


Installation guide

ForgeRock® Identity Platform serves as the basis for our simple and comprehensive Identity and Access Management solution. We help our customers deepen their relationships with their customers, and improve the productivity and connectivity of their employees and partners. For more information about ForgeRock and about the platform, see <https://www.forgerock.com> .

This guide describes options for installing IG for customized or secure environments. For information about how to install and configure IG for evaluation, refer to the [Getting started](#).

Migrate from web container mode to standalone mode

Consider these points to migrate from IG in web container mode to IG in standalone mode.

Session replication between IG instances

High-availability of sessions is not supported .

Streaming asynchronous responses and events

In [ClientHandler](#) and [ReverseProxyHandler](#), use only the default mode of `asyncBehavior:non_streaming`; responses are processed when the entity content is entirely available.

If the property is set to `streaming`, the setting is ignored.

Connection reuse when client certificates are used for authentication

In [ClientHandler](#) and [ReverseProxyHandler](#), use only the default mode of `stateTrackingEnabled:true`; when a client certificate is used for authentication, connections cannot be reused.

If the property is set to `false`, the setting is ignored.

Tomcat configuration

Feature	Standalone	Tomcat
Port number	Configure the connectors property of admin.json .	Configure in the Connector element of <code>/path/to/tomcat/conf/server.xml</code> : <pre data-bbox="938 409 1398 622" style="border: 1px solid #ccc; padding: 5px;"> <Connector port="8080" protocol="HTTP/1.1" connectionTimeout="20000" redirectPort="8443" /></pre>
HTTPS server-side configuration	Create a keystore, set up secrets, and configure secrets stores, ports, and ServerTlsOptions in admin.json . For information, refer to Configure IG for HTTPS (server-side) .	Create a keystore, and set up the SSL port in the Connector element of <code>/path/to/tomcat/conf/server.xml</code> . For information, refer to Configure IG for HTTPS (server-side) in Tomcat .
Session cookie name	Configure the session property of admin.json .	Configure <code>WEB-INF/web.xml</code> when you unpack the IG .war file.
Access logs	Configure in the Audit framework. For information, refer to Auditing your deployment and Audit framework .	Configure with <code>AccessLogValve</code> .
JDBC datasource	Configure with the <code>JdbcDataSource</code> object. For information, refer to JdbcDataSource . For an example, refer to Password replay from a database .	Configure in the <code>GlobalNamingResources</code> element of <code>/path/to/tomcat/conf/server.xml</code> .

Feature	Standalone	Tomcat
Environment variables	Configure in <code>\$HOME/.openig/bin/env.sh</code> , where <code>\$HOME/.openig</code> is the instance directory.	Configure in <code>/path/to/tomcat/bin/setenv.sh</code> .
Jar files	Add to <code>\$HOME/.openig/extra</code> , where <code>\$HOME/.openig</code> is the instance directory.	Add to to web container classpath; for example <code>/path/to/tomcat/webapps/ROOT/WEB-INF/lib</code> .

Upgrade

For information about upgrade between supported versions of IG, see [migrate.adoc#supported-upgrades](#).

This section describes how to upgrade a single IG instance. The most straightforward option when upgrading sites with multiple IG instances is to upgrade in place. One by one, stop, upgrade, and then restart each server individually, leaving the service running during the upgrade.

IG supports the following types of upgrade:

Drop-in software update

Usually, an update from a version of IG to a newer minor version. For example, the update from 2023.2 to 2023.4.

Drop-in software updates can introduce additional functionality and fix bugs or security issues. Consider the following restrictions for drop-in software updates:

- Do not require any update to the configuration
- Cannot cause feature regression
- Can change default or previously configured behavior **only** for bug fixes and security issues
- Can deprecate **but not remove** existing functionality

Major upgrade

Usually, an upgrade from a version of IG to a newer major version. For example, the upgrade from 7.2 to 2023.2.

Major upgrades can introduce additional functionality and fix bugs or security issues. Major upgrades do not have the restrictions of drop-in software update. Consider the

following features of major upgrades:

- Can require code or configuration changes
- Can cause feature regression
- Can change default or previously configured behavior
- Can deprecate **and** remove existing functionality

Supported upgrade paths

The following table lists supported upgrade paths to IG 2023.4:

Version	Upgrade type
IG 2023.2	Drop-in software update
IG 7.x	Major upgrade
IG 6.x	Major upgrade

For more information, refer to [Checking your product versions are supported](#)[↗] in the *ForgeRock Knowledge Base*.

For unsupported, legacy deployments, ForgeRock can assist you in the upgrade process.

Plan the upgrade

Do these planning tasks **before** you start an upgrade:

Planning task	Description
Find the upgrade path	Refer to migrate.adoc#supported-upgrades to see if you need a drop-in upgrade or a major upgrade.
Find out what changed	Read the release notes for all releases between the current version and the new version. Understand the new features and changes in the new version compared to the current version.
Check the requirements	Make sure you meet all of the requirements in the release notes for the new version. In particular, make sure you have a recent, supported Java version .

Planning task	Description
Plan for server downtime	<p>At least one of your IG servers will be down during upgrade. Plan to route client applications to another server until the upgrade process is complete and you have validated the result. Make sure the owners of client application are aware of the change, and let them know what to expect.</p> <p>If you have a single IG server, make sure the downtime happens in a low-usage window, and make sure you let client application owners plan accordingly.</p>
Back up	<p>The IG configuration is a set of files, including <code>admin.json</code>, <code>config.json</code>, <code>logback.xml</code>, <code>routes</code>, and <code>scripts</code>. Back up the IG configuration and store it in version control, so that you can roll back if something goes wrong.</p> <p>Back up any tools scripts you have edited for your deployment and any trust stores used to connect securely.</p>
Plan for <u>rollback</u>	<p>Sometimes even a well-planned upgrade fails to go smoothly. In such cases, you need a plan to roll back smoothly to the pre-upgrade version.</p> <p>For IG servers, roll back by restoring a backed-up configuration.</p>
Prepare a test environment	<p>Before applying the upgrade in your production environment, always try to upgrade IG in a test environment. This will help you gauge the amount of work required, without affecting your production environment, and will help smooth out unforeseen problems.</p> <p>The test environment should resemble your production environment as closely as possible.</p>

Drop-in software update with binaries

1. Read and act on Plan the upgrade.
2. Back up the IG configuration and store it in version control so that you can roll back if something goes wrong.
3. Download the IG .zip file.
4. Stop IG.
5. Make the new configuration available on the file system.

By default, IG configuration files are located under `$HOME/.openig` (on Windows `%appdata%\OpenIG`). For information about how to use a different location, refer to [Change the base location of the IG configuration](#).

6. [Restart IG](#).

By default, IG configuration files are located under `$HOME/.openig` (on Windows `%appdata%\OpenIG`). For information about how to use a different location, refer to [Change the base location of the IG configuration](#).

7. In a test environment that simulates your production environment, validate that the upgraded service performs as expected with the new configuration. Check the logs for new or unexpected notifications or errors.

8. Allow client application traffic to flow to the upgraded site.

Drop-in software update with Docker files

1. Read and act on [Plan the upgrade](#).

2. Back up the IG configuration and store it in version control so that you can roll back if something goes wrong.

3. [Stop the Docker image](#).

4. [Build the new base image for IG](#).

5. [Run the Docker image](#).

6. In a test environment that simulates your production environment, validate that the upgraded service performs as expected with the new configuration. Check the logs for new or unexpected notifications or errors.

7. Allow client application traffic to flow to the upgraded site.

Major upgrade with binaries

1. Read and act on [Plan the upgrade](#).

2. Use the [release notes](#) for **all** releases between the version you currently use and the new version, and create a new configuration as follows:

- Review all incompatible changes and removed functionality, and adjust your configuration as necessary.
- Switch to the replacement settings for deprecated functionality. Although [deprecated](#) objects continue to work, they add to the notifications in the logs and are eventually removed.

- Check the lists of fixes, limitations, and known issues to find out if they impact your deployment.
 - Recompile your Java extensions. The method signature or imports for supported and evolving APIs can change in each version.
 - Read the documentation updates for new examples and information that can help with your configuration.
3. Back up the IG configuration and store it in version control so that you can roll back if something goes wrong.
 4. [Download the IG .zip file](#).
 5. [Stop IG](#).
 6. Make the new configuration available on the file system.

By default, IG configuration files are located under `$HOME/.openig` (on Windows `%appdata%\OpenIG`). For information about how to use a different location, refer to [Change the base location of the IG configuration](#).

