

Apache NiFi 3

## Apache NiFi Toolkit Guide

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# Contents

<b>Overview.....</b>	<b>4</b>
Prerequisites for Running in a Secure Environment.....	4
<b>NiFi CLI.....</b>	<b>4</b>
Usage.....	4
Property/Argument Handling.....	6
Security Configuration.....	7
Example - Secure NiFi Registry without Proxied-Entity.....	7
Example - Secure NiFi Registry with Proxied-Entity.....	7
Interactive Usage.....	8
Output.....	8
Back-Referencing.....	9
Adding Commands.....	9
<b>Encrypt-Config Tool.....</b>	<b>10</b>
Usage.....	10
<b>File Manager.....</b>	<b>13</b>
Usage.....	13
Expected Behavior.....	14
Backup.....	14
Install.....	14
Restore.....	14
<b>Flow Analyzer.....</b>	<b>15</b>
Usage.....	15
<b>Node Manager.....</b>	<b>15</b>
Usage.....	15
Expected Behavior.....	16
Status.....	16
Disconnect.....	16
Connect.....	16
Remove.....	17
<b>Notify.....</b>	<b>17</b>
Usage.....	17
<b>S2S.....</b>	<b>18</b>
Usage.....	18

<b>TLS Toolkit.....</b>	<b>19</b>
Wildcard Certificates.....	19
Potential issues with wildcard certificates.....	19
Operation Modes.....	20
Standalone.....	20
Client/Server.....	21
Using An Existing Intermediate Certificate Authority (CA).....	22
nifi-cert.pem.....	23
nifi-key.key.....	25
Signing with Externally-signed CA Certificates.....	27
Additional Certificate Commands.....	28
<b>ZooKeeper Migrator.....</b>	<b>29</b>
Usage.....	29
Migrating Between Source and Destination ZooKeepers.....	30
ZooKeeper Migration Steps.....	30

## Overview

The NiFi Toolkit contains several command line utilities to setup and support NiFi in standalone and clustered environments. The utilities include:

- CLI - The cli tool enables administrators to interact with NiFi and NiFi Registry instances to automate tasks such as deploying versioned flows and managing process groups and cluster nodes.
- Encrypt Config - The encrypt-config tool encrypts the sensitive keys in the nifi.properties file to facilitate the setup of a secure NiFi instance.
- File Manager - The file-manager tool enables administrators to backup, install or restore a NiFi installation from backup.
- Flow Analyzer - The flow-analyzer tool produces a report that helps administrators understand the max amount of data which can be stored in backpressure for a given flow.
- Node Manager - The node-manager tool enables administrators to perform status checks on nodes as well as the ability to connect, disconnect, or remove nodes from the cluster.
- Notify - The notify tool enables administrators to send bulletins to the NiFi UI.
- S2S - The s2s tool enables administrators to send data into or out of NiFi flows over site-to-site.
- TLS Toolkit - The tls-toolkit utility generates the required keystores, truststore, and relevant configuration files to facilitate the setup of a secure NiFi instance.
- ZooKeeper Migrator - The zk-migrator tool enables administrators to:
  - move ZooKeeper information from one ZooKeeper cluster to another
  - migrate ZooKeeper node ownership

The utilities are executed with scripts found in the bin folder of your NiFi Toolkit installation.



**Note:** The NiFi Toolkit is downloaded separately from NiFi (see the Apache NiFi Downloads page).

## Prerequisites for Running in a Secure Environment

For secured nodes and clusters, two policies should be configured in advance:

- Access the controller - A user that will have access to these utilities should be authorized in NiFi by creating an "access the controller" policy (/controller) with both view and modify rights
- Proxy user request - If not previously set, node's identity (the DN value of the node's certificate) should be authorized to proxy requests on behalf of a user

When executing either the Notify or Node Manager tools in a secured environment the proxyDN flag option should be used in order to properly identify the user that was authorized to execute these commands. In non-secure environments, or if running the status operation on the Node Manager tool, the flag is ignored.

## NiFi CLI

This tool offers a CLI focused on interacting with NiFi and NiFi Registry in order to automate tasks, such as deploying flows from a NiFi Registry to a NiFi instance or managing process groups and cluster nodes.

## Usage

The CLI toolkit can be executed in standalone mode to execute a single command, or interactive mode to enter an interactive shell.

To execute a single command:

```
./bin/cli.sh <command> <args>
```

To launch the interactive shell:

```
./bin/cli.sh
```

To show help:

```
./bin/cli.sh -h
```

The following are available commands:

```
demo quick-import
nifi current-user
nifi cluster-summary
nifi connect-node
nifi delete-node
nifi disconnect-node
nifi get-root-id
nifi get-node
nifi get-nodes
nifi offload-node
nifi list-reg-clients
nifi create-reg-client
nifi update-reg-client
nifi get-reg-client-id
nifi pg-import
nifi pg-start
nifi pg-stop
nifi pg-get-vars
nifi pg-set-var
nifi pg-get-version
nifi pg-change-version
nifi pg-get-all-versions
nifi pg-list
nifi pg-status
nifi pg-get-services
nifi pg-enable-services
nifi pg-disable-services
registry current-user
registry list-buckets
registry create-bucket
registry delete-bucket
registry list-flows
registry create-flow
registry delete-flow
registry list-flow-versions
registry export-flow-version
registry import-flow-version
registry sync-flow-versions
registry transfer-flow-version
session keys
session show
session get
session set
session remove
session clear
```

```
exit
help
```

To display extensive help for a specific command:

```
./bin/cli.sh <command> -h
```

## Property/Argument Handling

Most commands will require specifying a baseUrl for the NiFi or NiFi Registry instance.

An example command to list the buckets in a NiFi Registry instance would be the following:

```
./bin/cli.sh registry list-buckets -u http://localhost:18080
```

In order to avoid specifying the URL (and possibly other optional arguments for TLS) on every command, you can define a properties file containing the repetitive arguments.

An example properties file for a local NiFi Registry instance would look like the following:

```
baseUrl=http://localhost:18080
keystore=
keystoreType=
keystorePasswd=
keyPasswd=
truststore=
truststoreType=
truststorePasswd=
proxiedEntity=
```

This properties file can then be used on a command by specifying -p:

```
./bin/cli.sh registry list-buckets -p /path/to/local-nifi-registry.properties
```

You could then maintain a properties file for each environment you plan to interact with, such as Dev, QA, and Prod.

In addition to specifying a properties file on each command, you can setup a default properties file to be used in the event that no properties file is specified.

The default properties file is specified using the session concept, which persists to the users home directory in a file called `.nifi-cli.config`.

An example of setting the default property files for NiFi would be the following:

```
./bin/cli.sh session set nifi.props /path/to/local-nifi.properties
```

An example for NiFi Registry would be the following:

```
./bin/cli.sh session set nifi.reg.props /path/to/local-nifi-registry.properties
```

This will write the above properties into the `.nifi-cli.config` in the user's home directory and will allow commands to be executed without specifying a URL or properties file:

```
./bin/cli.sh registry list-buckets
```

The above command will now use the `baseUrl` from `local-nifi-registry.properties`.

The order of resolving an argument is the following:

- A direct argument overrides anything in a properties file or session
- A properties file argument (`-p`) overrides the session
- The session is used when nothing else is specified

## Security Configuration

If NiFi and NiFi Registry are secured, then commands executed from the CLI will need to make a TLS connection and authenticate as a user with permissions to perform the desired action.

Currently the CLI supports authenticating with a client certificate and an optional proxied-entity. A common scenario would be running the CLI from one of the nodes where NiFi or NiFi Registry is installed, which allows the CLI to use the same keystore and truststore as the NiFi/NiFi Registry instance.

The security configuration can be specified per-command, or in one of the properties files described in the previous section.

The examples below are for NiFi Registry, but the same concept applies for NiFi commands.

### Example - Secure NiFi Registry without Proxied-Entity

Assuming we have a keystore containing the certificate for "CN=user1, OU=NIFI", an example properties file would be the following:

```
baseUrl=https://localhost:18443
keystore=/path/to/keystore.jks
keystoreType=JKS
keystorePasswd=changeme
keyPasswd=changeme
truststore=/path/to/truststore.jks
truststoreType=JKS
truststorePasswd=changeme
```

In this example, commands will be executed as "CN=user1, OU=NIFI". This user would need to be a user in NiFi Registry, and commands accessing buckets would be restricted to buckets this user has access to.

### Example - Secure NiFi Registry with Proxied-Entity

Assuming we have access to the keystore of NiFi Registry itself, and that NiFi Registry is also configured to allow Kerberos or LDAP authentication, an example properties file would be the following:

```
baseUrl=https://localhost:18443
keystore=/path/to/keystore.jks
keystoreType=JKS
keystorePasswd=changeme
keyPasswd=changeme
truststore=/path/to/truststore.jks
truststoreType=JKS
truststorePasswd=changeme
proxiedEntity=user1@NIFI.COM
```

In this example, the certificate in `keystore.jks` would be for the NiFi Registry server, for example "CN=localhost, OU=NIFI". This identity would need to be defined as a user in NiFi Registry and given permissions to 'Proxy'.

"CN=localhost, OU=NIFI" would be proxying commands to be executed as user1@NIFI.COM.

## Interactive Usage

In interactive mode the tab key can be used to perform auto-completion.

For example, typing tab at an empty prompt should display possible commands for the first argument:

```
#>
demo      exit      help      nifi      registry  session
```

Typing "nifi " and then a tab will show the sub-commands for NiFi:

```
#> nifi
cluster-summary      get-nodes            pg-enable-services  pg-set-var
connect-node         get-reg-client-id   pg-get-all-versions pg-start
create-reg-client    get-root-id         pg-get-services     pg-status
current-user        list-reg-clients    pg-get-vars         pg-stop
delete-node         offload-node        pg-get-version      update-
reg-client
disconnect-node     pg-change-version   pg-import
get-node            pg-disable-services pg-list
```

Arguments that represent a path to a file, such as -p or when setting a properties file in the session, will auto-complete the path being typed:

```
#> session set nifi.props /tmp/
dir1/  dir2/  dir3/
```

## Output

Most commands support the ability to specify an --outputType argument, or -ot for short.

Currently the output type may be simple or json.

The default output type in interactive mode is simple, and the default output type in standalone mode is json.

