b. In the livy interpreter section, make sure that the `zeppelin.livy.url` property contains the full Livy host name; replace `localhost` if necessary.

c. Scroll down to the "Save" button, and click "Save".

**Note:** on an Ambari-managed cluster you can find the Livy host from the Ambari dashboard: navigate to Spark > Summary > Livy Server.

3. (Optional) Configure Livy impersonation:

   a. From the Ambari dashboard, navigate to Spark > Configs.

   b. Open the "Custom livy-conf" category.

   c. Ensure that `livy.superusers` is listed; if not, add the property.

   d. Set `livy.superusers` to the user account associated with Zeppelin, `zeppelin.livy.principal`.

      For example, if `zeppelin.livy.principal` is `zeppelin-sr1@example.com`, set `livy.superusers` to the same account, `zeppelin-sr1@example.com`.

4. (Optional) Specify a timeout value for Livy sessions.

   By default, Livy preserves cluster resources by recycling sessions after one hour of session inactivity. When a Livy session times out, the Livy interpreter must be restarted.

   To specify a larger or smaller value using Ambari, navigate to the `livy.server.session.timeout` property in the "Advanced livy-conf" section of the Spark service. Specify the timeout in milliseconds (the default, one hour, is 3600000):

5. If you changed any Livy interpreter settings, restart the Livy interpreter.

   Navigate to the Interpreter configuration page in the Zeppelin Web UI. Locate the Livy interpreter and click "restart":

   To verify that the Livy server is running, access the Livy web UI in a browser window. The default port is 8998:

   `http://<livy-hostname>:8998/`
3.2. Configuring User Impersonation for Access to Hive

For clusters with Kerberos enabled: if you want Hive queries to run under the user ID associated with the Zeppelin session, enable user impersonation for the `%jdbc(hive)` interpreter.

1. Enable authentication via the Shiro configuration.

   In the Zeppelin UI, navigate to the JDBC interpreter section of the Interpreter page, and then specifying authorization type, keytab, and principal:

   a. Set `zeppelin.jdbc.auth.type` to `KERBEROS`.

   b. Set `zeppelin.jdbc.principal` to the value of the principal.

   c. Set `zeppelin.jdbc.keytab.location` to the keytab location.

2. The JDBC interpreter automatically adds the end user as proxy user and sends the string to HiveServer2; for example:

   

   ```
   jdbc:hive2://HiveHost:10000/default;principal=hive/_HOST@HOST1.COM;hive.server2.proxy.user=testuser
   ```
4. Using Zeppelin

A Zeppelin notebook is a browser-based GUI for interactive data exploration, modeling, and visualization.

As a notebook author or collaborator, you write code in a browser window. When you run the code from the browser, Zeppelin sends the code to backend processors such as Spark. The processor or service and returns results; you can then use Zeppelin to review and visualize results in the browser.

**Note:** Zeppelin on HDP does not support sharing a note by sharing its URL, due to lack of proper access control over how and with whom a note can be shared.

Apache Zeppelin is supported on the following browsers:

- Internet Explorer, latest supported releases. (Zeppelin is not supported on versions 8 or 9, due to lack of native support for WebSockets.)
- Google Chrome, latest stable release.
- Mozilla Firefox, latest stable release.
- Apple Safari, latest stable release. Note that when SSL is enabled for Zeppelin, Safari requires a Certificate Authority-signed certificate to access the Zeppelin UI.

4.1. Launching Zeppelin

To launch Zeppelin in your browser, access the host and port associated with the Zeppelin server. The default port is 9995:


When you first connect to Zeppelin, you will see the home page:

The following menus are available in the top banner of all Zeppelin pages:

- Notebook: open a note, filter the list of notes by name, or create a note
- User settings: listed as your username, or "anonymous" if your Zeppelin deployment uses the default Shiro configuration.
• List version information about Zeppelin
• Review interpreter settings and configure, add, or remove interpreter instances
• Save credentials for data sources
• Display configuration settings

Each instance of Zeppelin contains "notes", which are the fundamental elements of a Zeppelin notebook.

Zeppelin lists available notes on the left side of the welcome screen and in the "Notebook" menu. Zeppelin ships with several sample notes, including tutorials:

4.2. Working with Notes

A note consists of one or more paragraphs of code, which you can use to define and run snippets of code in a flexible manner.

A paragraph contains code to access services, run jobs, and display results. A paragraph consists of two main sections: an interactive box for code, and a box that displays results. To the right is a set of paragraph commands. The following graphic shows paragraph layout.
Zeppelin ships with several sample notes, including tutorials that demonstrate how to run Spark scala code, Spark SQL code, and create visualizations.

To run a tutorial:

1. Navigate to the tutorial: click one of the Zeppelin tutorial links on the left side of the welcome page, or use the Notebook pull-down menu.

2. Zeppelin presents the tutorial, a sequence of paragraphs prepopulated with code and text.

3. Starting with the first paragraph, click the triangle button at the upper right of the paragraph. The status changes to PENDING, RUNNING, and then FINISHED when done.