7. [Restart IG](#).

By default, IG configuration files are located under `$HOME/.openig` (on Windows `%appdata%\OpenIG`). For information about how to use a different location, refer to [Change the base location of the IG configuration](#).

8. In a test environment that simulates your production environment, validate that the upgraded service performs as expected with the new configuration. Check the logs for new or unexpected notifications or errors.
9. Allow client application traffic to flow to the upgraded site.

Major upgrade with Docker files

1. Read and act on [Plan the upgrade](#).
2. Use the [release notes](#) for all releases between the version you currently use and the new version, and create a new configuration as follows:
 - Review all incompatible changes and removed functionality, and adjust your configuration as necessary.
 - Switch to the replacement settings for deprecated functionality. Although [deprecated](#) objects continue to work, they add to the notifications in the logs and are eventually removed.
 - Check the lists of fixes, limitations, and known issues to find out if they impact your deployment.
 - Recompile your Java extensions. The method signature or imports for supported and evolving APIs can change in each version.

- Read the documentation updates for new examples and information that can help with your configuration.
- 3. Back up the IG configuration and store it in version control so that you can roll back if something goes wrong.
- 4. Stop the Docker image.
- 5. Build the new base image for IG.
- 6. Run the Docker image.
- 7. In a test environment that simulates your production environment, validate that the upgraded service performs as expected with the new configuration. Check the logs for new or unexpected notifications or errors.
- 8. Allow client application traffic to flow to the upgraded site.

Post upgrade tasks

After upgrade, review the what's new section in the release notes and consider activating new features and functionality.

Rollback

IMPORTANT

Before you roll back to a previous version of IG, consider whether any change to the the configuration during or since upgrade could be incompatible with the previous version.

Roll back with binaries

1. Plan for server downtime

Plan to route client applications to another server until the rollback process is complete and you have validated the result. Make sure the owners of client application are aware of the change, and let them know what to expect.

2. Stop IG
3. Download the replacement IG .zip file
4. Make the new configuration available on the file system.

By default, IG configuration files are located under `$HOME/.openig` (on Windows `%appdata%\OpenIG`). For information about how to use a different location, refer to Change the base location of the IG configuration.

5. Restart IG.

Roll back with Dockerfiles

1. Plan for server downtime

Plan to route client applications to another server until the rollback process is complete and you have validated the result. Make sure the owners of client application are aware of the change, and let them know what to expect.

2. Stop the Docker image.
3. Build the new base image for IG.
4. Run the Docker image.

Prepare to install

Requirements

Make sure your installation meets the requirements in the [release notes](#).

Create an IG service account

To limit the impact of a security breach, install and run IG from a dedicated service account. This is optional when you are evaluating IG, but essential in production installations.

A hacker is constrained by the rights granted to the user account where IG runs; therefore, never run IG as root user.

1. In a terminal window, use a command similar to the following to create a service account:

1. Linux
2. Windows

```
$ sudo /usr/sbin/useradd \  
--create-home \  
--comment "Account for running IG" \  
--shell /bin/bash IG
```

```
> net user username password /add /comment:"Account for  
running IG"
```

2. Apply the principle of least privilege to the account, for example:

- Read/write permissions on the installation directory, `/path/to/identity-gateway`.
- Execute permissions on the scripts in the installation `bin` directory, `/path/to/identity-gateway/bin`.

Prepare the network

Configure the network to include the hosts.

1. Add the following additional entry to your host file:

1. Linux
2. Windows

```
/etc/hosts
```

```
%SystemRoot%\system32\drivers\etc\hosts
```

```
127.0.0.1 localhost ig.example.com app.example.com  
am.example.com
```

For more information about host files, refer to the Wikipedia entry, [Hosts \(file\)](#) 

Set up Identity Cloud and AM for use with IG

This section contains procedures for setting up items in ForgeRock Identity Cloud and AM that you can use with IG. For more information about setting up Identity Cloud, refer to the [ForgeRock Identity Cloud docs](#). For more information about setting up AM, refer to the [Access Management docs](#).

Authenticate an IG agent to Identity Cloud

IG agents are automatically authenticated to Identity Cloud by a non-configurable authentication module. Authentication chains and modules are deprecated in Identity Cloud and replaced by journeys.

You can now authenticate IG agents to Identity Cloud with a journey. The procedure is currently optional, but will be required when authentication chains and modules are removed in a future release of Identity Cloud.

For more information, refer to Identity Cloud's [Journeys](#).

This section describes how to create a journey to authenticate an IG agent to Identity Cloud. The journey has the following requirements:

- It must be called Agent
- Its nodes must pass the agent credentials to the Agent Data Store Decision node.

When you define a journey in Identity Cloud, that same journey is used for all instances of IG, Java agent, and Web agent. Consider this point if you change the journey configuration.

1. Log in to the Identity Cloud admin UI as an administrator.
2. Click **Journeys > New Journey**.
3. Add a journey with the following information and click **Create journey**:
 - **Name**: Agent
 - **Identity Object**: The user or device to authenticate.
 - (Optional) **Description**: Authenticate an IG agent to Identity Cloud

The journey designer is displayed, with the **Start** entry point connected to the **Failure** exit point, and a **Success** node.

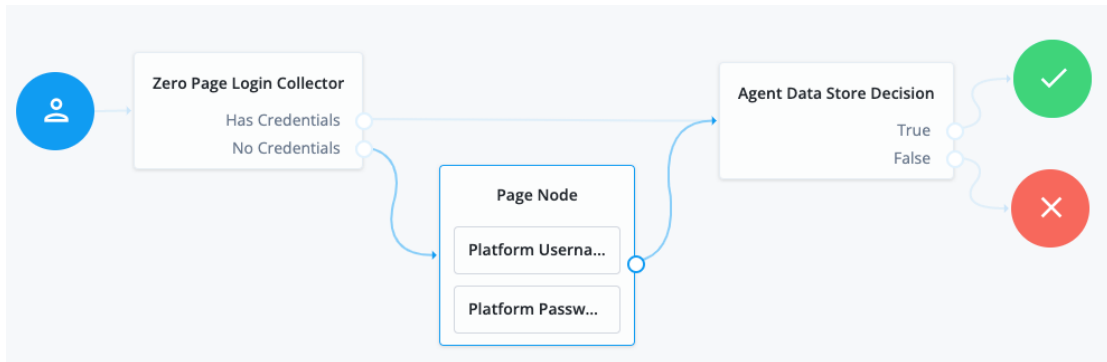
4. Using the **Q Filter nodes** bar, find and then drag the following nodes from the **Components** panel into the designer area:
 - Zero Page Login Collector node to check whether the agent credentials are provided in the incoming authentication request, and use their values in the following nodes.

This node is required for compatibility with Java agent and Web agent.
 - Page node to collect the agent credentials if they are not provided in the incoming authentication request, and use their values in the following nodes.
 - Agent Data Store Decision node to verify the agent credentials match the registered IG agent profile.

IMPORTANT

Many nodes can be configured in the panel on the right side of the page. Unless otherwise stated, do not configure the nodes, and use only the default values.

5. Drag the following nodes from the **Components** panel into the Page node:
 - Platform Username node to prompt the user to enter their username.
 - Platform Password node to prompt the user to enter their password.
6. Connect the nodes as follows and save the journey:



Authenticate an IG agent to AM

IMPORTANT

IG agents are automatically authenticated to AM by a non-configurable authentication module in AM. Authentication chains and modules were deprecated in AM 7 and are replaced by authentication nodes and trees.

From AM 7.3 you can authenticate IG agents to AM by using authentication nodes and trees. The procedure is currently optional, but will be required when authentication chains and modules are removed in a future release of AM.

For more information, refer to AM's [Authentication Nodes and Trees](#).

This section describes how to create an authentication tree to authenticate an IG agent to AM. The tree has the following requirements:

- It must be called Agent
- Its nodes must pass the agent credentials to the Agent Data Store Decision node.




When you define a tree in AM, that same tree is used for all instances of IG, Java agent, and Web agent. Consider this point if you change the tree configuration.

1. On the **Realms** page of the AM admin UI, choose the realm in which to create the authentication tree.

2. On the **Realm Overview** page, click **Authentication > Trees > + Create tree**.
3. Create a tree named **Agent**.

The authentication tree designer is displayed, with the **Start** entry point connected to the **Failure** exit point, and a **Success** node.