Example of simple output for list-buckets:

```
#> registry list-buckets -ot simple
My Bucket - 3c7b7467-0012-4d8f-a918-6aa42b6b9d39
```

Example of json output for list-buckets:

```
#> registry list-buckets -ot json
[ {
  "identifier" : "3c7b7467-0012-4d8f-a918-6aa42b6b9d39",
  "name" : "My Bucket",
  "createdTimestamp" : 1516718733854,
  "permissions" : {
    "canRead" : true,
    "canWrite" : true,
    "canDelete" : true
  },
  "link" : {
    "params" : {
      "rel" : "self"
    }
  },
}
```



```

    "href" : "buckets/3c7b7467-0012-4d8f-a918-6aa42b6b9d39"
  }
} ]

```

## Back-Referencing

When using the interactive CLI, a common scenario will be using an id from a previous result as the input to the next command. Back-referencing provides a shortcut for referencing a result from the previous command via a positional reference.



**Note:** Not every command produces back-references. To determine if a command supports back-referencing, check the usage.

```

#> registry list-buckets help
Lists the buckets that the current user has access to.
PRODUCES BACK-REFERENCES

```

A common scenario for utilizing back-references would be the following:

1. User starts by exploring the available buckets in a registry instance

```

#> registry list-buckets
#   Name                Id                                     Description
-   -
1   My Bucket           3c7b7467-0012-4d8f-a918-6aa42b6b9d39  (empty)
2   Other Bucket        175fb557-43a2-4abb-871f-81a354f47bc2  (empty)

```

2. User then views the flows in one of the buckets using a back-reference to the bucket id from the previous result in position 1

```

#> registry list-flows -b &1
Using a positional back-reference for 'My Bucket'
#   Name      Id                                     Description
-   -
1   My Flow    06acb207-d2f1-447f-85ed-9b8672fe6d30  This is my flow.

```

3. User then views the version of the flow using a back-reference to the flow id from the previous result in position 1

```

#> registry list-flow-versions -f &1
Using a positional back-reference for 'My Flow'
Ver  Date                Author                Message
---  -
1    Tue, Jan 23 2018 09:48 EST  anonymous             This is the
    first version of my flow.

```

4. User deploys version 1 of the flow using back-references to the bucket and flow id from step 2

```

#> nifi pg-import -b &1 -f &1 -fv 1
Using a positional back-reference for 'My Bucket'
Using a positional back-reference for 'My Flow'
9bd157d4-0161-1000-b946-c1f9b1832efd

```

The reason step 4 was able to reference the results from step 2, is because the list-flow-versions command in step 3 does not produce back-references, so the results from step 2 are still available.

## Adding Commands

To add a NiFi command, create a new class that extends `AbstractNiFiCommand`:

```
public class MyCommand extends AbstractNiFiCommand {

    public MyCommand() {
        super("my-command");
    }

    @Override
    protected void doExecute(NiFiClient client, Properties properties)
        throws NiFiClientException, IOException, MissingOptionException,
        CommandException {
        // TODO implement
    }

    @Override
    public String getDescription() {
        return "This is my new command";
    }
}
```

Add the new command to `NiFiCommandGroup`:

```
commands.add(new MyCommand());
```

To add a NiFi Registry command, perform the same steps, but extend from `AbstractNiFiRegistryCommand`, and add the command to `NiFiRegistryCommandGroup`.

## Encrypt-Config Tool

The `encrypt-config` command line tool (invoked as `./bin/encrypt-config.sh` or `bin\encrypt-config.bat`) reads from a `nifi.properties` file with plaintext sensitive configuration values, prompts for a master password or raw hexadecimal key, and encrypts each value. It replaces the plain values with the protected value in the same file, or writes to a new `nifi.properties` file if specified.

The default encryption algorithm utilized is AES/GCM 128/256-bit. 128-bit is used if the JCE Unlimited Strength Cryptographic Jurisdiction Policy files are not installed, and 256-bit is used if they are installed.

## Usage

To show help:

```
./bin/encrypt-config.sh -h
```

The following are available options:

- `-h,--help` Prints this usage message
- `-v,--verbose` Sets verbose mode (default false)
- `-n,--nifiProperties <arg>` The `nifi.properties` file containing unprotected config values (will be overwritten)
- `-l,--loginIdentityProviders <arg>` The `login-identity-providers.xml` file containing unprotected config values (will be overwritten)
- `-a,--authorizers <arg>` The `authorizers.xml` file containing unprotected config values (will be overwritten)

- `-f,--flowXml <arg>` The `flow.xml.gz` file currently protected with old password (will be overwritten)
- `-b,--bootstrapConf <arg>` The `bootstrap.conf` file to persist master key
- `-o,--outputNiFiProperties <arg>` The destination `nifi.properties` file containing protected config values (will not modify input `nifi.properties`)
- `-i,--outputLoginIdentityProviders <arg>` The destination `login-identity-providers.xml` file containing protected config values (will not modify input `login-identity-providers.xml`)
- `-u,--outputAuthorizers <arg>` The destination `authorizers.xml` file containing protected config values (will not modify input `authorizers.xml`)
- `-g,--outputFlowXml <arg>` The destination `flow.xml.gz` file containing protected config values (will not modify input `flow.xml.gz`)
- `-k,--key <arg>` The raw hexadecimal key to use to encrypt the sensitive properties
- `-e,--oldKey <arg>` The old raw hexadecimal key to use during key migration
- `-p,--password <arg>` The password from which to derive the key to use to encrypt the sensitive properties
- `-w,--oldPassword <arg>` The old password from which to derive the key during migration
- `-r,--useRawKey` If provided, the secure console will prompt for the raw key value in hexadecimal form
- `-m,--migrate` If provided, the `nifi.properties` and/or `login-identity-providers.xml` sensitive properties will be re-encrypted with a new key
- `-x,--encryptFlowXmlOnly` If provided, the properties in `flow.xml.gz` will be re-encrypted with a new key but the `nifi.properties` and/or `login-identity-providers.xml` files will not be modified
- `-s,--propsKey <arg>` The password or key to use to encrypt the sensitive processor properties in `flow.xml.gz`
- `-A,--newFlowAlgorithm <arg>` The algorithm to use to encrypt the sensitive processor properties in `flow.xml.gz`
- `-P,--newFlowProvider <arg>` The security provider to use to encrypt the sensitive processor properties in `flow.xml.gz`

As an example of how the tool works, assume that you have installed the tool on a machine supporting 256-bit encryption and with the following existing values in the `nifi.properties` file:

```
# security properties #
nifi.sensitive.props.key=thisIsABadSensitiveKeyPassword
nifi.sensitive.props.algorithm=PBEWITHMD5AND256BITAES-CBC-OPENSSL
nifi.sensitive.props.provider=BC
nifi.sensitive.props.additional.keys=

nifi.security.keystore=/path/to/keystore.jks
nifi.security.keystoreType=JKS
nifi.security.keystorePasswd=thisIsABadKeystorePassword
nifi.security.keyPasswd=thisIsABadKeyPassword
nifi.security.truststore=
nifi.security.truststoreType=
nifi.security.truststorePasswd=
```

Enter the following arguments when using the tool:

```
encrypt-config.sh
-b bootstrap.conf
-k 0123456789ABCDEFFEDCBA98765432100123456789ABCDEFFEDCBA9876543210
-n nifi.properties
```

As a result, the `nifi.properties` file is overwritten with protected properties and sibling encryption identifiers (`aes/gcm/256`, the currently supported algorithm):

```
# security properties #
nifi.sensitive.props.key=n2z+tTtBHuZ4V4V2|uWhdasyDXD4ZG2lMAes/
vqh6u4vaz4xgL4aEbF4Y/dXevqk3ulRcOwf1vc4RDQ==
```

```
nifi.sensitive.props.key.protected=aes/gcm/256
nifi.sensitive.props.algorithm=PBEWITHMD5AND256BITAES-CBC-OPENSSL
nifi.sensitive.props.provider=BC
nifi.sensitive.props.additional.keys=

nifi.security.keystore=/path/to/keystore.jks
nifi.security.keystoreType=JKS
nifi.security.keystorePasswd=oBjT92hIGRElIGOh||MZ6uYuWNBrOA6usq/
Jt3DaD2e4otNirZDytac/w/KFe0H0krJR03vcbo
nifi.security.keystorePasswd.protected=aes/gcm/256
nifi.security.keyPasswd=ac/BaE35SL/esLiJ||
+ULRvRLYdIDA2VqpE0eQXDEMjaLBMG2kbK0dOwBk/hGebDKlVg==
nifi.security.keyPasswd.protected=aes/gcm/256
nifi.security.truststore=
nifi.security.truststoreType=
nifi.security.truststorePasswd=
```

Additionally, the bootstrap.conf file is updated with the encryption key as follows:

```
# Master key in hexadecimal format for encrypted sensitive
configuration values
nifi.bootstrap.sensitive.key=0123456789ABCDEFEDCBA98765432100123456789ABCDEFEDCBA98765
```

Sensitive configuration values are encrypted by the tool by default, however you can encrypt any additional properties, if desired. To encrypt additional properties, specify them as comma-separated values in the nifi.sensitive.props.additional.keys property.

If the nifi.properties file already has valid protected values, those property values are not modified by the tool.

When applied to login-identity-providers.xml and authorizers.xml, the property elements are updated with an encryption attribute:

Example of protected login-identity-providers.xml:

```
<!-- LDAP Provider -->
<provider>
  <identifier>ldap-provider</identifier>
  <class>org.apache.nifi.ldap.LdapProvider</class>
  <property name="Authentication Strategy">START_TLS</property>
  <property name="Manager DN">someuser</property>
  <property name="Manager Password" encryption="aes/
gcm/128">q4r7WIgN0MaxdAKM||SGgdCTPGSFECuH4RraMYEdeyVbOx93abdWTVSWvhlw+k1A</
property>
  <property name="TLS - Keystore"></property>
  <property name="TLS - Keystore Password" encryption="aes/
gcm/128">Uah59TWX+Ru5GY5p||B44RT/LJtC08QWA5ehQf01JxIpf0qSJUzug25UwkF5a50g</
property>
  <property name="TLS - Keystore Type"></property>
  ...
</provider>
```

Example of protected authorizers.xml:

```
<!-- LDAP User Group Provider -->
<userGroupProvider>
  <identifier>ldap-user-group-provider</identifier>
  <class>org.apache.nifi.ldap.tenants.LdapUserGroupProvider</class>
```

```

    <property name="Authentication Strategy">START_TLS</property>
    <property name="Manager DN">someuser</property>
    <property name="Manager Password" encryption="aes/
gcm/128">q4r7WIgN0MaxdAKM||SGgdCTPGSFecuH4RraMYEdeyVbOx93abdWTVSWvhlw+k1A</
property>
    <property name="TLS - Keystore"></property>
    <property name="TLS - Keystore Password" encryption="aes/
gcm/128">Uah59Twx+Ru5GY5p||B44RT/LJtC08QWA5ehQf01JxIpf0qSJUzug25UwkF5a50g</
property>
    <property name="TLS - Keystore Type"></property>
    ...
</userGroupProvider>

```

## File Manager

The File Manager utility (invoked as `./bin/file-manager.sh` or `bin/file-manager.bat`) allows system administrators to take a backup of an existing NiFi installation, install a new version of NiFi in a designated location (while migrating any previous configuration settings) or restore an installation from a previous backup. File Manager supports NiFi version 1.0.0 and higher.