4. When the first cell finishes execution, results appear in the box underneath your code. Review the results.

5. Step through each cell, running the code and reviewing results.

4.2.1. Creating and Running a Note

To create a note:

1. Click "Create new note" on the welcome page, or click the "Notebook" menu and choose "+ Create new note."

2. Type your commands into the blank paragraph in the new note.

When you create a note, it appears in the list of notes on the left side of the home page and in the Notebook menu. By default, Zeppelin stores notes in the $ZEPPELIN_HOME/notebook folder.

To run your code:

1. Click the triangle button in the cell that contains your code:

   ![Triangle button](image)

2. Zeppelin displays status near the triangle button: PENDING, RUNNING, ERROR, or FINISHED.
3. When finished, results appear in the result section below your code.

The settings icon (outlined in red) offers several additional commands:

These commands allow you to perform several note operations, such as showing and hiding line numbers, clearing the results section, and deleting the paragraph.

4.2.2. Importing a Note

To import a note from a URL or from a JSON file in your local file system:

1. Click "Import note" on the Zeppelin home page:

   Notebook ☰
   🌐 Import note

2. Zeppelin displays an import dialog box:

3. To upload the file or specify the URL, click the associated box.
By default, the name of the imported note is the same as the original note. You can rename it by providing a new name in the "Import AS" field.

### 4.2.3. Exporting a Note

To export a note to a local JSON file, use the export note icon in the note toolbar:

[Image of export button]

Zeppelin downloads the note to the local file system.

Note: Zeppelin exports code and results sections in all paragraphs. If you have a lot of data in your results sections, consider trimming results before exporting them.

### 4.2.4. Using the Note Toolbar

At the top of each note there is a toolbar with buttons for running code in paragraphs and for setting configuration, security, and display options:

There are several buttons in the middle of the toolbar:

[Image of various buttons]

These buttons perform the following operations:

- Execute all paragraphs in the note sequentially, in the order in which they are displayed in the note.
- Hide or show the code section of all paragraphs.
- Hide or show the result sections in all paragraphs.
- Clear the result section in all paragraphs.
- Clone the current note.
- Export the current note to a JSON file.

Note that the code and result sections in all paragraphs are exported. If you have extra data in some of your result sections, trim the data before exporting it.

- Commit the current note content.
- Delete the note.
- Schedule the execution of all paragraphs using CRON syntax. This feature is not currently operational. If you need to schedule Spark jobs, consider using Oozie Spark action.

There are additional buttons on the right side of the toolbar:
These buttons perform the following operations (from left to right):

- Display all keyboard shortcuts.
- Configure interpreters that are bound to the current note.
- Configure note permissions.
- Switch display mode:
  - Default: the notebook can be shared with (and edited by) anyone who has access to the notebook.
  - Simple: similar to default, with available options shown only when your cursor is over the cell.
  - Report: only your results are visible, and are read-only (no editing).

Note: Zeppelin on HDP does not support sharing a note by sharing its URL, due to lack of proper access control over who and how a note can be shared.

4.3. Importing External Packages

If you want to use an external package within a Zeppelin note, you can follow one of these approaches:

- Specify the dependency for the associated interpreter on the Interpreter page. For more information, see Dependency Management for Interpreter at zeppelin.apache.org.

- For Spark jobs, you can pass a jar, package, or list of files to `spark-submit` using `SPARK_SUBMIT_OPTIONS`; for example:

  ```shell
  export SPARK_SUBMIT_OPTIONS="--packages com.databricks:spark-csv_2.10:1.2.0 --jars /path/mylib1.jar,/path/mylib2.jar --files /path/mylib1.py,/path/mylib2.zip,/path/mylib3.egg"
  ```

  ```conf/spark-defaults.conf
  spark.jars /path/mylib1.jar,/path/mylib2.jar spark.jars.packages com.databricks:spark-csv_2.10:1.2.0 spark.files /path/mylib1.py,/path/mylib2.egg,/path/mylib3.zip
  ```

If you want to import a library for a note that uses the Livy interpreter, see Using the `%livy` Interpreter to Access Spark.
4.4. Configuring and Using Zeppelin Interpreters

An interpreter is a plugin that enables you to access processing engines and data sources from the Zeppelin UI. For example, if you want to use scala code in your Zeppelin notebook, you need a scala interpreter. Each interpreter runs in its own JVM on the same node as the Zeppelin server. The Zeppelin server communicates with interpreters through the use of Thrift.

Apache Zeppelin on HDP supports the following interpreters:

- Spark
- Hive (supported via JDBC)
- Shell
- MarkDown
- Livy (supports Spark, SparkSQL, PySpark, and SparkR)
- AngularJS

4.4.1. Modifying Interpreter Settings

Before using an interpreter, you might want to modify default settings such as the home directory for the spark interpreter, the name of the Hive JDBC driver for the JDBC interpreter, or the keytab and principal name for a secure installation.

To set custom configuration values for an interpreter:

1. Click the user settings menu and navigate to the Interpreter page.
2. Scroll down to the Properties section for the interpreter of interest, and click "edit".
3. Make your changes.
4. Scroll to the end of the list of settings and click "Save".