The authentication tree designer provides the following features on the toolbar:

Button	Usage
	Lay out and align nodes according to the order they are connected.
	Toggle the designer window between normal and full-screen layout.
	Remove the selected node. Note that the Start entry point cannot be deleted.

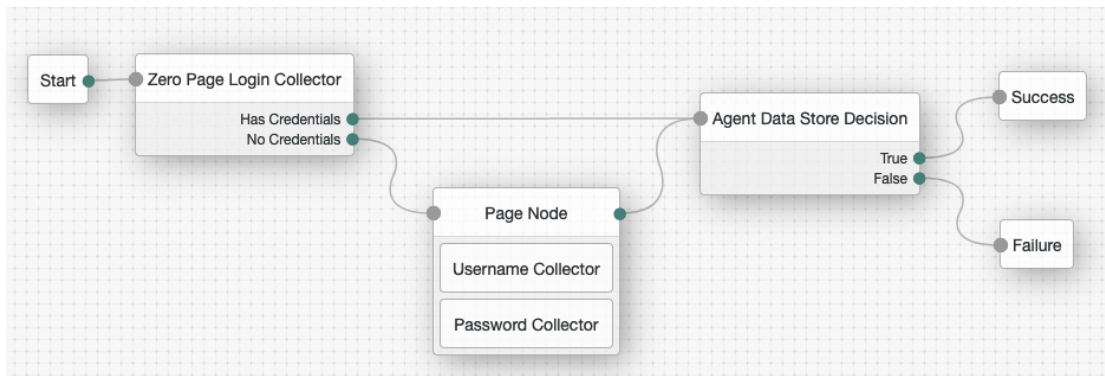
4. Using the **Q Filter** bar, find and then drag the following nodes from the **Components** panel into the designer area:
 - Zero Page Login Collector node to check whether the agent credentials are provided in the incoming authentication request, and use their values in the following nodes.

This node is required for compatibility with Java agent and Web agent.
 - Page node to collect the agent credentials if they are not provided in the incoming authentication request, and use their values in the following nodes.
 - Agent Data Store Decision node to verify the agent credentials match the registered IG agent profile.

IMPORTANT


Many nodes can be configured in the panel on the right side of the page. Unless otherwise stated, do not configure the nodes and use only the default values.

5. Drag the following nodes from the **Components** panel into the Page node:
 - Username Collector node to prompt the user to enter their username.
 - Password Collector node to prompt the user to enter their password.
6. Connect the nodes as follows and save the tree:




Register an IG agent in Identity Cloud

This procedure registers an agent that acts on behalf of IG.

1. Log in to the Identity Cloud admin UI as an administrator.
2. Click  **Gateways & Agents** > **+ New Gateway/Agent** > **Identity Gateway** > **Next**, and add an agent profile:
 - o **ID:** `agent-name`
 - o **Password:** `agent-password`

IMPORTANT

Use secure passwords in a production environment. Consider using a password manager to generate secure passwords.


3. Click **Save Profile** > **Done**. The agent profile page is displayed.
4. To add a redirect URL for CDSSO, go to the agent profile page and add the URL.
5. To change the introspection scope, click  **Native Consoles** > **Access Management**, and update the agent in the AM admin UI. By default, the agent can introspect OAuth 2.0 tokens issued to any client, in the realm and subrealm where it is created.

Register an IG agent in AM 7 and later

In AM 7 and later versions, follow these steps to register an agent that acts on behalf of IG.

1. In the AM admin UI, select the top-level realm, and then select **Applications** > **Agents** > **Identity Gateway**.
2. Add an agent with the following values:
 1. For SSO

2. For CDSSO

- **Agent ID** : ig_agent
- **Password** : password
- **Agent ID** : ig_agent
- **Password** : password
- **Redirect URL for CDSSO** :
<https://ig.ext.com:8443/home/cdsso/redirect> 

Register an IG agent in AM 6.5 and earlier

In AM 6.5 and earlier versions, follow these steps to register an agent that acts on behalf of IG.

1. In the AM admin UI, select the top-level realm, and then select **Applications > Agents > Java (or J2EE)**.

2. Add an agent with the following values:

1. For SSO

2. For CDSSO

- **Agent ID** : ig_agent
- **Agent URL** : <http://ig.example.com:8080/agentapp>
- **Server URL** : <http://am.example.com:8088/openam>
- **Password** : password
- **Agent ID** : ig_agent_cdsso
- **Agent URL** : <http://ig.ext.com:8080/agentapp>
- **Server URL** : <http://am.example.com:8088/openam>
- **Password** : password

3. On the **Global** tab, deselect **Agent Configuration Change Notification**.

This option stops IG from being notified about agent configuration changes in AM. IG doesn't need these notifications.

4. (For CDSSO) On the **SSO** tab, select the following values:

- **Cross Domain SSO** : Deselect this option
- **CDSSO Redirect URI** : /home/cdsso/redirect



5. (For CDSSO and policy enforcement) On the **SSO** tab, select the following values:

- **Cross Domain SSO** : Deselect this option

- **CDSO Redirect URI** : /home/pep-cdsso/redirect

Set up a demo user in Identity Cloud

This procedure sets up a demo user in the alpha realm.

- Log in to the Identity Cloud admin UI as an administrator.
- Go to  **Identities** > **Manage** >  **Alpha realm - Users**, and add a user with the following values:
 - **Username**: demo
 - **First name**: demo
 - **Last name**: user
 - **Email Address**: demo@example.com
 - **Password**: Ch4ng3!t

Set up a demo user in AM

AM is provided with a demo user in the top-level realm, with the following credentials:

- ID/username: demo
- Last name: user
- Password: Ch4ng31t
- Email address: demo@example.com
- Employee number: 123

For information about how to manage identities in AM, refer to AM's [Identity stores](#).

Install IG

Download and start IG

Download the IG .zip file

The .zip file unpacks into a /path/to/identity-gateway directory with the following content:

- bin : Start and stop executables

- `classes` : Initially empty; used to install patches from ForgeRock support
- `docker/Dockerfile` : Dockerfile and README to build an IG Docker image
- `legal-notices` : Licenses and copyrights
- `lib` : IG and third-party libraries

1. Create a local installation directory for IG. The examples in this section use `/path/to`.
2. Download `IG-2023.4.0.zip` from the [ForgeRock BackStage download site](#)[↗], and copy the `.zip` file to the installation directory:

```
$ cp IG-2023.4.0.zip /path/to/IG-2023.4.0.zip
```

3. Unzip the file:

```
$ unzip IG-2023.4.0.zip
```

The directory `/path/to/identity-gateway` is created.

Start IG

Start IG with default settings

Use the following step to start the instance of IG, specifying the configuration directory where IG looks for configuration files.

1. Start IG:

1. Linux
2. Windows

```
$ /path/to/identity-gateway/bin/start.sh  
  
...  
... started in 1234ms on ports : [8080 8443]
```

```
C:\path\to\identity-gateway\bin\start.bat
```

By default, IG configuration files are located under `$HOME/.openig` (on Windows `%appdata%\OpenIG`). For information about how to use a different

location, refer to [Change the base location of the IG configuration](#).

2. Check that IG is running in one of the following ways:

- Ping IG at `http://ig.example.com:8080/openig/ping`, and make sure an HTTP 200 is returned.
- Access the IG welcome page at `http://ig.example.com:8080`.
- When IG is running in development mode, display the product version and build information at `http://ig.example.com:8080/openig/api/info`.

Start IG with custom settings

By default, IG runs on HTTP, on port 8080, from the instance directory `$HOME/.openig`.

To start IG with custom settings, add the configuration file `admin.json` with the following properties, and restart IG:

- `vertx`: Finely tune Vert.x instances.
- `connectors`: Customize server port, TLS, and Vert.x-specific configurations. Each `connectors` object represents the configuration of an individual port.
- `prefix`: Set the instance directory, and therefore, the base of the route for administration requests.

The following example starts IG on non-default ports, and configures Vert.x-specific options for the connection on port 9091:

```
{
  "connectors": [{
    "port": 9090
  },
  {
    "port": 9091,
    "vertx": {
      "maxWebSocketFrameSize": 128000,
      "maxWebSocketMessageSize": 256000,
      "compressionLevel": 4
    }
  }
  ]
}
```

For more information, refer to [AdminHttpApplication \(admin.json\)](#).