## Usage

To show help:

```
./bin/file-manager.sh -h
```

The following are available options:

- `-b,--backupDir <arg>` Backup NiFi Directory (used with backup or restore operation)
- `-c,--nifiCurrentDir <arg>` Current NiFi Installation Directory (used optionally with install or restore operation)
- `-d,--nifiInstallDir <arg>` NiFi Installation Directory (used with install or restore operation)
- `-h,--help` Print help info (optional)
- `-i,--installFile <arg>` NiFi Install File (used with install operation)
- `-m,--moveRepositories` Allow repositories to be moved to new/restored nifi directory from existing installation, if available (used optionally with install or restore operation)
- `-o,--operation <arg>` File operation (install | backup | restore)
- `-r,--nifiRollbackDir <arg>` NiFi Installation Directory (used with install or restore operation)
- `-t,--bootstrapConf <arg>` Current NiFi Bootstrap Configuration File (used optionally)
- `-v,--verbose` Verbose messaging (optional)
- `-x,--overwriteConfigs` Overwrite existing configuration directory with upgrade changes (used optionally with install or restore operation)

Example usage on Linux:

```

# backup NiFi installation
# option -t may be provided to ensure backup of external bootstrap.conf file
./file-manager.sh
-o backup
-b /tmp/nifi_bak
-c /usr/nifi_old

```

```
-v
```

```
# install NiFi using compressed tar file into /usr/nifi directory (should
install as /usr/nifi/nifi-1.3.0).
# migrate existing configurations with location determined by external
bootstrap.conf and move over repositories from nifi_old
# options -t and -c should both be provided if migration of configurations,
state and repositories are required
./file-manager.sh
-o install
-i nifi-1.3.0.tar.gz
-d /usr/nifi
-c /usr/nifi/nifi_old
-t /usr/nifi/old_conf/bootstrap.conf
-v
-m
```

```
# restore NiFi installation from backup directory and move back repositories
# option -t may be provided to ensure bootstrap.conf is restored to the file
path provided, otherwise it is placed in the
# default directory under the rollback path (e.g. /usr/nifi_old/conf)
./file-manager.sh
-o restore
-b /tmp/nifi_bak
-r /usr/nifi_old
-c /usr/nifi
-m
-v
```

## Expected Behavior

### Backup

During the backup operation a backup directory is created in a designated location for an existing NiFi installation. Backups will capture all critical files (including any internal or external configurations, libraries, scripts and documents) however it excludes backing up repositories and logs due to potential size. If configuration/library files are external from the existing installation folder the backup operation will capture those as well.

### Install

During the install operation File Manager will perform installation using the designated NiFi binary file (either tar.gz or zip file) to create a new installation or migrate an existing nifi installation to a new one. Installation can optionally move repositories (if located within the configuration folder of the current installation) to the new installation as well as migrate configuration files to the newer installation.

### Restore

The restore operation allows an existing installation to revert back to a previous installation. Using an existing backup directory (created from the backup operation) the FileManager utility will restore libraries, scripts and documents as well as revert to previous configurations.



**Note:** If repositories were changed due to the installation of a newer version of NiFi these may no longer be compatible during restore. In that scenario exclude the -m option to ensure new repositories will be created or, if repositories live outside of the NiFi directory, remove them so they can be recreated on startup after restore.

## Flow Analyzer

The flow-analyzer tool (invoked as `./bin/flow-analyzer.sh` or `bin\flow-analyzer.bat`) analyzes the `flow.xml.gz` file and reports:

- Total Bytes Utilized by the System
- Min/Max Back Pressure Size
- Average Back Pressure Size
- Min/Max Flowfile Queue Size
- Average Flowfile Queue Size

## Usage

To execute the flow-analyzer tool:

```
flow-analyzer.sh <path to flow.xml.gz>
```

Example:

```
$ ./flow-analyzer.sh /Users/nifiuser/nifi-1.8.0/conf/flow.xml.gz
Using flow=/Users/nifiuser/nifi-1.8.0/conf/flow.xml.gz
Total Bytes Utilized by System=1518 GB
Max Back Pressure Size=1 GB
Min Back Pressure Size=1 GB
Average Back Pressure Size=2.504950495 GB
Max Flowfile Queue Size=10000
Min Flowfile Queue Size=10000
Avg Flowfile Queue Size=10000.000000000
```

## Node Manager

Node manager (invoked as `./bin/node-manager.sh` or `bin\node-manager.bat`) supports connecting, disconnecting and removing a node when in a cluster (an error message displays if the node is not part of a cluster) as well as obtaining the status of a node. When nodes are disconnected from a cluster and need to be connected or removed, a list of urls of connected nodes should be provided to send the required command to the active cluster. Node Manager supports NiFi version 1.0.0 and higher.

## Usage

To show help:

```
./bin/node-manager.sh -h
```

The following are available options:

- `-b,--bootstrapConf <arg>` Existing Bootstrap Configuration file (required)
- `-d,--nifiInstallDir <arg>` NiFi Root Folder (required)
- `-h,--help` Help Text (optional)
- `-o, --operation <arg>` Operations supported: status, connect (cluster), disconnect (cluster), remove (cluster)

- `-p,--proxyDN <arg>` Proxy or User DN (required for secured nodes doing connect, disconnect and remove operations)
- `-u,--clusterUrls <arg>` Comma delimited list of active urls for cluster (optional). Not required for disconnecting a node yet will be needed when connecting or removing from a cluster
- `-v,--verbose` Verbose messaging (optional)

To connect, disconnect, or remove a node from a cluster:

```
node-manager.sh -d {$NIFI_HOME} -b { nifi bootstrap file path}
-o {remove|disconnect|connect|status} [-u {url list}] [-p {proxy name}] [-v]
```

Example usage on Linux:

```
# disconnect without cluster url list
./node-manager.sh
-d /usr/nifi/nifi_current
-b /usr/nifi/nifi_current/conf/bootstrap.conf
-o disconnect
-p ydavis@nifi
-v
```

```
#with url list
./node-manager.sh
-d /usr/nifi/nifi_current
-b /usr/nifi/nifi_current/conf/bootstrap.conf
-o connect
-u 'http://nifi-server-1:8080,http://nifi-server-2:8080'
-v
```

Example usage on Windows:

```
node-manager.bat
-d "C:\\Program Files\\nifi\\nifi-1.2.0-SNAPSHOT"
-b "C:\\Program Files\\nifi\\nifi-1.2.0-SNAPSHOT\\conf\\bootstrap.conf"
-o disconnect
-v
```

## Expected Behavior

### Status

To obtain information on UI availability of a node, the status operation can be used to determine if the node is running. If the `-u` (clusterUrls) option is not provided the current node url is checked otherwise the urls provided will be checked.

### Disconnect

When a node is disconnected from the cluster, the node itself should appear as disconnected and the cluster should have a bulletin indicating the disconnect request was received. The cluster should also show `n-1/n` nodes available in the cluster. For example, if 1 node is disconnected from a 3-node cluster, then "2 of 3" nodes should show on the remaining nodes in the cluster. Changes to the flow should not be allowed on the cluster with a disconnected node.

### Connect

When the connect command is executed to reconnect a node to a cluster, upon completion the node itself should show that it has rejoined the cluster by showing `n/n` nodes. Previously it would have shown Disconnected. Other nodes



in the cluster should receive a bulletin of the connect request and also show n/n nodes allowing for changes to be allowed to the flow.

## Remove

When the remove command is executed the node should show as disconnected from a cluster. The nodes remaining in the cluster should show n-1/n-1 nodes. For example, if 1 node is removed from a 3-node cluster, then the remaining 2 nodes should show "2 of 2" nodes. The cluster should allow a flow to be adjusted. The removed node can rejoin the cluster if restarted and the flow for the cluster has not changed. If the flow was changed, the flow template of the removed node should be deleted before restarting the node to allow it to obtain the cluster flow (otherwise an uninherited flow file exception may occur).

## Notify

Notify (invoked as `./bin/notify.sh` or `bin\notify.bat`) allows administrators to send messages as bulletins to NiFi. Notify is supported on NiFi version 1.2.0 and higher.

## Usage

To show help:

```
./bin/notify.sh -h
```

The following are available options:

- `-b,--bootstrapConf <arg>` Existing Bootstrap Configuration file (required)
- `-d,--nifiInstallDir <arg>` NiFi Root Folder (required)
- `-h,--help` Help Text (optional)
- `-l,--level <arg>` Status level of bulletin - INFO, WARN, ERROR
- `-m,--message <arg>` Bulletin message (required)
- `-p,--proxyDN <arg>` Proxy or User DN (required for secured nodes)
- `-v,--verbose` Verbose messaging (optional)

To send notifications:

```
notify.sh -d {$NIFI_HOME} -b {nifi bootstrap file path} -m {message} [-l  
{level}] [-v]
```

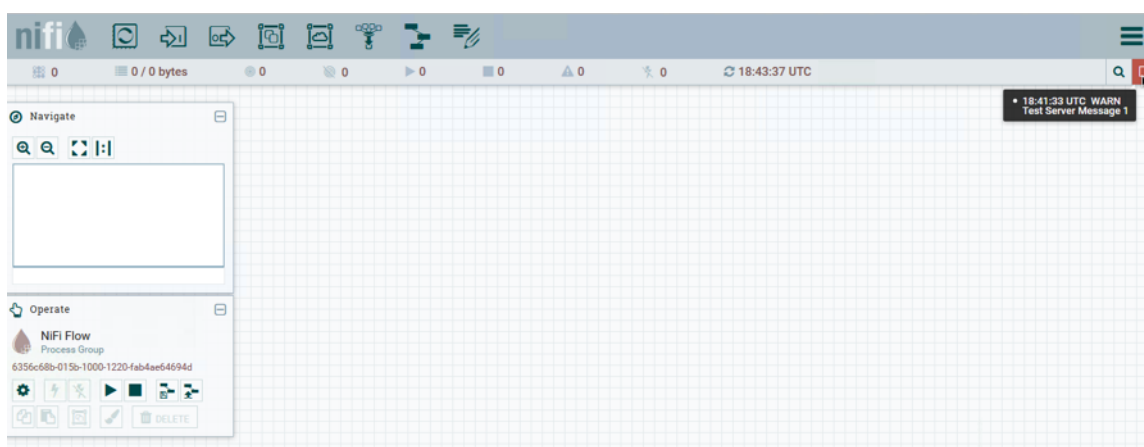
Example usage on Linux:

```
./notify.sh -d /usr/nifi/nifi_current -b /usr/nifi/nifi_current/conf/  
bootstrap.conf -m "Test Message Server 1" -l "WARN" -p "ydavis@nifi" -v
```

Example usage on Windows:

```
notify.bat -v -d "C:\\Program Files\\nifi\\nifi-1.2.0-SNAPSHOT" -b "C:\\  
\\Program Files\\nifi\\nifi-1.2.0-SNAPSHOT\\conf\\bootstrap.conf" -m "Test  
Message Server 1" -v
```

Executing the above command line should result in a bulletin appearing in NiFi:



## S2S

S2S is a command line tool (invoked as `./bin/s2s.sh` or `bin\s2s.bat`) that can either read a list of DataPackets from stdin to send over site-to-site or write the received DataPackets to stdout.