Note: The Interpreter page is subject to access control settings. If the page does not list a set of interpreters, check with your system administrator.

4.4.2. Using Zeppelin Interpreters

Before using an interpreter, ensure that the interpreter is available for use in your note:

1. Navigate to your note.
2. Click on "interpreter binding":

![Interpreter binding](image)
3. Under "Settings", make sure that the interpreter you want to use is selected (in blue text). Unselected interpreters appear in white text:

![Interpreter List](image)

4. To select an interpreter, click on the interpreter name to select the interpreter. Each click operates as a toggle.

5. You should unselect interpreters that will not be used. This makes your choices clearer. For example, if you plan to use `%livy` to access Spark, unselect the `%spark` interpreter.

Whenever one or more interpreters could be used to access the same underlying service, you can specify the precedence of interpreters within a note:

- Drag and drop interpreters into the desired positions in the list.
- When finished, click "Save".

**Using an Interpreter in a Paragraph**

To use an interpreter, specify the interpreter directive at the beginning of a paragraph, using the format `%[INTERPRETER_NAME]`. The directive must appear before any code that uses the interpreter.

The following paragraph uses the `%sh` interpreter to access the system shell and list the current working directory:

```
%sh
pwd

home/zeppelin
```

Some interpreters support more than one form of the directive. For example, the `%livy` interpreter supports directives for PySpark, SparkR, and Spark SQL.

To view interpreter directives and settings, navigate to the Interpreter page and scroll through the list of interpreters or search for the interpreter name. The list of directives is
at the start of the associated interpreter section of the notebook, followed by options and property settings.

```
%livy %livy, %livy.pyspark, %livy.sparkr, %livy.sql
```

**Note:** The Interpreter page is subject to access control settings. If the Interpreters page does not list settings, check with your system administrator for more information.

### Using Interpreter Groups

Each interpreter belongs to an interpreter group. Interpreters in the same group can reference each other. For example, if the Spark SQL interpreter and the Spark interpreter are in the same group, the Spark SQL interpreter can reference the Spark interpreter to access its SparkContext.

For more information about interpreters, see [Interpreters in Apache Zeppelin](zeppelin.apache.org) at zeppelin.apache.org.

#### 4.4.3. Using the `%jdbc` Interpreter to Access Hive

The `%jdbc` interpreter supports access to Apache Hive data.

To use the JDBC interpreter for Hive access, specify the following directive:

```
%jdbc(hive)
```

Next, add the statement that accesses Hive; here is a sample paragraph:

```
%jdbc(hive)
SELECT * FROM db_name;
```

If you receive an error, you might need to complete the following two additional steps:

1. Copy Hive jar files to `/usr/hdp/current/zeppelin-server/interpreter/jdbc` (or create a soft link).

2. On the Interpreters page in the Zeppelin Web UI, restart the JDBC interpreter.

The JDBC interpreter connects via Thrift.

#### 4.4.4. Using the `%livy` Interpreter to Access Spark

The Livy interpreter offers several advantages over the default Spark interpreter (`%spark`):

- Sharing of Spark context across multiple Zeppelin instances.
- Reduced resource use, by recycling resources after 60 minutes of activity (by default). The default Spark interpreter runs jobs--and retains job resources--indefinitely.
- User impersonation. When the Zeppelin server runs with authentication enabled, the Livy interpreter propagates user identity to the Spark job so that the job runs as the originating user. This is especially useful when multiple users are expected to connect
to the same set of data repositories within an enterprise. (The default Spark interpreter
runs jobs as the default Zeppelin user.)

• The ability to run Spark in yarn-cluster mode.

Prerequisite: Before using Livy in a note, check the Interpreter page to ensure that the Livy
interpreter is configured properly for your cluster:

Note: The Interpreter page is subject to access control settings. If the Interpreters page
does not list settings, check with your system administrator for more information.

To use access Spark using Livy, specify the corresponding interpreter directive in a
paragraph, before the code that accesses Spark; for example:

• PySpark:

```python
%livy.pyspark
print "1"
```

• SparkR:

```r
%livy.sparkr
hello <- function( name ) {
    sprintf( "Hello, %s", name );
}

hello("livy")
```

Important

To use SQLContext with Livy, do not create SQLContext explicitly. Zeppelin
creates SQLContext by default.

If necessary, remove the following lines from the SparkSQL declaration area of
your note:

```scala
//val sqlContext = new org.apache.spark.sql.SQLContext(sc)
//import sqlContext.implicits._
```

Livy sessions are recycled after a specified period of session inactivity. The default is one
hour. If your session times out, you will need to restart the interpreter. On the Interpreters
configuration page, locate the Livy interpreter and click "restart".

Importing External Packages

To import an external package for use in a note that runs with Livy:

1. Navigate to the interpreter settings.
2. If you are running the Livy interpreter in local mode (as specified by `livy.spark.master`), add jar files to the `/usr/hdp/<version>/livy/repl-jars` directory.

3. If you are running the Livy interpreter in yarn-cluster mode, either complete step 2 or edit the Livy configuration on the Interpreters page as follows:

   a. Add a new key, `livy.spark.jars.packages`.

   b. Set its value to `<group>:<id>:<version>`.