Stop IG

Use the `stop.sh` script to stop an instance of IG, specifying the instance directory as an argument. If the instance directory is not specified, IG uses the default instance directory:

1. Linux
2. Windows

```
$ /path/to/identity-gateway/bin/stop.sh $HOME/.openig
```

```
C:\path\to\identity-gateway\bin\stop.bat %appdata%\OpenIG
```

Configure IG for HTTPS (server-side)

When IG is *server-side*, applications send requests to IG or request services from IG. IG is acting as a server of the application, and the application is acting as a client.

To run IG as a server over HTTPS, you must configure connections to TLS-protected endpoints, based on [ServerTlsOptions](#).

Using keys and certificates

The examples in this doc set use self-signed certificates, but your deployment is likely to use certificates issued by a certificate authority (CA certificates).

The way to obtain CA certificates depends on the certificate authority that you are using, and is not described in this document. As an example, refer to [Let's Encrypt](#).

Integrate CA certificates by using secret stores:

- For PEM files, use a [FileSystemSecretStore](#) and [PemPropertyFormat](#)
- For PKCS12 keystores, use a [KeyStoreSecretStore](#)

For examples, refer to [Serve the same certificate for TLS connections to all server names](#).

Note the following points about using secrets:

- When IG starts up, it listens for HTTPS connections, using the `ServerTlsOptions` configuration in `admin.json`. The keys and certificates are fetched at startup.
- Keys and certificates must be present at startup.
- If keys or certificates change, you must to restart IG.
- When the `autoRefresh` property of `FileSystemSecretStore` or `KeyStoreSecretStore` is enabled, the secret store is automatically reloaded when the filesystem or keystore is changed.

For information about secret stores provided in IG, refer to [Secrets object and secret stores](#).

Serve the same certificate for TLS connections to all server names

This example uses PEM files and a PKCS#12 keystore for self-signed certificates, but you can adapt it to use official (non self-signed) keys and certificates.

Before you start, install IG, as described in [Download and start IG](#).

1. Locate a directory for the secrets, for example, `/path/to/secrets`.
2. Create self-signed keys in one of the following ways. If you have your own keys, use them and skip this step.

▼ [Use your own keys](#)

If you have your own keys, use them and skip this step.

▼ [Set up a self-signed certificate in a \(PKCS#12\) keystore](#)

1. Create the keystore, replacing `/path/to/secrets` with your path:

```
$ keytool \  
-genkey \  
-alias https-connector-key \  
-keyalg RSA \  
-keystore /path/to/secrets/IG-keystore \  
-storepass password \  
-keypass password \  
-dname "CN=ig.example.com,O=Example Corp,C=FR"
```

NOTE

Because keytool converts all characters in its key aliases to lowercase, use only lowercase in alias definitions of a keystore.

2. In the secrets directory, add a file called `keystore.pass`, containing the keystore password `password`:

```
$ cd /path/to/secrets/  
$ echo -n 'password' > keystore.pass
```

Make sure the password file contains only the password, with no trailing spaces or carriage returns.

▼ [Set up self-signed certificate stored in PEM file](#)

- a. Locate a directory for secrets, and go to it:

```
$ cd /path/to/secrets
```

- b. Create the following secret key and certificate pair as PEM files:

```
$ openssl req \  
-newkey rsa:2048 \  
-new \  
-nodes \  
-x509 \  
-days 3650 \  
-subj \  
"/CN=ig.example.com/OU=example/O=com/L=fr/ST=fr/C=fr" \  
\   
-keyout ig.example.com-key.pem \  
-out ig.example.com-certificate.pem
```

Two PEM files are created, one for the secret key, and another for the associated certificate.

- c. Map the key and certificate to the same secret ID in IG:

```
$ cat ig.example.com-key.pem ig.example.com-   
certificate.pem > key.manager.secret.id.pem
```

3. Set up TLS on IG in one of the following ways:

▼ [Keys stored in a \(PKCS#12\) keystore](#)

Add the following file to IG, replacing `/path/to/secrets` with your path:

1. Linux
2. Windows

```
$HOME/.openig/config/admin.json
```

```
%appdata%\OpenIG\config\admin.json
```

```
{   
  "connectors": [   
    {   
      "port": 8080   
    },   
  ],   
}
```

```

    {
      "port": 8443,
      "tls": "ServerTlsOptions-1"
    }
  ],
  "heap": [
    {
      "name": "ServerTlsOptions-1",
      "type": "ServerTlsOptions",
      "config": {
        "keyManager": {
          "type": "SecretsKeyManager",
          "config": {
            "signingSecretId": "key.manager.secret.id",
            "secretsProvider": "ServerIdentityStore"
          }
        }
      }
    },
    {
      "type": "FileSystemSecretStore",
      "name": "SecretsPasswords",
      "config": {
        "directory": "/path/to/secrets",
        "format": "PLAIN"
      }
    },
    {
      "name": "ServerIdentityStore",
      "type": "KeyStoreSecretStore",
      "config": {
        "file": "/path/to/secrets/IG-keystore",
        "storePasswordSecretId": "keystore.pass",
        "secretsProvider": "SecretsPasswords",
        "mappings": [
          {
            "secretId": "key.manager.secret.id",
            "aliases": ["https-connector-key"]
          }
        ]
      }
    }
  ]
}

```

Notice the following features of the file:

- IG starts on port 8080, and on 8443 over TLS.
- IG's private keys for TLS are managed by the SecretsKeyManager, whose ServerIdentityStore references a KeyStoreSecretStore.
- The KeyStoreSecretStore maps the keystore alias to the secret ID for retrieving the server keys (private key + certificate).
- The password of the KeyStoreSecretStore is provided by the FileSystemSecretStore.

▼ Keys stored in PEM file

Add the following file to IG, replacing /path/to/secrets with your path:

1. Linux
2. Windows

```
$HOME/.openig/config/admin.json
```

```
%appdata%\OpenIG\config\admin.json
```

```
{
  "connectors": [
    {
      "port": 8080
    },
    {
      "port": 8443,
      "tls": "ServerTlsOptions-1"
    }
  ],
  "heap": [
    {
      "name": "ServerTlsOptions-1",
      "type": "ServerTlsOptions",
      "config": {
        "keyManager": {
          "type": "SecretsKeyManager",
          "config": {
            "signingSecretId": "key.manager.secret.id",
            "secretsProvider": "ServerIdentityStore"
          }
        }
      }
    }
  ]
}
```

```

    },
    {
      "name": "ServerIdentityStore",
      "type": "FileSystemSecretStore",
      "config": {
        "format": "PLAIN",
        "directory": "/path/to/secrets",
        "suffix": ".pem",
        "mappings": [{
          "secretId": "key.manager.secret.id",
          "format": {
            "type": "PemPropertyFormat"
          }
        }]
      }
    }
  ]
}

```

Notice how this file differs to that for the keystore-based approach:

- The ServerIdentityStore is a FileSystemSecretStore.
- The FileSystemSecretStore reads the keys that are stored as file in the PEM standard format.

4. Start IG:

1. Linux
2. Windows

```

$ /path/to/identity-gateway/bin/start.sh

...
... started in 1234ms on ports : [8080 8443]

```

```

C:\path\to\identity-gateway\bin\start.bat

```

By default, IG configuration files are located under \$HOME/.openig (on Windows %appdata%\OpenIG). For information about how to use a different location, refer to [Change the base location of the IG configuration](#).

Serve different certificates for TLS connections to different server names

This example uses PEM files for self-signed certificates, but you can adapt it to use official (non self-signed) keys and certificates.

Before you start, install IG, as described in [Download and start IG](#).

1. Locate a directory for secrets, for example, `/path/to/secrets`, and go to it.

```
$ cd /path/to/secrets
```

2. Create the following secret key and certificate pair as PEM files:

- a. For `ig.example.com`:

- i. Create a key and certificate:

```
$ openssl req \  
-newkey rsa:2048 \  
-new \  
-nodes \  
-x509 \  
-days 3650 \  
-subj \  
"/CN=ig.example.com/OU=example/O=com/L=fr/ST=fr/C=fr" \  
-keyout ig.example.com-key.pem \  
-out ig.example.com-certificate.pem
```

Two PEM files are created, one for the secret key, and another for the associated certificate.