## Usage

To show help:

```
./bin/s2s.sh -h
```

The following are available options:

- `--batchCount <arg>` Number of flow files in a batch
- `--batchDuration <arg>` Duration of a batch
- `--batchSize <arg>` Size of flow files in a batch
- `-c,--compression` Use compression
- `-d,--direction` Direction (valid directions: SEND, RECEIVE) (default: SEND)
- `-h,--help` Help Text (optional)
- `-i,--portIdentifier <arg>` Port id
- `--keystore <arg>` Keystore
- `--keyStorePassword <arg>` Keystore password
- `--keyStoreType <arg>` Keystore type (default: JKS)
- `-n,--portName` Port name
- `-p,--transportProtocol` Site to site transport protocol (default: RAW)
- `--peerPersistenceFile <arg>` File to write peer information to so it can be recovered on restart
- `--penalization <arg>` Penalization period
- `--proxyHost <arg>` Proxy hostname
- `--proxyPassword <arg>` Proxy password
- `--proxyPort <arg>` Proxy port
- `--proxyUsername <arg>` Proxy username
- `--timeout <arg>` Timeout
- `--trustStore <arg>` Truststore
- `--trustStorePassword <arg>` Truststore password
- `--trustStoreType <arg>` Truststore type (default: JKS)
- `-u,--url <arg>` NiFi URL to connect to (default: `http://localhost:8080/nifi`)

The s2s cli input/output format is a JSON list of DataPackets. They can have the following formats:

```
[{"attributes":{"key":"value"},"data":"aGVsbG8gbmlmaQ=="}]
```

where data is the base64 encoded value of the FlowFile content (always used for received data) or:

```
[{"attributes":{"key":"value"},"dataFile":"/Users/pvillard/Documents/GitHub/nifi/nifi-toolkit/nifi-toolkit-assembly/target/nifi-toolkit-1.9.0-SNAPSHOT-bin/nifi-toolkit-1.9.0-SNAPSHOT/bin/EXAMPLE"}]
```

where dataFile is a file to read the FlowFile content from.

Example usage to send a FlowFile with the contents of "hey nifi" to a local unsecured NiFi over http with an input port named "input":

```
echo '[{"data":"aGV5IG5pZmk="}]' | bin/s2s.sh -n input -p http
```

## TLS Toolkit

In order to facilitate the secure setup of NiFi, you can use the `tls-toolkit` command line utility to automatically generate the required keystores, truststore, and relevant configuration files. This is especially useful for securing multiple NiFi nodes, which can be a tedious and error-prone process.



**Note:** Please note that there are new requirements for trusted certificates in macOS 10.15. Details can be found [here](#), but of particular importance is that all TLS server certificates issued after July 1, 2019 must have a validity period of 825 days or less.

## Wildcard Certificates

Wildcard certificates (i.e. two nodes `node1.nifi.apache.org` and `node2.nifi.apache.org` being assigned the same certificate with a CN or SAN entry of `*.nifi.apache.org`) are not officially supported and not recommended. There are numerous disadvantages to using wildcard certificates, and a cluster working with wildcard certificates has occurred in previous versions out of lucky accidents, not intentional support. Wildcard SAN entries are acceptable if each cert maintains an additional unique SAN entry and CN entry.

### Potential issues with wildcard certificates

- In many places throughout the codebase, cluster communications use certificate identities many times to identify a node, and if the certificate simply presents a wildcard DN, that doesn't resolve to a specific node
- Admins may need to provide a custom node identity in `authorizers.xml` for `*.nifi.apache.org` because all proxy actions only resolve to the cert DN (see the *System Administration documentation* in the *Reference* section for more information).
- Admins have no traceability into which node performed an action because they all resolve to the same DN
- Admins running multiple instances on the same machine using different ports to identify them can accidentally put `node1` hostname with `node2` port, and the address will resolve fine because it's using the same certificate, but the host header handler will block it because the `node1` hostname is (correctly) not listed as an acceptable host for `node2` instance
- If the wildcard certificate is compromised, all nodes are compromised



**Note:** JKS keystores and truststores are recommended for NiFi. This tool allows the specification of other keystore types on the command line but will ignore a type of PKCS12 for use as the truststore because that format has some compatibility issues between BouncyCastle and Oracle implementations.

## Operation Modes

The `tls-toolkit` command line tool has two primary modes of operation:

1. Standalone - generates the certificate authority, keystores, truststores, and `nifi.properties` files in one command.
2. Client/Server - uses a Certificate Authority Server that accepts Certificate Signing Requests from clients, signs them, and sends the resulting certificates back. Both client and server validate the other's identity through a shared secret.

### Standalone

Standalone mode is invoked by running `./bin/tls-toolkit.sh standalone` or `bin\tls-toolkit.sh standalone`.

#### Usage

To show help:

```
./bin/tls-toolkit.sh standalone -h
```

The following are available options:

- `-a,--keyAlgorithm <arg>` Algorithm to use for generated keys (default: RSA)
- `--additionalCACertificate <arg>` Path to additional CA certificate (used to sign toolkit CA certificate) in PEM format if necessary
- `-B,--clientCertPassword <arg>` Password for client certificate. Must either be one value or one for each client DN (auto-generate if not specified)
- `-c,--certificateAuthorityHostname <arg>` Hostname of NiFi Certificate Authority (default: localhost)
- `-C,--clientCertDn <arg>` Generate client certificate suitable for use in browser with specified DN (Can be specified multiple times)
- `-d,--days <arg>` Number of days issued certificate should be valid for (default: 825)
- `-f,--nifiPropertiesFile <arg>` Base `nifi.properties` file to update (Embedded file identical to the one in a default NiFi install will be used if not specified)
- `-g,--differentKeyAndKeystorePasswords` Use different generated password for the key and the keystore
- `-G,--globalPortSequence <arg>` Use sequential ports that are calculated for all hosts according to the provided hostname expressions (Can be specified multiple times, MUST BE SAME FROM RUN TO RUN)
- `-h,--help` Print help and exit
- `-k,--keySize <arg>` Number of bits for generated keys (default: 2048)
- `-K,--keyPassword <arg>` Key password to use. Must either be one value or one for each host (auto-generate if not specified)
- `-n,--hostnames <arg>` Comma separated list of hostnames
- `--nifiDnPrefix <arg>` String to prepend to hostname(s) when determining DN (default: CN=)
- `--nifiDnSuffix <arg>` String to append to hostname(s) when determining DN (default: , OU=NIFI)
- `-o,--outputDirectory <arg>` The directory to output keystores, truststore, config files (default: ../bin)
- `-O,--isOverwrite` Overwrite existing host output
- `-P,--trustStorePassword <arg>` Keystore password to use. Must either be one value or one for each host (auto-generate if not specified)
- `-s,--signingAlgorithm <arg>` Algorithm to use for signing certificates (default: SHA256WITHRSA)
- `-S,--keyStorePassword <arg>` Keystore password to use. Must either be one value or one for each host (auto-generate if not specified)
- `--subjectAlternativeNames <arg>` Comma-separated list of domains to use as Subject Alternative Names in the certificate
- `-T,--keyStoreType <arg>` The type of keystores to generate (default: jks)

"Hostname" and "Subject Alternative Name" Patterns:

- Square brackets can be used in order to easily specify a range of hostnames or subject alternative names. Example: [01-20]
- Parentheses can be used in order to specify that more than one NiFi instance will run on the given host(s). Example: (5)

Examples:

Create 4 sets of keystore, truststore, nifi.properties for localhost along with a client certificate with the given DN:

```
bin/tls-toolkit.sh standalone -n 'localhost(4)' -C 'CN=username,OU=NIFI'
```

Create keystore, truststore, nifi.properties for 10 NiFi hostnames in each of 4 subdomains:

```
bin/tls-toolkit.sh standalone -n 'nifi[01-10].subdomain[1-4].domain'
```

Create 2 sets of keystore, truststore, nifi.properties for 10 NiFi hostnames in each of 4 subdomains along with a client certificate with the given DN:

```
bin/tls-toolkit.sh standalone -n 'nifi[01-10].subdomain[1-4].domain(2)' -C 'CN=username,OU=NIFI'
```

The same command with a range of subject alternate names:

```
bin/tls-toolkit.sh standalone -n 'nifi[01-10].subdomain[1-4].domain(2)' -C 'CN=username,OU=NIFI' --subjectAlternativeNames 'nifi[21-30].other[2-5].example.com(2)'
```

## Client/Server

Client/Server mode relies on a long-running Certificate Authority (CA) to issue certificates. The CA can be stopped when you're not bringing nodes online.

### Server

CA server mode is invoked by running `./bin/tls-toolkit.sh server` or `bin\tls-toolkit.sh server`.