   Here is an example for the `spray-json` library, which implements JSON in Scala:

   `io.spray:spray-json_2.10:1.3.1`
5. Configuring Zeppelin Security

Zeppelin uses Apache Shiro to provide authentication and authorization (access control).

This chapter describes how to configure and enable several Zeppelin security features:

1. Configure authentication. Zeppelin supports a Shiro-based identity source for testing and informal use, as well as LDAP and Active Directory identity sources for production use. After authentication is enabled, when users connect to Apache Zeppelin they are prompted for login credentials.

2. Optionally, limit who can configure Zeppelin interpreter, credential, and configuration settings; notebooks; and data.

3. Optionally, configure the Zeppelin UI to run over SSL (HTTPS).

4. Optionally, configure Zeppelin to run on a Kerberos-enabled cluster.

5.1. Getting Started

5.1.1. Prerequisites

To use LDAP or Active Directory (AD) as the identity store, LDAP or AD must be installed and running on your cluster. You will need LDAP or AD coordinates to configure them for use with Zeppelin. In addition, the associated user accounts must be defined on your Zeppelin nodes.

5.1.2. Configuring Security on an Ambari-Managed Cluster

If your cluster is managed by Ambari, navigate to the Configs tab. Edit settings in the "Advanced zeppelin-env" and "Advanced zeppelin-config" categories, as described in following subsections.

Changes to shiro.ini_content require restarting the Zeppelin server. Ambari indicates this with a warning, and offers a menu option to restart Zeppelin.

5.1.3. Configuring Security on a Cluster Not Managed by Ambari

If your cluster is not managed by Ambari:

1. Locate the shiro.ini template file in the Zeppelin /conf folder:
   /usr/hdp/current/zeppelin-server/conf/shiro.ini.template.

2. Copy the template file as shiro.ini:
   /usr/hdp/current/zeppelin-server/conf/shiro.ini

3. Edit shiro.ini file contents, as described in the following subsections.
4. After editing the shiro.ini file, restart the Zeppelin server:

```
./bin/zeppelin-daemon.sh restart
```

## 5.1.4. shiro.ini Structure

The shiro_ini_content property (Ambari) and shiro.ini file (non-Ambari) contain several sections for configuring authentication:

- **[main]**, which contains definitions for LDAP or Active Directory objects and properties.

- **[users]**, which can be used to specify user accounts and passwords for simple deployments that do not require secure passwords, and require only a small number of statically-defined accounts.

- **[roles]**, for defining roles associated with access control.

- **[urls]**, for configuring URL-based security. For Zeppelin, the [urls] section is used to specify authentication method and define access control filters.

For more information about Shiro configuration and processing, see Apache Shiro Configuration.

## 5.2. Configure Zeppelin for Authentication: Non-Production Use

The following steps provide a quick, basic form of authentication. This approach is not for production use; usernames and passwords are exposed in clear text. For production use, you should use LDAP or Active Directory as the identity source.

To configure authentication for informal use or testing:

1. Populate the **[urls]** section as follows:
   a. Specify authc as the authentication method in the URL section of shiro.ini contents, and make sure that the authc line is not commented out.
   
   ```
   a. Specify authc as the authentication method in the URL section of shiro.ini contents, and make sure that the authc line is not commented out.

   b. To disable anonymous access to Zeppelin, add a comment character (#) at the start of the line containing /** = anon.

   Here is an example:

   ```
   [urls]
   #/api/version = anon
   #/** = anon
   /** = authc
   ```

   2. Populate the **[users]** section as follows:

   Specify authorized accounts and associated passwords in shiro_ini settings: for clusters managed by Ambari, update shiro_ini_content; for non-Ambari clusters, update the shiro.ini file.
The following example configures authentication for users admin, user1, and user2, with passwords password1, password2, and password3, respectively:

```
[users]
admin = password1
user1 = password2
user2 = password3
```

3. Restart the Zeppelin server using Ambari or, for a cluster not managed by Ambari, follow the instructions in Installing and Configuring Apache Zeppelin in the Non-Ambari Cluster Installation Guide.

4. After completing these steps, Zeppelin requires authentication of user credentials before allowing access to the Zeppelin UI.

### 5.3. Configure Zeppelin for Authentication: LDAP and Active Directory

Zeppelin supports LDAP and Active Directory (AD) as identity stores for authentication. Because Active Directory is based on LDAP requirements, the configuration process is similar; however, the properties differ.

Before configuring LDAP or AD, user accounts must exist on Zeppelin nodes; and users, groups, and domain information must be stored in your LDAP or AD directory. You will need user, group, and domain information to configure LDAP or AD for Zeppelin.

*Important*

You should configure and enable SSL to the Zeppelin Web server whenever you enable LDAP or AD authentication. Without SSL, network communication is visible.

### 5.3.1. Configuring Authentication for Production Using Active Directory

To enable AD authentication, complete the following steps.

**Note:** Zeppelin currently uses Bind requests to authenticate end users; it does not support the LDAP compare operation.

The following steps describe basic settings. For more information about these and other settings, see Shiro Settings: Reference and Shiro authentication for Apache Zeppelin.

1. Secure the HTTP channel.

   In the [urls] section of shiro.ini contents, uncomment the line /** = authc and comment out the line /** = anon (to disable anonymous access):