- ii. Map the key and certificate to the same secret ID in IG:

```
$ cat ig.example.com-key.pem ig.example.com-  
certificate.pem > key.manager.secret.id.pem
```

- b. For servers grouped by a wildcard:

- i. Create a key and certificate:

```
$ openssl req \  
-newkey rsa:2048 \  
-new \  
-nodes \  
-x509 \  
-days 3650 \  
-subj
```

```
"/CN=*.example.com/OU=example/O=com/L=fr/ST=fr/C=fr" \
-keyout wildcard.example.com-key.pem \
-out wildcard.example.com-certificate.pem
```

ii. Map the key and certificate to the same secret ID in IG:

```
$ cat wildcard.example.com-key.pem
wildcard.example.com-certificate.pem >
wildcard.secret.id.pem
```

c. For other, unmapped servers

i. Create a key and certificate:

```
$ openssl req \
-newkey rsa:2048 \
-new \
-nodes \
-x509 \
-days 3650 \
-subj
"/CN=un.mapped.com/OU=example/O=com/L=fr/ST=fr/C=fr" \
-keyout default.example.com-key.pem \
-out default.example.com-certificate.pem
```

ii. Map the key and certificate to the same secret ID in IG:

```
$ cat default.example.com-key.pem
default.example.com-certificate.pem >
default.secret.id.pem
```

3. Add the following file to IG, replacing `/path/to/secrets` with your path, and then restart IG:

1. Linux
2. Windows

```
$HOME/.openig/config/admin.json
```

```
%appdata%\OpenIG\config\admin.json
```

```

{
  "connectors": [
    {
      "port": 8080
    },
    {
      "port": 8443,
      "tls": "ServerTlsOptions-1"
    }
  ],
  "heap": [
    {
      "name": "ServerTlsOptions-1",
      "type": "ServerTlsOptions",
      "config": {
        "sni": {
          "serverNames": {
            "ig.example.com": "key.manager.secret.id",
            "*.example.com": "wildcard.secret.id"
          },
          "defaultSecretId" : "default.secret.id",
          "secretsProvider": "ServerIdentityStore"
        }
      }
    },
    {
      "name": "ServerIdentityStore",
      "type": "FileSystemSecretStore",
      "config": {
        "format": "PLAIN",
        "directory": "path/to/secrets",
        "suffix": ".pem",
        "mappings": [
          {
            "secretId": "key.manager.secret.id",
            "format": {
              "type": "PemPropertyFormat"
            }
          },
          {
            "secretId": "wildcard.secret.id",
            "format": {
              "type": "PemPropertyFormat"
            }
          }
        ]
      }
    }
  ]
}

```

```

    {
      "secretId": "default.secret.id",
      "format": {
        "type": "PemPropertyFormat"
      }
    }
  ]
}
]
}

```

Notice the following features of the file:

- The `ServerTlsOptions` object maps two servers to secret IDs, and includes a default secret ID
- The secret IDs correspond to the secret IDs in the `FileSystemSecretStore`, and the PEM files generated in an earlier step.

4. Run the following commands to request TLS connections to different servers, using different certificates:

- Connect to `ig.example.com`, and note that the certificate subject corresponds to the certificate created for `ig.example.com`:

```

$ openssl s_client -connect localhost:8443 -servername
ig.example.com

...
Server certificate
-----BEGIN CERTIFICATE-----
MII...dZC
-----END CERTIFICATE-----
subject=/CN=ig.example.com/OU=example/O=com/L=fr/ST=fr/
C=fr
issuer=/CN=ig.example.com/OU=example/O=com/L=fr/ST=fr/C
=fr

```

- Connect to `other.example.com`, and note that the certificate subject corresponds to the certificate created with the wildcard, `*.example.com`:

```

$ openssl s_client -connect localhost:8443 -servername
other.example.com

...
Server certificate

```

```
-----BEGIN CERTIFICATE-----
MII...fY=
-----END CERTIFICATE-----
subject=/CN=*.example.com/OU=example/O=com/L=fr/ST=fr/C=
=fr
issuer=/CN=*.example.com/OU=example/O=com/L=fr/ST=fr/C=
fr
```

- c. Connect to `unmapped.site.com`, and note that the certificate subject corresponds to the certificate created for the default secret ID:

```
$ openssl s_client -connect localhost:8443 -servername
unmapped.site.com

...
Server certificate
-----BEGIN CERTIFICATE-----
MII..rON
-----END CERTIFICATE-----
subject=/CN=un.mapped.com/OU=example/O=com/L=fr/ST=fr/C=
=fr
issuer=/CN=un.mapped.com/OU=example/O=com/L=fr/ST=fr/C=
fr
```

Configure environment variables and system properties

Configure environment variables and system properties as follows:

- By adding environment variables on the command line when you start IG.
- By adding environment variables in `$HOME/.openig/bin/env.sh`, where `$HOME/.openig` is the instance directory. After changing `env.sh`, restart IG to load the new configuration.

Start IG with a customized router scan interval

By default, IG scans every 10 seconds for changes to the route configuration files. Any changes to the files are automatically loaded into the configuration without restarting IG. For more information about the router scan interval, refer to [Router](#).

The following example overwrites the default value of the Router scan interval to two seconds when you start up IG:

1. Linux
2. Windows

```
$ IG_ROUTER_SCAN_INTERVAL='2 seconds' /path/to/identity-gateway/bin/start.sh
```

```
C:\IG_ROUTER_SCAN_INTERVAL='2 seconds'  
C:\start.bat %appdata%\OpenIG
```

Define environment variables for startup, runtime, and stop

IG provides the following environment variables for Java runtime options:

IG_OPTS

(Optional) Java runtime options for IG and its startup process, such as JVM memory sizing options.

Include all options that are not shared with the `stop` script.

The following example specifies environment variables in the `env.sh` file to customize JVM options and keys:

1. Linux
2. Windows

```
# Specify JVM options  
JVM_OPTS="-Xms256m -Xmx2048m"  
  
# Specify the DH key size for stronger ephemeral DH keys, and  
# to protect against weak keys  
JSSE_OPTS="-Djdk.tls.ephemeralDHKeySize=2048"  
  
# Wrap them up into the IG_OPTS environment variable  
export IG_OPTS="${IG_OPTS} ${JVM_OPTS} ${JSSE_OPTS}"
```

```
C:\set "JVM_OPTS=-Xms256m -Xmx2048m"  
C:\set "JSSE_OPTS=-Djdk.tls.ephemeralDHKeySize=2048"  
C:\set "IG_OPTS=%IG_OPTS% %JVM_OPTS% %JSSE_OPTS%"
```

JAVA_OPTS

(Optional) Java runtime options for IG include all options that are shared by the start and stop script.

Add .jar files for IG extensions

IG includes a complete Java [application programming interface](#) for extending your deployment with customizations. For more information, refer to [Extend IG through the Java API](#)

Create a directory to hold .jar files for IG extensions:

1. Linux
2. Windows

```
$HOME/.openig/extra
```

```
%appdata%\OpenIG\extra
```

When IG starts up, the JVM loads .jar files in the extra directory.

Set up logs and configuration files

The following table summarizes the default location of the IG configuration and logs.

Purpose	Default location on Linux	Default location on Windows
Log messages from IG and third-party dependencies	\$HOME/.openig/logs	%appdata%\OpenIG\logs
Administration (admin.json) Gateway (config.json)	\$HOME/.openig/config	%appdata%\OpenIG\config
Routes (Route)	\$HOME/.openig/config/routes	%appdata%\OpenIG\config\routes
SAML 2.0	\$HOME/.openig/SAML	%appdata%\OpenIG\OpenIG\SAML
Groovy scripts for scripted filters and handlers, and other objects	\$HOME/.openig/scripts/groovy	%appdata%\OpenIG\scripts\groovy

Purpose	Default location on Linux	Default location on Windows
Temporary directory To change the directory, configure <code>temporaryDirectory</code> in admin.json	<code>\$HOME/.openig/tmp</code>	<code>%appdata%\OpenIG\OpenIG\tmp</code>
JSON schema for custom audit To change the directory, configure <code>topicsSchemasDirectory</code> in AuditService .	<code>\$HOME/.openig/audit-schemas</code>	<code>%appdata%\OpenIG\OpenIG\audit-schemas</code>

Secure the configuration and logs

For the `/logs`, `/tmp`, and all configuration directories, allow the following access:

- Highest privilege the IG system account.
- Least privilege for specific accounts, on a case-by-case basis
- No privilege for all other accounts, by default

Change the base location of the IG configuration

By default, the base location for IG configuration files is in the following directory:

1. Linux
2. Windows

```
$HOME/.openig
```

```
%appdata%\OpenIG
```

To change the location use an argument with the startup command. The following example reads the configuration from the `config` directory under `/path/to/config-dir`:

+

1. Linux

2. Windows

```
$ /path/to/identity-gateway/bin/start.sh /path/to/config-dir
```

```
C:\path\to\identity-gateway\bin\start.bat /path/to/config-dir
```

Configure IG For HTTPS (client-side)

When IG sends requests over HTTP to a proxied application, or requests services from a third-party application, IG is acting as a client of the application, and the application is acting as a server. IG is *client-side*.