### Usage

To show help:

```
./bin/tls-toolkit.sh server -h
```

The following are available options:

- `-a,--keyAlgorithm <arg>` Algorithm to use for generated keys (default: RSA)
- `--configJsonIn <arg>` The place to read configuration info from (defaults to the value of configJson), implies useConfigJson if set (default: configJson value)
- `-d,--days <arg>` Number of days issued certificate should be valid for (default: 825)
- `-D,--dn <arg>` The dn to use for the CA certificate (default: CN=YOUR\_CA\_HOSTNAME,OU=NIFI)
- `-f,--configJson <arg>` The place to write configuration info (default: config.json)
- `-F,--useConfigJson` Flag specifying that all configuration is read from configJson to facilitate automated use (otherwise configJson will only be written to)
- `-g,--differentKeyAndKeystorePasswords` Use different generated password for the key and the keystore
- `-h,--help` Print help and exit
- `-k,--keySize <arg>` Number of bits for generated keys (default: 2048)
- `-p,--PORT <arg>` The port for the Certificate Authority to listen on (default: 8443)
- `-s,--signingAlgorithm <arg>` Algorithm to use for signing certificates (default: SHA256WITHRSA)
- `-T,--keyStoreType <arg>` The type of keystores to generate (default: jks)

- `-t,--token <arg>` The token to use to prevent MITM (required and must be same as one used by clients)

### Client

The client can be used to request new Certificates from the CA. The client utility generates a keypair and Certificate Signing Request (CSR) and sends the CSR to the Certificate Authority. CA client mode is invoked by running `./bin/tls-toolkit.sh client` or `bin\tls-toolkit.sh client`.

### Usage

To show help:

```
./bin/tls-toolkit.sh client -h
```

The following are available options:

- `-a,--keyAlgorithm <arg>` Algorithm to use for generated keys (default: RSA)
- `-c,--certificateAuthorityHostname <arg>` Hostname of NiFi Certificate Authority (default: localhost)
- `-C,--certificateDirectory <arg>` The directory to write the CA certificate (default: .)
- `--configJsonIn <arg>` The place to read configuration info from, implies `useConfigJson` if set (default: configJson value)
- `-D,--dn <arg>` The DN to use for the client certificate (default: CN=<localhost name>,OU=NIFI) (this is auto-populated by the tool)
- `-f,--configJson <arg>` The place to write configuration info (default: config.json)
- `-F,--useConfigJson` Flag specifying that all configuration is read from configJson to facilitate automated use (otherwise configJson will only be written to)
- `-g,--differentKeyAndKeystorePasswords` Use different generated password for the key and the keystore
- `-h,--help` Print help and exit
- `-k,--keySize <arg>` Number of bits for generated keys (default: 2048)
- `-p,--PORT <arg>` The port to use to communicate with the Certificate Authority (default: 8443)
- `--subjectAlternativeNames <arg>` Comma-separated list of domains to use as Subject Alternative Names in the certificate
- `-T,--keyStoreType <arg>` The type of keystores to generate (default: jks)
- `-t,--token <arg>` The token to use to prevent MITM (required and must be same as one used by CA)

After running the client you will have the CA's certificate, a keystore, a truststore, and a config.json with information about them as well as their passwords.

For a client certificate that can be easily imported into the browser, specify: `-T PKCS12`.

## Using An Existing Intermediate Certificate Authority (CA)

In some enterprise scenarios, a security/IT team may provide a signing certificate that has already been signed by the organization's certificate authority (CA). This intermediate CA can be used to sign the node (sometimes referred to as leaf) certificates that will be installed on each NiFi node, or the client certificates used to identify users. In order to inject the existing signing certificate into the toolkit process, follow these steps:

1. Generate or obtain the signed intermediate CA keys in the following format (see additional commands below):
  - Public certificate in PEM format: `nifi-cert.pem`
  - Private key in PEM format: `nifi-key.key`
2. Place the files in the toolkit working directory. This is the directory where the tool is configured to output the signed certificates. This is not necessarily the directory where the binary is located or invoked.
  - For example, given the following scenario, the toolkit command can be run from its location as long as the output directory `-o` is `../hardcoded/`, and the existing `nifi-cert.pem` and `nifi-key.key` will be used.

- e.g. `$. /toolkit/bin/tls-toolkit.sh standalone -o ./hardcoded/ -n 'node4.nifi.apache.org' -P thisIsABadPassword -S thisIsABadPassword -O` will result in a new directory at `./hardcoded/node4.nifi.apache.org` with a keystore and truststore containing a certificate signed by `./hardcoded/nifi-key.key`
- If the `-o` argument is not provided, the default working directory (`.`) must contain `nifi-cert.pem` and `nifi-key.key`
- e.g. `$ cd ./hardcoded/ && ./toolkit/bin/tls-toolkit.sh standalone -n 'node5.nifi.apache.org' -P thisIsABadPassword -S thisIsABadPassword -O`

```
# Example directory structure *before* commands above are run

## 0s @ 18:07:58 $ tree -L 2
.
### hardcoded
#   ### CN=myusername.hardcoded_OU=NiFi.pl2
#   ### CN=myusername.hardcoded_OU=NiFi.password
#   ### nifi-cert.pem
#   ### nifi-key.key
#   ### node1.nifi.apache.org
#   ### node2.nifi.apache.org
#   ### node3.nifi.apache.org
### toolkit
### LICENSE
### NOTICE
### README
### bin
### conf
### docs
### lib
```

The `nifi-cert.pem` and `nifi-key.key` files should be ASCII-armored (Base64-encoded ASCII) files containing the CA public certificate and private key respectively. Here are sample files of each to show the expected format:

### nifi-cert.pem

```
# The first command shows the actual content of the encoded file,
and the second parses it and shows the internal values

.../certs $ more nifi-cert.pem
-----BEGIN CERTIFICATE-----
MIIDZTCCAk2gAwIBAgIKAWTeM3kDAAAAADANBgkqhkiG9w0BAQsFADAxMQ0wCwYD
VQQLDAROSUZJMSAwHgYDVQQDDDBduaWZpLWNhLm5pZmkuYXBhY2h1Lm9yZzAeFw0x
ODA3MjgwdMA0MzJaFw0yMTA3MjcwMDA0MzJaMDExDTALBgNVBAsMBSBE5JRkxkxIDAE
BgNVBAMMF25pZmktY2EubmlmaS5hcGFjaGUub3JnMIIBIjANBgkqhkiG9w0BAQEF
AAOCAQ8AMIIBCgKCAQEAgkVrrC+AkFbjnCpupSy84tTFDsRVUIWYj/k2pVwC145M
3bpr0pRCzLuzovAjFCmT5L+isTvNjhionsqif07Ebd/M2psYE/Rih2MULsX6KgRe
1nRUiBeKF08hlmSBMGDFPj39yDzE/V9edxV/KGjRqVgw/Qy0vwaS5uWdXnLDhzoV
4/Mz7lGmYoMasZluexlH93jjBl1+EFLL2Xoa06oLbEojJ9TKaWhpg8ietEedf7WM0
zqBEz2kHo9ddFk9yxiCkT4SUKnDWkhwc/o6uslvEXoSwtmufHY/A3gVihjWPiGz
qyLF19JuN7CyJepkVVqTdsKBG7S85G/kBlizUj5jOwIDAQABO38wfTAOBgNVHQ8B
Af8EBAMCAf4wDAYDVR0TBAAUwAwEB/zAdBgNVHQ4EFgQUKiwBkMMQ1zUabD4gI7L
VOWOcy0wHwYDVR0jBBGwFoAUKiwBkMMQ1zUabD4gI7LVOWOcy0wHQYDVR0lBBYw
FAYIKwYBBQUHAWIGCCsGAQUFBwMBMA0GCSqGSIb3DQEBCwUAA4IBAQAxfHFIZL0w
mwIqnSI/ir8f/uzDMq06APHGdhdeIKV0HR74BtK95KFg42zeXxAEFEic98PC/FPV
tKpm2WUa1sLMB+oP27cRx5Znr2+pktaqnM7f2JgMeJ8bduNH3RUkr9jwgkcJRwyC
I4fwHC9k18aizNdoF2q2UgQXxNXaLYPel7deuNVwwrf1MgeFfVrwbT2uPJTMRilD
FQyc6haF4vsOSSRzE6OyDoc+/1PpyPW750eSXeVCbc3AEAvRuTZMBQvBQUqVM5le
MDG+K3rCeieSBPOnGNrEC/PiA/CvaMXBEog+XPawlSgYfuCz4r1M3BdRa54z3+o0
```

```

lc8xbzd7w8Q3
-----END CERTIFICATE-----
.../certs $ openssl x509 -in nifi-cert.pem -text -noout
Certificate:
  Data:
    Version: 3 (0x2)
    Serial Number:
      01:64:de:33:79:03:00:00:00:00
    Signature Algorithm: sha256WithRSAEncryption
    Issuer: OU=NIFI, CN=nifi-ca.nifi.apache.org
    Validity
      Not Before: Jul 28 00:04:32 2018 GMT
      Not After : Jul 27 00:04:32 2021 GMT
    Subject: OU=NIFI, CN=nifi-ca.nifi.apache.org
    Subject Public Key Info:
      Public Key Algorithm: rsaEncryption
      Public-Key: (2048 bit)
      Modulus:
        00:aa:45:6b:ac:2f:80:90:56:e3:9c:2a:6e:a5:2c:
        bc:e2:d4:c5:0e:c4:55:50:85:98:8f:f9:36:a5:5c:
        02:d7:8e:4c:dd:ba:6b:d2:94:42:cc:bb:b3:a2:f0:
        23:14:29:93:e4:bf:a2:b1:3b:cd:8e:18:a8:9e:ca:
        a2:7f:4e:c4:6d:df:cc:da:9b:18:13:f4:62:87:63:
        14:2e:c5:fa:2a:04:5e:d6:74:54:88:17:8a:17:4f:
        21:96:64:81:30:60:c5:3e:3d:fd:c8:3c:c4:fd:5f:
        5e:77:15:7f:28:68:d1:a9:58:30:fd:0c:b4:bf:06:
        92:e6:e5:9d:5e:72:c3:87:3a:15:e3:f3:33:ee:51:
        a6:62:83:1a:b1:9d:6e:7b:19:47:f7:78:e3:06:5d:
        7e:10:52:f6:5e:86:b4:ea:82:db:12:88:c9:f5:32:
        9a:5a:1a:46:f2:27:ad:11:e7:5f:ed:63:34:ce:a0:
        44:cf:69:07:a3:d7:5d:16:4f:72:c6:20:a4:4f:84:
        94:2a:70:d6:92:1c:1c:fe:8e:ae:b3:5b:c4:5e:84:
        b0:fa:d9:ae:7c:76:3f:03:78:15:8a:18:d6:3c:81:
        b3:ab:22:c5:97:d2:6e:37:b0:b2:25:ea:64:55:5a:
        93:76:c9:01:1b:b4:bc:e4:6f:e4:06:58:b3:52:3e:
        63:3b
      Exponent: 65537 (0x10001)
    X509v3 extensions:
      X509v3 Key Usage: critical
        Digital Signature, Non Repudiation, Key Encipherment, Data
        Encipherment, Key Agreement, Certificate Sign, CRL Sign
      X509v3 Basic Constraints:
        CA:TRUE
      X509v3 Subject Key Identifier:
        2A:25:81:29:B3:0C:43:5C:D4:69:B0:F8:80:8E:CB:54:E5:8E:73:2D
      X509v3 Authority Key Identifier:
        keyid:2A:25:81:29:B3:0C:43:5C:D4:69:B0:F8:80:8E:CB:54:E5:8E:73:2D

      X509v3 Extended Key Usage:
        TLS Web Client Authentication, TLS Web Server Authentication
    Signature Algorithm: sha256WithRSAEncryption
    31:7c:71:48:64:b3:b0:9b:02:2a:9d:22:3f:8a:bf:1f:fe:ec:
    c3:32:ad:3a:00:f1:c6:76:17:5e:20:a5:74:1d:1e:f8:06:d2:
    bd:e4:a1:60:e3:6c:de:5f:10:04:15:e8:9c:f7:c3:c2:fc:53:
    d5:b4:aa:66:d9:65:1a:d6:c9:4c:07:ea:0f:db:b7:11:c7:96:
    67:af:6f:a9:92:d6:aa:9c:ce:df:d8:98:0c:78:9f:1b:76:e3:
    47:dd:15:24:af:d8:f0:82:47:09:47:0c:82:23:87:f0:1c:2f:
    64:d7:c6:a2:cc:d7:4e:7f:6a:b6:52:04:17:c4:d5:da:2d:83:
    de:d7:b7:5e:b8:d5:70:c2:b7:e5:32:07:85:7d:5a:f0:6d:3d:
    ae:3c:94:cc:46:2d:43:15:0c:9c:ea:16:85:e2:fb:0e:49:24:
    73:13:a3:b2:0e:87:3e:ff:53:e9:c8:f5:bb:e4:e7:92:5d:e5:
    42:6d:cd:c0:10:0b:d1:b9:36:4c:05:0b:c1:41:4a:95:33:9d:
    5e:30:31:be:2b:7a:c2:7a:27:92:04:f3:a7:18:da:c4:0b:f3:

```



```
e2:03:f0:af:68:c5:c1:12:88:3e:c4:f0:30:d5:28:18:7e:e0:
b3:e2:b9:4c:dc:17:51:6b:9e:33:df:ea:0e:95:cf:31:6f:37:
7b:c3:c4:37
```

## nifi-key.key

# The first command shows the actual content of the encoded file, and the second parses it and shows the internal values

```
.../certs $ more nifi-key.key
-----BEGIN RSA PRIVATE KEY-----
MIIEpAIBAAKCAQEAqVrrC+AkFbjnCpupSy84tTFDsRVUIWYj/k2pVwC145M3bpr
0pRCzLuzovAjfCmT5L+isTvNjhionsqif07Ebd/M2psYE/Rih2MULsX6KgReInRU
iBeKF08hlmSBMGDFPj39yDzE/V9edxV/KGjRqVgw/Qy0vwaS5uWdXnLDhzoV4/Mz
7lGmYoMasZluexlH93jjBl1+EFL2Xoa06oLbEojJ9TKaWhpG8ietEedf7WM0zqBE
z2kHo9ddFk9yxiCkT4SUKnDWkhwc/o6uslvEXoSw+tmufHY/A3gVihjWPiGzqyLF
19JuN7CyJepkVVqTdsKBG7S85G/kBlizUj5jOwIDAQABAoIBAAdWRnV89oVBuT0Z
dvsXGmyLzph8U9DMcO6DRp+Jf3XaY+WKCtugCCDaVbtHrbtIrl7EAzav5QoifGGb
SbVCP6Q0aJdi5360oSpEUrJRRZ5Z4dxLlvimSwUGG+RnIEn9YYJlGWJve+2PFnr7
KieLnL03V6UPzxoMjnhcnJNdTp+dBwzSazVQwye2csSJlVMk49t2lxBwce7ohuh+
9fL7G3HU5S9d08QTlbrknMHahcwlSYyJd0KSjRJC6wAxnAZmJYJ1jQCI8YICq0j
RX2rhxEXuEMXQcaifQXzCrmQEXreKUISDvNeu/h7YU9UvJWPZSFGnEGgmMP2XvQm
EjK3rQECgYEA5+OkpLsiLNMHGzj72PiBkq82sTLQJ2+8udYp6PheOGkhjjXoBse5
YynyHlQt6CnVpJQ33mQUkJ+3ils0SMFtmI3rz3udzleeklso2L2J3+CI4kt7fFCb
FFbVXv+dLNRm+tOw68J48asyad8kEnHYq9Us+/3MLDmFJYtthkgzCpECgYEAu/ml
lQaWaZAQcQ8UuVeasxMYoN8zMmzfrkxc8AfNwKxF9nc44ywo4nJr+u/UVRGYpRgM
rdll5vz0Iq68qk03spaW7vDjn8hJQhkReQwliT9Fp/51r9MHZGTVarORJGa2oZ0g
iNe8LniZD3bQl9hEvju9mn0x9Q62Q7dapVpfwscgYEATClTPpQQ59dIjERom5vr
wffwftTIO/w8HgFkKxrgyuAVLJSCJtKFH6H1+M7bpKrsz6ZDCs+kkwMm76ASLf3t
1D2h3mNkgHG4SzlmuBD90jB666p0lrci6FjYDap7i+DC3F4j9+vxYYxt9Aln09UV
z94hx+LaA/rlk9OHY3Eyb6ECgYBA/cCtNNjeaKv2mxM8PbjD/289d85YueHgfpcH
gPs3iZiq7W+iw8ri+FKzMSaFvw66zgTcOtULtxulviqG6ym9umk29dOQRgxmKQqs
gnckq6uGuOjxwJHqrlZHjQw6vLSaThxIk+aZu+iAh+U8TZbW4ZjmrOiGdMUuJlD
oGpyHwKBgQCRjfqQjReLYvtU7j6BD9BDbCfmipwaRNP0CuAGOVtS+UnJuaIhsXFQ
QGEBuOnfFijIvb7YcXRL4plRYPMvdqYRNObuI6A+lxNtr000nxa/HUfzKVeI9Tsn
9AKMwnXS8ZcfStsVf3oDFffXYRqCaWeuhpMmg9TwdXoAuwfpE5GCmW==
-----END RSA PRIVATE KEY-----
.../certs $ openssl rsa -in nifi-key.key -text -noout
Private-Key: (2048 bit)
modulus:
    00:aa:45:6b:ac:2f:80:90:56:e3:9c:2a:6e:a5:2c:
    bc:e2:d4:c5:0e:c4:55:50:85:98:8f:f9:36:a5:5c:
    02:d7:8e:4c:dd:ba:6b:d2:94:42:cc:bb:b3:a2:f0:
    23:14:29:93:e4:bf:a2:b1:3b:cd:8e:18:a8:9e:ca:
    a2:7f:4e:c4:6d:df:cc:da:9b:18:13:f4:62:87:63:
    14:2e:c5:fa:2a:04:5e:d6:74:54:88:17:8a:17:4f:
    21:96:64:81:30:60:c5:3e:3d:fd:c8:3c:c4:fd:5f:
    5e:77:15:7f:28:68:d1:a9:58:30:fd:0c:b4:bf:06:
    92:e6:e5:9d:5e:72:c3:87:3a:15:e3:f3:33:ee:51:
    a6:62:83:1a:b1:9d:6e:7b:19:47:f7:78:e3:06:5d:
    7e:10:52:f6:5e:86:b4:ea:82:db:12:88:c9:f5:32:
    9a:5a:1a:46:f2:27:ad:11:e7:5f:ed:63:34:ce:a0:
    44:cf:69:07:a3:d7:5d:16:4f:72:c6:20:a4:4f:84:
    94:2a:70:d6:92:1c:1c:fe:8e:ae:b3:5b:c4:5e:84:
    b0:fa:d9:ae:7c:76:3f:03:78:15:8a:18:d6:3c:81:
    b3:ab:22:c5:97:d2:6e:37:b0:b2:25:ea:64:55:5a:
    93:76:c9:01:1b:b4:bc:e4:6f:e4:06:58:b3:52:3e:
    63:3b
publicExponent: 65537 (0x10001)
privateExponent:
```

```
07:56:46:75:7c:f6:85:41:b9:3d:19:76:fb:17:1a:
6c:8b:ce:91:fc:53:d0:cc:70:ee:83:46:9f:89:7f:
75:da:63:e5:8a:0a:eb:60:08:20:da:55:bb:47:ad:
bb:48:af:5e:c4:03:36:af:e5:03:a2:7c:61:9b:49:
b5:42:a7:a4:34:68:97:62:e7:7e:b4:a1:2a:44:52:
b2:51:45:9e:59:e1:dc:4b:d6:f8:a6:4b:05:06:1b:
e4:67:20:49:fd:61:82:75:19:62:6f:7b:ed:8f:16:
7a:fb:2a:27:8b:9c:bd:37:57:a5:0f:cf:1a:0c:26:
78:5c:9c:93:5d:4e:9f:9d:07:0c:d2:6b:35:50:c3:
27:b6:72:c4:89:95:53:24:e3:db:76:97:10:70:71:
ee:e8:86:e8:7e:f5:f2:fb:1b:71:d4:e5:2f:5d:d3:
c4:13:d5:ba:e4:9c:c1:da:85:cc:35:49:8c:89:77:
42:92:8d:12:42:07:ac:00:c6:70:19:98:96:09:d6:
34:02:23:c6:08:0a:ad:23:45:7d:ab:87:11:17:b8:
43:17:41:c6:a2:15:05:f3:0a:b9:90:11:7a:de:29:
42:12:0e:f3:5e:bb:f8:7b:61:4f:54:bc:95:8f:65:
21:46:9c:41:a0:9c:c3:f6:5e:f4:26:12:32:b7:ad:
01
```