```
[urls]
//api/version = anon
#/** = anon
/** = authc
```
Note: The \[urls\] section is processed from top to bottom; earlier statements have precedence. If you have two conflicting lines, the first is honored.

2. In the \[main\] section of shiro.ini contents, enable activeDirectoryRealm and modify the following settings for your operating environment. For clusters managed by Ambari, update shiro_ini_content; for non-Ambari clusters, update the shiro.ini file.

Note that there are two types of directory references, those that refer to the AD database, and those that refer to user accounts and groups. Domain information can differ between the two.

[main]

# authentication settings
activeDirectoryRealm = org.apache.zeppelin.server.ActiveDirectoryGroupRealm
activeDirectoryRealm.url = ldap://<ldap-domain>:389
activeDirectoryRealm.searchBase = DC=<user-org-level-domain>,DC=<user-second-level-domain>,DC=<user-top-level-domain>

# general settings
sessionManager = org.apache.shiro.web.session.mgt.DefaultWebSessionManager
cacheManager = org.apache.shiro.cache.MemoryConstrainedCacheManager
securityManager.cacheManager = $cacheManager
securityManager.sessionManager = $sessionManager
securityManager.sessionManager.globalSessionTimeout = 86400000

shiro.loginUrl = /api/login

3. Optional: Zeppelin supports connections to AD over SSL. To force Zeppelin to make an SSL connection to AD, change the value of activeDirectoryRealm.url from ldap to ldaps and specify the AD SSL port; for example:

activeDirectoryRealm.url = ldaps://hdp.example.com:636

If LDAP is using a self-signed certificate, import the certificate into the truststore of JVM running Zeppelin:

echo -n | openssl s_client -connect ldap.example.com:389 | sed -ne '/-BEGIN CERTIFICATE-/,/-END CERTIFICATE-/p' > /tmp/examplecert.crt
keytool -import -keystore $JAVA_HOME/jre/lib/security/cacerts -storepass changeit -noprompt -alias mycert -file /tmp/examplecert.crt

4. Secure the Websocket channel.

On an Ambari-managed cluster, navigate to the "Advanced zeppelin-config" section and set zeppelin.anonymous.allowed to false. HDP 2.6: check category

On a cluster not managed by Ambari, edit the conf/zeppelin-site.xml file. Set zeppelin.anonymous.allowed to false. (If the file does not exist, rename conf/zeppelin-site.xml.template to conf/zeppelin-site.xml, and then edit zeppelin-site.xml.)

5. Optional: If you want to keep clear passwords from appearing in shiro.ini, complete the following steps:
a. At your OS command line interface, use the Hadoop credential command to create an entry for the Active Directory credential:

```bash
> hadoop credential create activeDirectoryRealm.systemPassword -provider jceks:///etc/zeppelin/conf/credentials.jceks
Enter password:
Enter password again:
activeDirectoryRealm.systemPassword has been successfully created.
org.apache.hadoop.security.alias.JavaKeyStoreProvider has been updated.
```

b. Using chmod 400, make the credentials.jceks file readable and writable only by the Zeppelin system user.

c. Add the following line to shiro.ini contents:

```bash
activeDirectoryRealm.systemPassword -provider jceks:///etc/zeppelin/conf/credentials.jceks
```

6. Restart the Zeppelin server using Ambari or, for a cluster not managed by Ambari, manually restart the Zeppelin server:

```
./bin/zeppelin-daemon.sh restart
```

To use Zeppelin after configuring AD authentication:

1. Open the Zeppelin UI in a new browser tab:

```
http://<zeppelin-hostname>:9995
```

2. Click the Login button at the top right corner of the page.

3. In the login dialog box, specify a valid Active Directory username and password.

   Unless the activeDirectoryRealm.principalSuffix property was set during AD configuration, users must fully qualify their account name; for example:

```
ad-username@AD.DOMAIN.COM
```

4. If Zeppelin access to Active Directory is configured accurately, Zeppelin presents its home page.

**5.3.2. Configuring Authentication for Production Using LDAP**

To use any form of LDAP other than AD, complete the steps in this section.

**Note:** Zeppelin currently uses LDAP Bind requests to authenticate end users; it does not support the LDAP compare operation.

The following steps describe basic settings. For more information about these and additional settings, see [Shiro Settings: Reference](#) and [Shiro authentication for Apache Zeppelin](#).

1. Secure the HTTP channel.
In the [urls] section of shiro.ini contents, uncomment the line /** = authc, and comment out the line /** = anon (to disable anonymous access):

```
[urls]
/api/version = anon
#/** = anon
/** = authc
```

**Note:** The [urls] section is processed from top to bottom; earlier statements have precedence. If you have two conflicting lines, the first is honored.

2. In the [main] section of shiro.ini contents, enable ldapRealm and modify the following settings for your operating environment. For clusters managed by Ambari, update shiro_ini_content; for non-Ambari clusters, update the shiro.ini file.