When IG sends requests securely over HTTPS, IG must be able to trust the server. By default, IG uses the Java environment truststore to trust server certificates. The Java environment truststore includes public key signing certificates from many well-known Certificate Authorities (CAs).

When servers present certificates signed by trusted CAs, then IG can send requests over HTTPS to those servers, without any configuration to set up the HTTPS client connection. When server certificates are self-signed or signed by a CA whose certificate is not automatically trusted, the following objects can be required to configure the connection:

- [KeyStoreSecretStore](#), to manage a secret store for cryptographic keys and certificates, based on a standard Java keystore.
- [SecretsTrustManager](#), to manage trust material that verifies the credentials presented by a peer.
- (Optional) [SecretsKeyManager](#), to manage keys that authenticate a TLS connection to a peer.
- [ClientHandler](#) and [ReverseProxyHandler](#) reference to [ClientTlsOptions](#), for connecting to TLS-protected endpoints.

The following procedure describes how to set up IG for HTTPS (client-side), when server certificates are self-signed or signed by untrusted CAs.

Set up IG for HTTPS (client-side) for untrusted servers

1. Locate or set up the following directories:
 - Directory containing the sample application .jar: `sampleapp_install_dir`
 - Directory to store the sample application certificate and IG keystore:
`/path/to/secrets`
2. Extract the public certificate from the sample application:

```
$ cd /path/to/secrets
```

```
$ jar --verbose --extract \  
--file sampleapp_install_dir/IG-sample-application-  
2023.4.0-SNAPSHOT.jar tls/sampleapp-cert.pem  
  
inflated: tls/sampleapp-cert.pem
```

The file `/path/to/secrets/tls/sampleapp-cert.pem` is created.

- From the same directory, import the certificate into the IG keystore, and answer `yes` to trust the certificate:

```
$ keytool -importcert \  
-alias ig-sampleapp \  
-file tls/sampleapp-cert.pem \  
-keystore reverseproxy-truststore.p12 \  
-storetype pkcs12 \  
-storepass password  
  
...  
Trust this certificate? [no]: yes  
  
Certificate was added to keystore
```

NOTE

Because `keytool` converts all characters in its key aliases to lowercase, use only lowercase in alias definitions of a keystore.

- List the keys in the IG keystore to make sure that a key with the alias `ig-sampleapp` is present:

```
$ keytool -list \  
-v \  
-keystore /path/to/secrets/reverseproxy-truststore.p12 \  
-storetype pkcs12 \  
-storepass password  
  
Keystore type: PKCS12  
Keystore provider: SUN  
Your keystore contains 1 entry  
Alias name: ig-sampleapp  
...
```

5. In the terminal where you run IG, create an environment variable for the value of the keystore password:

```
$ export KEYSTORE_SECRET_ID='cGFzc3dvcmQ='
```

The password is retrieved by the SystemAndEnvSecretStore, and must be base64-encoded.

6. Add the following route to serve static resources, such as .css, for the sample application:

1. Linux
2. Windows

```
$HOME/.openig/config/routes/static-resources.json
```

```
%appdata%\OpenIG\config\routes\static-resources.json
```

```
{
  "name" : "sampleapp-resources",
  "baseURI" : "http://app.example.com:8081",
  "condition": "${find(request.uri.path, '^/css')}",
  "handler": "ReverseProxyHandler"
}
```

7. Add the following route to IG:

1. Linux
2. Windows

```
$HOME/.openig/config/routes/client-side-https.json
```

```
%appdata%\OpenIG\config\routes\client-side-https.json
```

```
{
  "name": "client-side-https",
  "condition": "${find(request.uri.path, '/home/client-side-https')}",
  "baseURI": "https://app.example.com:8444",
  "heap": [
    {
      "name": "Base64EncodedSecretStore-1",
```

```

"type": "Base64EncodedSecretStore",
"config": {
  "secrets": {
    "keystore.secret.id": "cGFzc3dvcmQ="
  }
},
{
  "name": "KeyStoreSecretStore-1",
  "type": "KeyStoreSecretStore",
  "config": {
    "file": "/path/to/secrets/reverseproxy-
truststore.p12",
    "storeType": "PKCS12",
    "storePasswordSecretId": "keystore.secret.id",
    "secretsProvider": "Base64EncodedSecretStore-1",
    "mappings": [
      {
        "secretId": "trust.manager.secret.id",
        "aliases": [ "ig-sampleapp" ]
      }
    ]
  }
},
{
  "name": "SecretsTrustManager-1",
  "type": "SecretsTrustManager",
  "config": {
    "verificationSecretId": "trust.manager.secret.id",
    "secretsProvider": "KeyStoreSecretStore-1"
  }
},
{
  "name": "ReverseProxyHandler-1",
  "type": "ReverseProxyHandler",
  "config": {
    "tls": {
      "type": "ClientTlsOptions",
      "config": {
        "trustManager": "SecretsTrustManager-1"
      }
    },
    "hostnameVerifier": "ALLOW_ALL"
  },
  "capture": "all"
}

```

```
    }  
  ],  
  "handler": "ReverseProxyHandler-1"  
}
```

Notice the following features of the route:

- The route matches requests to `/home/client-side-https`.
- The `baseURI` changes the request URI to point to the HTTPS port for the sample application.
- The `Base64EncodedSecretStore` provides the keystore password.
- The `SecretsTrustManager` uses a `KeyStoreSecretStore` to manage the trust material.
- The `KeyStoreSecretStore` points to the sample application certificate. The password to access the keystore is provided by the `SystemAndEnvSecretStore`.
- The `ReverseProxyHandler` uses the `SecretsTrustManager` for the connection to TLS-protected endpoints. All hostnames are allowed.

8. Test the setup:

- a. Start the sample application

```
$ java -jar sampleapp_install_dir/IG-sample-  
application-2023.4.0-SNAPSHOT.jar
```

- b. Go to <http://ig.example.com:8080/home/client-side-https>.

The request is proxied transparently to the sample application, on the TLS port 8444.

- c. Check the route log for a line like this:

```
GET https://app.example.com:8444/home/client-side-https
```

Encrypt and share JWT sessions

`JwtSession` objects store session information in JWT cookies on the user agent. The following sections describe how to set authenticated encryption for `JwtSession`, using symmetric keys.

Authenticated encryption encrypts data and then signs it with HMAC, in a single step. For more information, refer to [Authenticated Encryption](#). For information about `JwtSession`,

refer to [JwtSession](#).

Encrypt JWT sessions

This section describes how to set up a keystore with a symmetric key for authenticated encryption of a JWT session.

1. Set up a keystore to contain the encryption key, where the keystore and the key have the password `password`:

- a. Locate a directory for secrets, and go to it:

```
$ cd /path/to/secrets
```

- b. Generate the key:

```
$ keytool \  
-genseckey \  
-alias symmetric-key \  
-keystore jwtsessionkeystore.pkcs12 \  
-storepass password \  
-storetype pkcs12 \  
-keyalg HmacSHA512 \  
-keysize 512
```

NOTE

Because `keytool` converts all characters in its key aliases to lowercase, use only lowercase in alias definitions of a keystore.

2. Add the following route to IG:

1. Linux
2. Windows

```
$HOME/.openig/config/routes/jwt-session-encrypt.json
```

```
%appdata%\OpenIG\config\routes\jwt-session-encrypt.json
```

```
{  
  "name": "jwt-session-encrypt",  
  "heap": [{  
    "name": "KeyStoreSecretStore-1",
```

```

    "type": "KeyStoreSecretStore",
    "config": {
      "file":
"/path/to/secrets/jwtsessionkeystore.pkcs12",
      "storeType": "PKCS12",
      "storePasswordSecretId": "keystore.secret.id",
      "secretsProvider": ["SystemAndEnvSecretStore-1"],
      "mappings": [{
        "secretId": "jwtsession.symmetric.secret.id",
        "aliases": ["symmetric-key"]
      }]
    }
  },
  {
    "name": "SystemAndEnvSecretStore-1",
    "type": "SystemAndEnvSecretStore"
  }
],
"session": {
  "type": "JwtSession",
  "config": {
    "authenticatedEncryptionSecretId":
"jwtsession.symmetric.secret.id",
    "encryptionMethod": "A256CBC-HS512",
    "secretsProvider": ["KeyStoreSecretStore-1"],
    "cookie": {
      "name": "IG",
      "domain": ".example.com"
    }
  }
},
"handler": {
  "type": "StaticResponseHandler",
  "config": {
    "status": 200,
    "headers": {
      "Content-Type": [ "text/plain; charset=UTF-8" ]
    },
    "entity": "Hello world!"
  }
},
"condition": "${request.uri.path == '/jwt-session-
encrypt'}"
}

```

Notice the following features of the route:

- The route matches requests to `/jwt-session-encrypt`.
- The `KeyStoreSecretStore` uses the `SystemAndEnvSecretStore` in the heap to manage the store password.
- The `JwtSession` uses the `KeyStoreSecretStore` in the heap to manage the session encryption secret.