prime1:

```
00:e7:e3:a4:a4:bb:22:2c:d3:07:1b:38:fb:d8:f8:
81:92:af:36:b1:32:d0:27:6f:bc:b9:d6:29:e8:f8:
5e:38:69:21:8e:35:e8:06:c7:b9:63:29:f2:1e:54:
2d:e8:29:d5:a4:94:37:de:64:14:90:9f:b7:8a:5b:
34:48:c1:6d:98:8d:eb:cf:7b:9d:ce:57:9e:93:5b:
28:d8:bd:89:df:e0:88:e2:4b:7b:7c:50:9b:14:56:
d5:5e:ff:9d:2c:da:e6:fa:d3:b0:eb:c2:78:f1:ab:
32:69:df:24:12:71:d8:ab:d5:2c:fb:fd:cc:2c:39:
85:25:84:ed:86:48:33:0a:91
```

prime2:

```
00:bb:f9:a5:95:06:96:69:90:10:71:0f:14:b9:57:
9a:b3:13:18:a0:df:33:32:6c:df:ae:4c:5c:f0:07:
cd:c0:ac:45:f6:77:38:e3:2c:28:e2:72:6b:fa:ef:
d4:55:11:98:a5:18:0c:ad:d9:65:e6:fc:f4:22:ae:
bc:aa:4d:37:b2:96:96:ee:f0:c9:9f:c8:49:42:19:
11:79:0c:35:8a:df:45:a7:fe:75:af:d3:07:cc:64:
d5:6a:b3:91:24:66:b6:a1:9d:20:88:d7:bc:2c:d8:
b3:0f:76:d0:d7:d8:44:be:3b:bd:9a:7d:31:f5:0e:
b6:43:b7:5a:a5:5a:5f:7f:0b
```

exponent1:

```
00:b4:2d:53:3e:94:10:e7:d7:48:8c:44:68:9b:9b:
eb:c1:f7:d6:7d:34:c8:3b:fc:3c:1e:01:64:2b:1a:
e0:ca:e0:15:2c:94:82:26:d2:85:1f:a1:f5:f8:ce:
db:a4:aa:ec:cf:a6:43:0a:cf:a4:93:03:26:ef:a0:
12:2d:fd:ed:94:3d:a1:de:63:64:a8:71:b8:4b:32:
e7:b8:10:fd:d2:30:7a:eb:aa:4e:d6:b7:22:e8:58:
d8:0d:aa:7b:8b:e0:c2:dc:5e:23:f7:eb:f1:61:85:
ed:f4:09:67:d3:d5:15:cf:de:21:c7:e2:da:03:fa:
e5:93:d3:87:63:71:32:07:a1
```

exponent2:

```
40:fd:c0:ad:34:d8:de:68:ab:f6:9b:13:3c:3d:b8:
c3:ff:6f:3d:77:ce:58:b9:e1:e0:7e:90:87:80:fb:
37:89:98:aa:ed:6f:a2:c3:ca:e2:f8:52:b3:31:26:
85:bf:0e:ba:ce:04:dc:3a:d5:0b:b7:1b:a5:be:2a:
86:eb:29:bd:ba:69:36:f5:d3:90:46:0c:66:29:0a:
ac:82:77:24:ab:ab:86:b8:e8:f1:c0:91:ea:ae:56:
47:8d:0c:3a:bc:b4:9a:4e:1c:48:93:e6:80:ce:ef:
a2:02:1f:94:f1:36:5b:5b:86:63:9a:b3:a2:19:d3:
14:b8:99:43:a0:6a:72:1f
```

coefficient:

```
00:91:8d:fa:90:8d:17:a5:61:5b:54:ee:3e:81:0f:
d0:43:6c:27:e6:8a:9c:1a:44:d3:f4:0a:e0:06:39:
5b:52:f9:49:c9:b9:a2:21:b1:71:50:40:61:01:b8:
e9:df:16:28:c8:bd:be:d8:71:74:4b:e2:99:51:60:
f3:2f:0e:a6:11:34:e6:ee:23:a0:3e:d7:13:6d:af:
```

```
4d:34:9f:16:bf:1d:47:f3:29:57:88:f5:3b:27:f4:
02:8c:5a:75:d2:f1:97:1f:4a:db:15:7f:7a:03:15:
f7:d7:61:1a:82:69:67:ae:86:93:26:83:d4:f0:75:
7a:00:bb:07:e9:13:91:82:9b
```

## Signing with Externally-signed CA Certificates

To sign generated certificates with a certificate authority (CA) generated outside of the TLS Toolkit, ensure the necessary files are in the right format and location. For example, an organization Large Organization has an internal CA (CN=ca.large.org, OU=Certificate Authority). This root CA is offline and only used to sign other internal CAs. The Large IT team generates an intermediate CA (CN=nifi\_ca.large.org, OU=NiFi, OU=Certificate Authority) to be used to sign all NiFi node certificates (CN=node1.nifi.large.org, OU=NiFi, CN=node2.nifi.large.org, OU=NiFi, etc.).

To use the toolkit to generate these certificates and sign them using the intermediate CA, ensure that the following files are present:

- nifi-cert.pem - the public certificate of the intermediate CA in PEM format
- nifi-key.key - the Base64-encoded private key of the intermediate CA in PKCS #1 PEM format

If the intermediate CA was the root CA, it would be self-signed - the signature over the certificate would be issued from the same key. In that case (the same as a toolkit-generated CA), no additional arguments are necessary. However, because the intermediate CA is signed by the root CA, the public certificate of the root CA needs to be provided as well to validate the signature. The `--additionalCACertificate` parameter is used to specify the path to the signing public certificate. The value should be the absolute path to the root CA public certificate.

Example:

```
# Generate cert signed by intermediate CA (which is signed by root CA) --
WILL FAIL

$ ./bin/tls-toolkit.sh standalone -n 'nodel.nifi.apache.org' \
-P passwordpassword \
-S passwordpassword \
-o /opt/certs/externalCA \
-O

2018/08/02 18:48:11 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandaloneCommandLine: No
  nifiPropertiesFile specified, using embedded one.
2018/08/02 18:48:12 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandalone: Running
  standalone certificate generation with output directory /opt/certs/
  externalCA
2018/08/02 18:48:12 INFO [main] org.apache.nifi.toolkit.tls.util.TlsHelper:
  Verifying the certificate signature for CN=nifi_ca.large.org,
  OU=Certificate Authority
2018/08/02 18:48:12 INFO [main] org.apache.nifi.toolkit.tls.util.TlsHelper:
  Attempting to verify certificate CN=nifi_ca.large.org, OU=NiFi,
  OU=Certificate Authority signature with CN=nifi_ca.large.org, OU=NiFi,
  OU=Certificate Authority
2018/08/02 18:48:12 WARN [main] org.apache.nifi.toolkit.tls.util.TlsHelper:
  Certificate CN=nifi_ca.large.org, OU=NiFi, OU=Certificate Authority
  not signed by CN=nifi_ca.large.org, OU=NiFi, OU=Certificate Authority
  [certificate does not verify with supplied key]
Error generating TLS configuration. (The signing certificate was not signed
by any known certificates)

# Provide additional CA certificate path for signature verification of
intermediate CA

$ ./bin/tls-toolkit.sh standalone -n 'nodel.nifi.apache.org' \
```

```

-P passwordpassword \
-S passwordpassword \
-o /opt/certs/externalCA \
--additionalCACertificate /opt/certs/externalCA/root.pem \
-O

2018/08/02 18:48:44 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandaloneCommandLine: No
  nifiPropertiesFile specified, using embedded one.
2018/08/02 18:48:44 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandalone: Running
  standalone certificate generation with output directory /opt/certs/
  externalCA
2018/08/02 18:48:44 INFO [main] org.apache.nifi.toolkit.tls.util.TlsHelper:
  Verifying the certificate signature for CN=nifi_ca.large.org, OU=NiFi,
  OU=Certificate Authority
2018/08/02 18:48:44 INFO [main] org.apache.nifi.toolkit.tls.util.TlsHelper:
  Attempting to verify certificate CN=nifi_ca.large.org, OU=NiFi,
  OU=Certificate Authority signature with CN=ca.large.org, OU=Certificate
  Authority
2018/08/02 18:48:44 INFO [main] org.apache.nifi.toolkit.tls.util.TlsHelper:
  Certificate was signed by CN=ca.large.org, OU=Certificate Authority
2018/08/02 18:48:44 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandalone: Using existing
  CA certificate /opt/certs/externalCA/nifi-cert.pem and key /opt/certs/
  externalCA/nifi-key.key
2018/08/02 18:48:44 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandalone: Writing new
  ssl configuration to /opt/certs/externalCA/nodel.nifi.apache.org
2018/08/02 18:48:44 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandalone: Successfully
  generated TLS configuration for nodel.nifi.apache.org 1 in /opt/certs/
  externalCA/nodel.nifi.apache.org
2018/08/02 18:48:44 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandalone: No
  clientCertDn specified, not generating any client certificates.
2018/08/02 18:48:44 INFO [main]
  org.apache.nifi.toolkit.tls.standalone.TlsToolkitStandalone: tls-toolkit
  standalone completed successfully

```

## Additional Certificate Commands

- To convert from DER encoded public certificate (cert.der) to PEM encoded (cert.pem):
  - If the DER file contains both the public certificate and private key, remove the private key with this command:
    - `perl -pe 'BEGIN{undef $/;} s|-----BEGIN PRIVATE KEY-----.*?-----END PRIVATE KEY-----|Removed private key|gs' cert.der > cert.pem`
  - If the DER file only contains the public certificate, use this command:
    - `openssl x509 -inform der -in cert.der -out cert.pem`
- To convert from a PKCS12 keystore (keystore.p12) containing both the public certificate and private key into PEM encoded files (\$PASSWORD is the keystore password):
  - `openssl pkcs12 -in keystore.p12 -out cert.der -nodes -password "pass:$PASSWORD"`
  - `openssl pkcs12 -in keystore.p12 -nodes -nocerts -out key.key -password "pass:$PASSWORD"`
  - Follow the steps above to convert cert.der to cert.pem
- To convert from a Java Keystore (keystore.jks) containing private key into PEM encoded files (\$P12\_PASSWORD is the PKCS12 keystore password, \$JKS\_PASSWORD is the Java keystore password you want to set, and \$ALIAS can be any value - the NiFi default is nifi-key):
  - `openssl pkcs12 -in keystore.jks -out cert.der -nodes -password "pass:$P12_PASSWORD" -name $ALIAS`
  - `openssl pkcs12 -in keystore.jks -out key.key -nodes -password "pass:$JKS_PASSWORD" -name $ALIAS`
  - Follow the steps above to convert cert.der to cert.pem