```
[main]

# authentication settings
ldapRealm = org.apache.zeppelin.server.LdapGroupRealm
ldapRealm.contextFactory.environment[ldap.searchBase] = DC=<user-second-level-domain>,DC=<user-top-level-domain>
ldapRealm.userDnTemplate = uid={0},OU=<user-account>,DC=<user-second-level-domain>,DC=<user-top-level-domain>
ldapRealm.contextFactory.url = ldap://<ldap-domain>:389
ldapRealm.contextFactory.authenticationMechanism = simple

# general settings
sessionManager = org.apache.shiro.web.session.mgt.DefaultWebSessionManager
cacheManager = org.apache.shiro.cache.MemoryConstrainedCacheManager
securityManager.cacheManager = $cacheManager
securityManager.sessionManager = $sessionManager
securityManager.sessionManager.globalSessionTimeout = 86400000

shiro.loginUrl = /api/login
```

3. Optional: Zeppelin supports connections to LDAP over SSL. To force Zeppelin to make an SSL connection to LDAP, change the contextFactory.url value from ldap to ldaps and specify the LDAP SSL port; for example:

```
ldapRealm.contextFactory.url = ldaps://hdp.example.com:636
```

If LDAP is using a self-signed certificate, import the certificate into the truststore of JVM running Zeppelin:

```
echo -n | openssl s_client -connect ldap.example.com:389 | sed -ne '/-BEGIN CERTIFICATE/-,/-END CERTIFICATE-/p' > /tmp/examplecert.crt
dirktol -import -keystore $JAVA_HOME/jre/lib/security/cacerts -storepass changeit -noprompt -alias mycert -file /tmp/examplecert.crt
```

4. Secure the Websocket channel.

On an Ambari-managed cluster, navigate to the "Advanced zeppelin-config" section and set zeppelin.anonymous.allowed to false.
On a cluster not managed by Ambari, edit the conf/zeppelin-site.xml file. Set zeppelin.anonymous.allowed to false. (If the file does not exist, rename conf/zeppelin-site.xml.template to conf/zeppelin-site.xml.)

5. Restart the Zeppelin server using Ambari or, for a cluster not managed by Ambari, manually restart the Zeppelin server:

   ./bin/zeppelin-daemon.sh restart

6. To use Zeppelin after configuring LDAP authentication:
   a. Open the Zeppelin UI in a new browser tab:

   http://<zeppelin-hostname>:9995

   b. Click the Login button at the top right corner of the page.

   c. In the login dialog box, specify a valid LDAP username and password.

   d. If Zeppelin access to LDAP is configured accurately, Zeppelin presents its home page.

5.4. Enable Access Control for Zeppelin Elements

After configuring authentication, you might want to restrict access control to configure Zeppelin interpreters, access notes, or access data. You can authorize access at three levels within Zeppelin:

- **UI authorization** restricts access to Zeppelin Interpreter, Credential, and Configuration pages based on administrative privileges.

- **Note-level authorization** restricts access to notes based on permissions (owner, reader, or writer) granted to users and groups.

- **Data-level authorization** restricts access to specific data sets.

5.4.1. Enabling Access Control for Interpreter, Configuration, and Credential Settings

By default, any authenticated account can access Zeppelin interpreter, credential, and configuration settings. When access control is enabled, unauthorized users can see the page heading, but no settings. There are two steps: defining roles, and specifying which roles have access to which settings.

**Prerequisite:** Users and groups must be defined on all Zeppelin nodes and in the associated identity store.

To enable access control for the Zeppelin interpreter, credential, or configuration pages, complete the following steps:

1. Define a [roles] section in shiro.ini contents, and specify permissions for defined groups.

   The following example grants all permissions ("*") to users in group admin:
[roles]
admin = *

2. In the [urls] section of the shiro.ini contents, uncomment the interpreter, configurations, or credential line(s) to enable access to the interpreter, configuration, or credential page(s), respectively. (If the [urls] section is not defined, add the section. Include the three /api lines listed in the following example.)

The following example specifies access to interpreter, configurations, and credential settings for role "admin":

[urls]
/api/version = anon
/api/interpreter/** = authc, roles[admin]
/api/configurations/** = authc, roles[admin]
/api/credential/** = authc, roles[admin]
/** = anon
/** = authc

To add more roles, separate role identifiers with commas inside the square brackets.

Note: The sequence of lines in the [urls] section is important. The /api/version line must be the first line in the [urls] section:

/api/version = anon

Next, specify the three /api lines in any order:

/api/interpreter/** = authc, roles[admin]
/api/configurations/** = authc, roles[admin]
/api/credential/** = authc, roles[admin]

The authc line must be last in the [urls] section:

/** = authc

3. When unauthorized users attempt to access the interpreter, configurations, or credential page, they see the page heading but not settings.

5.4.2. Enabling Access Control for Notebooks

The next optional security step is to add access control for Zeppelin notes, granting permissions to specific users and groups. There are two main steps to this process: defining the searchBase property in the Zeppelin Shiro configuration, and then specifying permissions.

To restrict notebook access to authorized users:

1. Administrator:

   In Zeppelin configuration settings, specify activeDirectoryRealm.searchBase or ldapRealm.searchBase, depending on whether you use AD or LDAP for authentication. The value of searchBase controls where Zeppelin looks for users and groups.
For more information, refer to Shiro Settings: Reference. For an example, see Configure Authentication for Authentication: LDAP and Active Directory.

2. Owner of a notebook:
   a. Navigate to the note.
   b. Click the lock icon on the notebook:

   ![Lock Icon]

   c. Zeppelin presents a popup menu. Enter the user and groups that should have access to the note. To search for an account, start typing the name.

   **Note**: If you are using Shiro as the identity store, users should be listed in the [user] section. If you are using AD or LDAP users and groups should be stored in the realm associated with your Shiro configuration.

   ![Note Permissions]

   For more information, see Apache Zeppelin Notebook Authorization.

### 5.4.3. Enabling Access Control for Data

Access control for data brought into Zeppelin depends on the underlying data source:

- To configure access control for Spark data, Zeppelin must be running as an end user ("identity propagation"). Zeppelin implements access control using Livy. When identity propagation is enabled via Livy, data access is controlled by the type of data source being accessed. For example, when you access HDFS data, access is controlled by HDFS permissions.

- To configure access control for Hive data, use the JDBC interpreter.

- To configure access control for the Spark shell, define permissions for end users running the shell.
5.5. Configure SSL for Zeppelin

To configure the Zeppelin UI for access over SSL:

1. In Ambari, access the "Advanced zeppelin-config" section of the Zeppelin configuration settings:

2. Set `zeppelin.ssl` to true.

3. Configure key manager and key store settings with the correct values for your system:
   a. Set `zeppelin.ssl.key.manager.password` to the password associated with the key manager.
   b. Set `zeppelin.ssl.keystore.password` to the password associated with the key store.
   c. Set `zeppelin.ssl.keystore.path` to the path associated with the key store.
   d. Set `zeppelin.ssl.keystore.type` to the type of key store configured on the cluster (for example, JKS).

4. If you wish to use client-side certificate authentication, enable client-side authentication and configure the associated trust store settings:
   a. Set `zeppelin.ssl.cient.auth` to true
   b. Set `zeppelin.ssl.truststore.path` to the path associated with your trust store.
   c. Set `zeppelin.ssl.truststore.password` to the password associated with your trust store.
   d. Set `zeppelin.ssl.truststore.type` to the type of trust store configured on the cluster (for example, JKS).

5. Check to make sure that all settings are valid.

6. Connect using HTTPS.

Note: When SSL is enabled for Zeppelin, the Safari browser requires a Certificate Authority-signed certificate to access the Zeppelin UI.

5.6. Configure Zeppelin for a Kerberos-Enabled Cluster

The Zeppelin daemon needs a Kerberos account and keytab to run in a Kerberized cluster.

- When you enable Kerberos on an Ambari-managed cluster, Ambari configures Kerberos for Zeppelin and automatically creates a Kerberos account and keytab for it. For more information, see Configuring Ambari and Hadoop for Kerberos.
• If your cluster is not managed with Ambari and you plan to enable Kerberos for the Zeppelin server, see Creating Service Principals and Keytab Files for HDP in the Hadoop Security Guide.

5.7. Shiro Settings: Reference

This section lists more information about Shiro settings described in the authentication and authorization configuration subsections, plus a few more settings that might be useful.

5.7.1. Active Directory Settings

Active Directory (AD) stores users and groups in a hierarchical tree structure, built from containers including the organizational unit (ou), organization (o), and domain controller (dc). The path to each entry is a Distinguished Name (DN) that uniquely identifies a user or group.

User and group names typically have attributes such as a common name (cn) or unique ID (uid).

Specify the DN as a string, for example `cn=admin,dc=example,dc=com`. White space is ignored.

`activeDirectoryRealm.url` specifies the host and port where Active Directory is set up. For more information, see Apache Shiro Realms.

If the protocol element is specified as `ldap`, SSL is not used. If the protocol is specified as `ldaps`, access is over SSL.

**Note:** If Active Directory uses a self-signed certificate, import the certificate into the truststore of the JVM running Zeppelin; for example:

```bash
echo -n | openssl s_client -connect ldap.example.com:389 | sed -ne '/-BEGIN CERTIFICATE-/-END CERTIFICATE-/p' > /tmp/examplecert.crt
keytool -import -keystore $JAVA_HOME/jre/lib/security/cacerts -storepass changeit -noprompt -alias mycert -file /tmp/examplecert.crt
```

`activeDirectoryRealm.principalSuffix` simplifies the logon information that users must use to log in. Otherwise, AD requires a username fully qualified with domain information. For example, if a fully-qualified user account is `user@hdpqa.example.com`, you can specify a shorter suffix such as `user@hdpqa`.

`activeDirectoryRealm.principalSuffix = @<user-org-level-domain>`

`activeDirectoryRealm.searchBase` defines the base distinguished name from which the directory search starts. A distinguished name defines
each entry; "dc" entries define a hierarchical directory
tree.

activeDirectoryRealm.systemUsername,
activeDirectoryRealm.systemPassword
defines the username and password that Zeppelin uses
to connect to Active Directory when it searches for users
and groups. These two settings are used for controlling
access to UI features, not for authentication. The Bind
method does not require a valid user password.

activeDirectoryRealm.groupRolesMap

a comma-separated list that maps groups to roles. These
settings are used by Zeppelin to restrict UI features to
specific AD groups. The following example maps group
hdpdv_admin at hdp3.example.com to the "admin"
role:

CN=hdpdv_admin,DC=hdp3,DC=example,DC=com:admin

activeDirectoryRealm.authorizationCachingEnabled

specifies whether to use caching to improve
performance. To enable caching, set this property to
true.

5.7.2. LDAP Settings

LDAP stores users and groups in a hierarchical tree structure, built from containers including
the organizational unit (ou), organization (o), and domain controller (dc). The path to each
entry is a Distinguished Name (DN) that uniquely identifies a user or group.

User and group names typically have attributes such as a common name (cn) or unique ID
(uid).

Specify the DN as a string, for example cn=admin,dc=example,dc=com. White space is
ignored.

Zeppelin LDAP authentication uses templates for user DNs. See LDAP Realm Settings for
options you can set for an LDAP realm.

ldapRealm

specifies the class name to use for LDAP
authentication. You should set this to
org.apache.zeppelin.server.LdapGroupRealm
unless you are familiar with LDAP and prefer to use
For more information, see Apache Shiro Realms.

ldapRealm.contextFactory.environment[ldap.searchBase]
defines the base distinguished name from
which the LDAP search starts. Shiro searches for
userDnTemplate at this address.

If the protocol is specified as ldap, SSL is not used. If
the protocol is specified as ldaps, access is over SSL.
ldapRealm.userDnTemplate specifies the search location where the user is to be found. Shiro replaces `{0}` with the username acquired from the Zeppelin UI. Zeppelin uses User DN templates to configure associated realms.

ldapRealm.contextFactory.url specifies the host and port on which LDAP is running.

If the protocol element is specified as `ldap`, SSL will not be used. If the protocol is specified as `ldaps`, access will be over SSL.

**Note:** If LDAP is using a self-signed certificate, import the certificate into the truststore of JVM running Zeppelin; for example:

```bash
echo -n | openssl s_client -connect ldap.example.com:389 | sed -ne '/-BEGIN CERTIFICATE-/ ,/-END CERTIFICATE-/p' > /tmp/examplecert.crt
keytool -import -keystore $JAVA_HOME/jre/lib/security/cacerts -storepass changeit -noprompt -alias mycert -file /tmp/examplecert.crt
```

ldapRealm.contextFactory.systemUsername, ldapRealm.contextFactory.systemPassword define the username and password that Zeppelin uses to connect to LDAP, to search for users and groups. These two settings are used for controlling access to UI features, not for authentication. The Bind method does not require a valid user password.

ldapRealm.authorizationCachingEnabled specifies whether to use caching to improve performance. To enable caching, set this property to `true`.

### 5.7.3. General Settings

securityManager.sessionManager.globalSessionTimeout specifies how long to wait (in milliseconds) before logging out a user, if they are logged in and are not moving the cursor.

The default is 86,400,000 milliseconds, which equals 24 hours.

### 5.7.4. Example

The following example shows a minimum set of `shiro.ini` settings for authentication and access control, assuming that the corresponding account information is configured in Active Directory (at adhost.field.hortonworks.com) and on Zeppelin nodes.

```ini
[main]
# AD authentication settings
```
activeDirectoryRealm = org.apache.zeppelin.server.ActiveDirectoryGroupRealm
activeDirectoryRealm.searchBase = DC=org,DC=hortonworks,DC=com

# general settings
sessionManager = org.apache.shiro.web.session.mgt.DefaultWebSessionManager
cacheManager = org.apache.shiro.cache.MemoryConstrainedCacheManager
securityManager.cacheManager = $cacheManager
securityManager.sessionManager = $sessionManager
securityManager.sessionManager.globalSessionTimeout = 86400000
shiro.loginUrl = /api/login

[roles]
admin = *

[urls]
# authentication method and access control filters
/api/version = anon
/api/interpreter/** = authc, roles[admin]
/api/configurations/** = authc, roles[admin]
/api/credential/** = authc, roles[admin]
#/** = anon
/** = authc
6. Stopping the Zeppelin Server and Livy Server

To stop the Zeppelin server on a cluster managed by Ambari, use the Ambari Web UI.

To stop the Zeppelin server on a cluster that is not managed by Ambari, issue the following command from user `zeppelin`:

```
/usr/hdp/current/zeppelin-server/bin/zeppelin-daemon.sh stop
```

To stop the Livy server, issue the following command from user `livy`:

```
/usr/hdp/<hdp_version>/livy/bin/livy-server stop
```

For example:

```
/usr/hdp/2.5.3.0-37/livy/bin
```