- `keytool -importkeystore -srckeystore keystore.jks -destkeystore keystore.p12 -srcstoretype JKS -deststoretype PKCS12 -destkeypass "$P12_PASSWORD" -deststorepass "$P12_PASSWORD" -srcstorepass "$JKS_PASSWORD" -srcalias "$ALIAS" -destalias "$ALIAS"`
  - Follow the steps above to convert from `keystore.p12` to `cert.pem` and `key.key`
4. To convert from PKCS #8 PEM format to PKCS #1 PEM format:
    - If the private key is provided in PKCS #8 format (the file begins with `-----BEGIN PRIVATE KEY-----` rather than `-----BEGIN RSA PRIVATE KEY-----`), the following command will convert it to PKCS #1 format, move the original to `nifi-key-pkcs8.key`, and rename the PKCS #1 version as `nifi-key.key`:
      - `openssl rsa -in nifi-key.key -out nifi-key-pkcs1.key && mv nifi-key.key nifi-key-pkcs8.key && mv nifi-key-pkcs1.key nifi-key.key`
  5. To combine a private key in PEM format (`private.key`) and public certificate in PEM format (`certificate.pem`) into PKCS12 keystore:
    - The following command will create the PKCS12 keystore (`keystore.p12`) from the two independent files. A Java keystore (JKS) cannot be formed directly from the PEM files:
      - `openssl pkcs12 -export -out keystore.p12 -inkey private.key -in certificate.pem`
  6. To convert a PKCS12 keystore (`keystore.p12`) to JKS keystore (`keystore.jks`):
    - The following command will create the JKS keystore (`keystore.jks`). The `-destalias` flag is optional, as NiFi does not currently read from a specific alias in the keystore. The user will be prompted for a keystore password, which must be set and have minimum 8 characters, and a key password, which can be the same as the keystore password or different:
      - `keytool -importkeystore -srckeystore keystore.p12 -srcstoretype pkcs12 -destkeystore keystore.jks -deststoretype jks -destalias nifi-key`

## ZooKeeper Migrator

You can use the `zk-migrator` tool to perform the following tasks:

- Moving ZooKeeper information from one ZooKeeper cluster to another
- Migrating ZooKeeper node ownership

For example, you may want to use the ZooKeeper Migrator when you are:

- Upgrading from NiFi 0.x to NiFi 1.x in which embedded ZooKeepers are used
- Migrating from an embedded ZooKeeper in NiFi 0.x or 1.x to an external ZooKeeper
- Upgrading from NiFi 0.x with an external ZooKeeper to NiFi 1.x with the same external ZooKeeper
- Migrating from an external ZooKeeper to an embedded ZooKeeper in NiFi 1.x

## Usage

The `zk-migrator` tool is invoked as `./bin/zk-migrator.sh` or `bin\zk-migrator.bat`.

To show help:

```
./bin/zk-migrator.sh -h
```

The following are available options:

- `-a,--auth <username:password>` Allows the specification of a username and password for authentication with ZooKeeper. This option is mutually exclusive with the `-k,--krb-conf` option.

- `-f,--file <filename>` The file used for ZooKeeper data serialized as JSON. When used with the `-r,--receive` option, data read from ZooKeeper will be stored in the given filename. When used with the `-s,--send` option, the data in the file will be sent to ZooKeeper.
- `-h,--help` Prints help, displays available parameters with descriptions
- `--ignore-source` Allows the ZooKeeper Migrator to write to the ZooKeeper and path from which the data was obtained.
- `-k,--krb-conf <jaas-filename>` Allows the specification of a JAAS configuration file to allow authentication with a ZooKeeper configured to use Kerberos. This option is mutually exclusive with the `-a,--auth` option.
- `-r,--receive` Receives data from ZooKeeper and writes to the given filename (if the `-f,--file` option is provided) or standard output. The data received will contain the full path to each node read from ZooKeeper. This option is mutually exclusive with the `-s,--send` option.
- `-s,--send` Sends data to ZooKeeper that is read from the given filename (if the `-f,--file` option is provided) or standard input. The paths for each node in the data being sent to ZooKeeper are absolute paths, and will be stored in ZooKeeper under the path portion of the `-z,--zookeeper` argument. Typically, the path portion of the argument can be omitted, which will store the nodes at their absolute paths. This option is mutually exclusive with the `-r,--receive` option.
- `--use-existing-acl` Allows the Zookeeper Migrator to write ACL values retrieved from the source Zookeeper server to destination server. Default action will apply Open rights for unsecured destinations or Creator Only rights for secured destinations.
- `-z,--zookeeper <zookeeper-endpoint>` The ZooKeeper server(s) to use, specified by a connect string, comprised of one or more comma-separated host:port pairs followed by a path, in the format of host:port[,host2:port... ,hostn:port]/znode/path.

## Migrating Between Source and Destination ZooKeepers

Before you begin, confirm that:

- You have installed the destination ZooKeeper cluster.
- You have installed and configured a NiFi cluster to use the destination ZooKeeper cluster.
- If you are migrating ZooKeepers due to upgrading NiFi from 0.x to 1.x., you have already followed appropriate NiFi upgrade steps.
- You have configured Kerberos as needed.
- You have not started processing any dataflow (to avoid duplicate data processing).
- If one of the ZooKeeper clusters you are using is configured with Kerberos, you are running the ZooKeeper Migrator from a host that has access to NiFi's ZooKeeper client jaas configuration file (see the *System Administration documentation* in the *Reference* section for more information).

## ZooKeeper Migration Steps

1. Collect the following information:

Required Information	Description
Source ZooKeeper hostname (sourceHostname)	The hostname must be one of the hosts running in the ZooKeeper ensemble, which can be found in <code>&lt;NiFi installation dir&gt;/conf/zookeeper.properties</code> . Any of the hostnames declared in the <code>server.N</code> properties can be used.
Destination ZooKeeper hostname (destinationHostname)	The hostname must be one of the hosts running in the ZooKeeper ensemble, which can be found in <code>&lt;NiFi installation dir&gt;/conf/zookeeper.properties</code> . Any of the hostnames declared in the <code>server.N</code> properties can be used.
Source ZooKeeper port (sourceClientPort)	This can be found in <code>&lt;NiFi installation dir&gt;/conf/zookeeper.properties</code> . The port is specified in the <code>clientPort</code> property or at the end of the server string.

Destination ZooKeeper port (destinationClientPort)	This can be found in <NiFi installation dir>/conf/zookeeper.properties. The port is specified in the clientPort property or at the end of the server string.
Export data path	Determine the path that will store a json file containing the export of data from ZooKeeper. It must be readable and writable by the user running the zk-migrator tool.
Source ZooKeeper Authentication Information	This information is in <NiFi installation dir>/conf/state-management.xml. For NiFi 0.x, if Creator Only is specified in state-management.xml, you need to supply authentication information using the -a,--auth argument with the values from the Username and Password properties in state-management.xml. For NiFi 1.x, supply authentication information using the -k,--krb-conf argument.  If the state-management.xml specifies Open, no authentication is required.
Destination ZooKeeper Authentication Information	This information is in <NiFi installation dir>/conf/state-management.xml. For NiFi 0.x, if Creator Only is specified in state-management.xml, you need to supply authentication information using the -a,--auth argument with the values from the Username and Password properties in state-management.xml. For NiFi 1.x, supply authentication information using the -k,--krb-conf argument.  If the state-management.xml specifies Open, no authentication is required.
Root path to which NiFi writes data in Source ZooKeeper (sourceRootPath)	This information can be found in <NiFi installation dir>/conf/state-management.xml under the Root Node property in the cluster-provider element. (default: /nifi)
Root path to which NiFi writes data in Destination ZooKeeper (destinationRootPath)	This information can be found in <NiFi installation dir>/conf/state-management.xml under the Root Node property in the cluster-provider element.



**Note:** As of NiFi 1.10.x, because of an upgrade to ZooKeeper 3.5.x, the migrator may have a permission error "NoAuthException: KeeperErrorCode = NoAuth for /zookeeper/config" when attempting to use / as the destination root path. This is because the /zookeeper/config znode has read-only permissions. Instead use a destination path of /nifi/components or similar.

2. Stop all processors in the NiFi flow. If you are migrating between two NiFi installations, the flows on both must be stopped.
3. Export the NiFi component data from the source ZooKeeper. The following command reads from the specified ZooKeeper running on the given hostname:port, using the provided path to the data, and authenticates with ZooKeeper using the given username and password. The data read from ZooKeeper is written to the file provided.
  - For NiFi 0.x
    - For an open ZooKeeper:
      - `zk-migrator.sh -r -z sourceHostname:sourceClientPort/sourceRootPath/components -f /path/to/export/zk-source-data.json`
    - For a ZooKeeper using username:password for authentication:
      - `zk-migrator.sh -r -z sourceHostname:sourceClientPort/sourceRootPath/components -a <username:password> -f /path/to/export/zk-source-data.json`
  - For NiFi 1.x
    - For an open ZooKeeper:
      - `zk-migrator.sh -r -z sourceHostname:sourceClientPort/sourceRootPath/components -f /path/to/export/zk-source-data.json`
    - For a ZooKeeper using Kerberos for authentication:
      - `zk-migrator.sh -r -z sourceHostname:sourceClientPort/sourceRootPath/components -k /path/to/jaasconfig/jaas-config.conf -f /path/to/export/zk-source-data.json`

4. (Optional) If you have used the new NiFi installation to do any processing, you can also export its ZooKeeper data as a backup prior to performing the migration.
  - For an open ZooKeeper:
    - `zk-migrator.sh -r -z destinationHostname:destinationClientPort/destinationRootPath/components -f /path/to/export/zk-destination-backup-data.json`
  - For a ZooKeeper using Kerberos for authentication:
    - `zk-migrator.sh -r -z destinationHostname:destinationClientPort/destinationRootPath/components -k /path/to/jaasconfig/jaas-config.conf -f /path/to/export/zk-destination-backup-data.json`
5. Migrate the ZooKeeper data to the destination ZooKeeper. If the source and destination ZooKeepers are the same, the `--ignore-source` option can be added to the following examples.
  - For an open ZooKeeper:
    - `zk-migrator.sh -s -z destinationHostname:destinationClientPort/destinationRootPath/components -f /path/to/export/zk-source-data.json`
  - For a ZooKeeper using Kerberos for authentication:
    - `zk-migrator.sh -s -z destinationHostname:destinationClientPort/destinationRootPath/components -k /path/to/jaasconfig/jaas-config.conf -f /path/to/export/zk-source-data.json`
6. Once the migration has completed successfully, start the processors in the NiFi flow. Processing should continue from the point at which it was stopped when the NiFi flow was stopped.