3. In the terminal where you will run the IG instance, create an environment variable for the value of the keystore password:

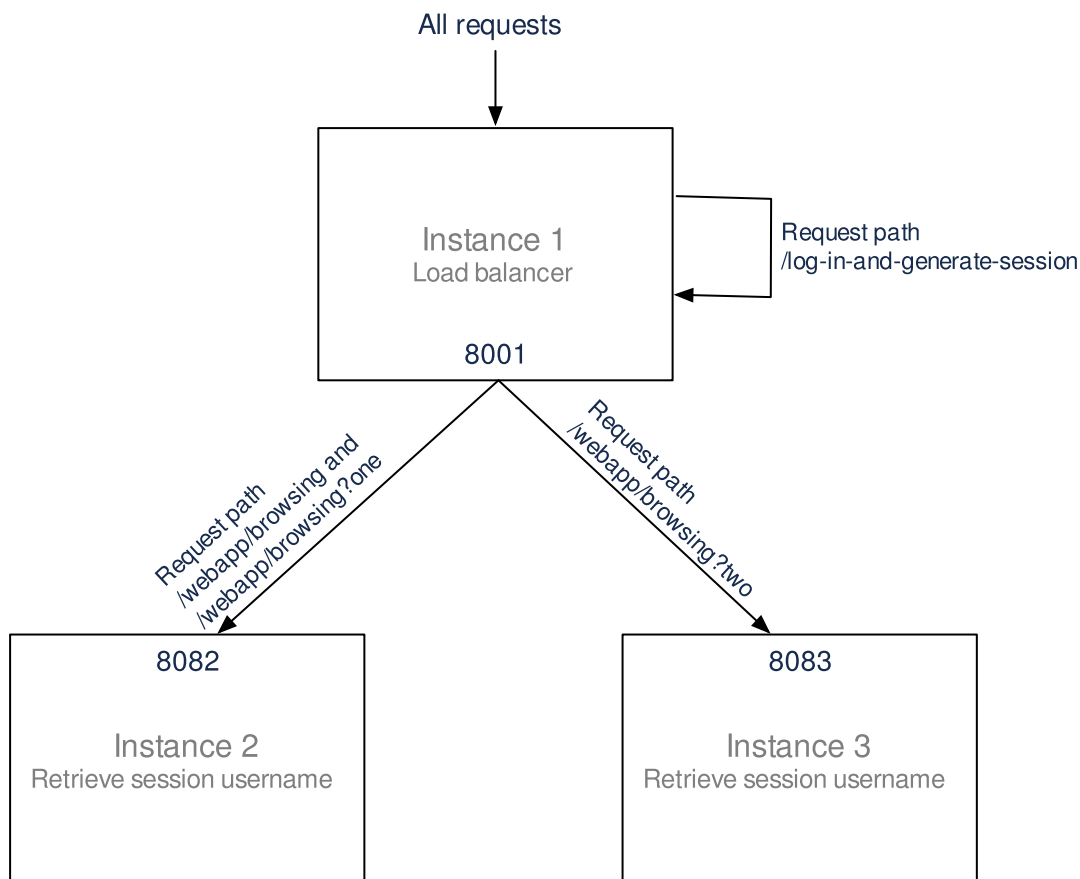
```
$ export KEYSTORE_SECRET_ID='cGFzc3dvcmQ='
```

The password is retrieved by the `SystemAndEnvSecretStore`, and must be base64-encoded.

Share JWT sessions between multiple instances of IG

When a session is shared between multiple instances of IG, the instances are able to share the session information for load balancing and failover.

This section gives an example of how to set up a deployment with three instances of IG that share a `JwtSession`.



1. Set up a keystore to contain the encryption key, where the keystore and the key have the password password :

a. Locate a directory for secrets, and go to it:

```
$ cd /path/to/secrets
```

b. Generate the key:

```
$ keytool \  
-genseckey \  
-alias symmetric-key \  
-keystore jwtsessionkeystore.pkcs12 \  
-storepass password \  
-storetype pkcs12 \  
-keyalg HmacSHA512 \  
-keysize 512
```

NOTE

Because keytool converts all characters in its key aliases to lowercase, use only lowercase in alias definitions of a keystore.

2. Prepare the IG installation:

a. Create an installation directory for IG in /path/to .

b. Download and unzip IG-2023.4.0.zip in /path/to , as described in [Download and start IG](#). The directory /path/to/identity-gateway is created.

3. Set up the first instance of IG, which acts as the load balancer:

a. Create a configuration directory for the instance and go to it:

```
$ mkdir -p /path/to/config-instance1/config/routes
```

b. Add the following route:

1. Linux
2. Windows

```
/path/to/config-instance1/config/routes/instance1-  
loadbalancer.json
```

```
%appdata%\path\to\config-  
instance1\config\routes\instance1-loadbalancer.json
```

```
{  
  "name": "instance1-loadbalancer",  
  "heap": [{  
    "name": "KeyStoreSecretStore-1",  
    "type": "KeyStoreSecretStore",  
    "config": {  
      "file":  
"/path/to/secrets/jwtsessionkeystore.pkcs12",  
      "storeType": "PKCS12",  
      "storePasswordSecretId": "keystore.secret.id",  
      "secretsProvider": ["SystemAndEnvSecretStore-1"],  
      "mappings": [{  
        "secretId": "jwtsession.symmetric.secret.id",  
        "aliases": ["symmetric-key"]  
      }]  
    }  
  },  
  {  
    "name": "SystemAndEnvSecretStore-1",  
    "type": "SystemAndEnvSecretStore"  
  }  
],  
  "session": {  
    "type": "JwtSession",  
    "config": {  
      "authenticatedEncryptionSecretId":  
"/jwtsession.symmetric.secret.id",  
      "encryptionMethod": "A256CBC-HS512",  
      "secretsProvider": ["KeyStoreSecretStore-1"],  
      "cookie": {  
        "name": "IG",  
        "domain": ".example.com"  
      }  
    }  
  },  
  "handler": {  
    "type": "DispatchHandler",  
    "config": {  
      "bindings": [{  
        "condition": "${find(request.uri.path,  
'/webapp/browsing')} and (contains(request.uri.query,
```

```

'one') or empty(request.uri.query))}",
    "baseURI": "http://ig.example.com:8002",
    "handler": "ReverseProxyHandler"
  }, {
    "condition": "${find(request.uri.path,
'/webapp/browsing') and contains(request.uri.query,
'two')}",
    "baseURI": "http://ig.example.com:8003",
    "handler": "ReverseProxyHandler"
  }, {
    "condition": "${find(request.uri.path, '/log-
in-and-generate-session')}",
    "handler": {
      "type": "Chain",
      "config": {
        "filters": [{
          "type": "AssignmentFilter",
          "config": {
            "onRequest": [{
              "target": "${session.authUsername}",
              "value": "Sam Carter"
            }]
          }
        }],
        "handler": {
          "type": "StaticResponseHandler",
          "config": {
            "status": 200,
            "headers": {
              "Content-Type": [ "text/html;
charset=UTF-8" ]
            },
            "entity": "<html><body>Sam Carter
logged IN. (JWT session generated)</body></html>"
          }
        }
      }
    }
  }
],
"capture": "all"
}

```

Notice the following features of the route:

- The route has no condition, so it matches all requests.
- When the request matches `/log-in-and-generate-session`, the `DispatchHandler` creates a JWT session, whose `authUsername` attribute contains the name `Sam Carter`.
- When the request matches `/webapp/browsing`, the `DispatchHandler` dispatches the request to instance 2 or instance 3, depending on the rest of the request path.

c. Add the following configuration:

1. Linux
2. Windows

```
/path/to/config-instance1/config/admin.json
```

```
%appdata%\path\to\config-instance1\config\admin.json
```

```
{  
  "connectors": [{  
    "port": 8001  
  }]  
}
```

d. In the terminal where you will run the IG instance, create an environment variable for the value of the keystore password:

```
$ export KEYSTORE_SECRET_ID='cGFzc3dvcmQ='
```

The password is retrieved by the `SystemAndEnvSecretStore`, and must be base64-encoded.

e. Start IG:

1. Linux
2. Windows

```
$ /path/to/identity-gateway/bin/start.sh  
/path/to/config-instance1/  
  
...  
... started in 1234ms on ports : [8001]
```

```
C:\path\to\identity-gateway\bin\start.bat
%appdata%\path\to\config-instance1
```

4. Set up and start the second instance of IG:

a. Create a configuration directory for the instance:

```
$ mkdir -p /path/to/config-instance2/config/routes
```

b. Add the following route:

1. Linux
2. Windows

```
/path/to/config-instance2/config/routes/instance2-
retrieve-session-username.json
```

```
%appdata%\path\to\config-
instance2\config\routes\instance2-retrieve-session-
username.json
```

```
{
  "name": "instance2-retrieve-session-username",
  "heap": [{
    "name": "KeyStoreSecretStore-1",
    "type": "KeyStoreSecretStore",
    "config": {
      "file":
"/path/to/secrets/jwtsessionkeystore.pkcs12",
      "storeType": "PKCS12",
      "storePasswordSecretId": "keystore.secret.id",
      "secretsProvider": ["SystemAndEnvSecretStore-1"],
      "mappings": [{
        "secretId": "jwtsession.symmetric.secret.id",
        "aliases": ["symmetric-key"]
      }]
    }
  }],
  {
    "name": "SystemAndEnvSecretStore-1",
    "type": "SystemAndEnvSecretStore"
  }
],
  "session": {
```

```

    "type": "JwtSession",
    "config": {
      "authenticatedEncryptionSecretId":
"jwtsession.symmetric.secret.id",
      "encryptionMethod": "A256CBC-HS512",
      "secretsProvider": ["KeyStoreSecretStore-1"],
      "cookie": {
        "name": "IG",
        "domain": ".example.com"
      }
    }
  },
  "handler": {
    "type": "StaticResponseHandler",
    "config": {
      "status": 200,
      "headers": {
        "Content-Type": [ "text/html; charset=UTF-8" ]
      },
      "entity": "<html><body>${session.authUsername!=
null?'Hello, '.concat(session.authUsername).concat('
!'):'Session.authUsername is not defined'}! (instance2)
</body></html>"
    }
  },
  "condition": "${find(request.uri.path,
'/webapp/browsing')}",
  "capture": "all"
}

```

Notice the following features of the route compared to the route for instance 1:

- The route matches the condition `/webapp/browsing`. When a request matches `/webapp/browsing`, the `DispatchHandler` dispatches it to instance 2.
- The `StaticResponseHandler` displays information from the session context.

c. Add the following configuration:

1. Linux
2. Windows

```
/path/to/config-instance2/config/admin.json
```

```
%appdata%\path\to\config-instance2\config\admin.json
```

```
{  
  "connectors": [{  
    "port": 8002  
  }]  
}
```

- d. In the terminal where you will run the IG instance, create an environment variable for the value of the keystore password:

```
$ export KEYSTORE_SECRET_ID='cGFzc3dvcmQ='
```

The password is retrieved by the SystemAndEnvSecretStore, and must be base64-encoded.

- e. Start IG:

1. Linux
2. Windows

```
$ /path/to/identity-gateway/bin/start.sh  
/path/to/config-instance2/  
  
...  
... started in 1234ms on ports : [8002]
```

```
C:\path\to\identity-gateway\bin\start.bat  
%appdata%\path\to\config-instance2
```

5. Set up and start the third instance of IG:

- a. Create a configuration directory:

```
$ mkdir -p /path/to/config-instance3/config/routes
```

- b. Add the following route:

1. Linux
2. Windows

```
/path/to/config-instance3/config/routes/instance3-  
retrieve-session-username.json
```

```
%appdata%\path\to\config-  
instance3\config\routes\instance3-retrieve-session-  
username.json
```

```
{  
  "name": "instance3-retrieve-session-username",  
  "heap": [{  
    "name": "KeyStoreSecretStore-1",  
    "type": "KeyStoreSecretStore",  
    "config": {  
      "file":  
"/path/to/secrets/jwtsessionkeystore.pkcs12",  
      "storeType": "PKCS12",  
      "storePasswordSecretId": "keystore.secret.id",  
      "secretsProvider": ["SystemAndEnvSecretStore-1"],  
      "mappings": [{  
        "secretId": "jwtsession.symmetric.secret.id",  
        "aliases": ["symmetric-key"]  
      }]  
    }  
  },  
  {  
    "name": "SystemAndEnvSecretStore-1",  
    "type": "SystemAndEnvSecretStore"  
  }  
],  
  "session": {  
    "type": "JwtSession",  
    "config": {  
      "authenticatedEncryptionSecretId":  
"/jwtsession.symmetric.secret.id",  
      "encryptionMethod": "A256CBC-HS512",  
      "secretsProvider": ["KeyStoreSecretStore-1"],  
      "cookie": {  
        "name": "IG",  
        "domain": ".example.com"  
      }  
    }  
  }  
},  
  "handler": {  
    "type": "StaticResponseHandler",  
    "config": {  
      "status": 200,  
      "headers": {
```



```

        "Content-Type": [ "text/html; charset=UTF-8" ]
    },
    "entity": "<html><body>${session.authUsername!=
null?'Hello, '.concat(session.authUsername).concat('
!'): 'Session.authUsername is not defined'}! (instance3)
</body></html>"
    }
},
"condition": "${find(request.uri.path,
'/webapp/browsing')}",
"capture": "all"
}

```

Notice that the route is the same as that for instance 2, apart from the text in the entity of the StaticResponseHandler.

c. Add the following configuration:

1. Linux
2. Windows

```
/path/to/config-instance3/config/admin.json
```

```
%appdata%\path\to\config-instance3\config\admin.json
```

```

{
  "connectors": [{
    "port": 8003
  }]
}

```

d. In the terminal where you will run the IG instance, create an environment variable for the value of the keystore password:

```
$ export KEYSTORE_SECRET_ID='cGFzc3dvcmQ='
```

The password is retrieved by the SystemAndEnvSecretStore, and must be base64-encoded.

e. Start IG:

1. Linux
2. Windows

```
$ /path/to/identity-gateway/bin/start.sh
/path/to/config-instance3/
```

```
...
... started in 1234ms on ports : [8003]
```

```
C:\path\to\identity-gateway\bin\start.bat
%appdata%\path/to/config-instance3
```

6. Test the setup:

- a. Access instance 1, to generate a session:

```
$ curl -v http://ig.example.com:8001/log-in-and-
generate-session

GET /log-in-and-generate-session HTTP/1.1
...

HTTP/1.1 200 OK
Content-Length: 84
Set-Cookie: IG=eyJ...HyI; Path=/; Domain=.example.com;
HttpOnly
...
Sam Carter logged IN. (JWT session generated)
```

- b. Using the JWT cookie returned in the previous step, access instance 2:

```
$ curl -v http://ig.example.com:8001/webapp/browsing?
one --header "cookie:IG=eyJ...HyI"

GET /webapp/browsing?one HTTP/1.1
...
cookie: IG=eyJ...HyI
...
HTTP/1.1 200 OK
...
Hello, Sam Carter !! (instance2)
```

Note that instance 2 can access the session info.

- c. Using the JWT cookie again, access instance 3:

```
$ curl -v http://ig.example.com:8001/webapp/browsing?
two --header "cookie:IG=eyJ...HyI"

GET /webapp/browsing?two HTTP/1.1
...
cookie: IG=eyJ...HyI
...
HTTP/1.1 200 OK
...
Hello, Sam Carter !! (instance3)
```

Note that instance 3 can access the session info.

Prepare for load balancing and failover

For a high scale or highly available deployment, you can prepare a pool of IG servers with nearly identical configurations, and then load balance requests across the pool, routing around any servers that become unavailable. Load balancing allows the service to handle more load.

Before you spread requests across multiple servers, however, you must determine what to do with state information that IG saves in the context, or retrieves locally from the IG server system. If information is retrieved locally, then consider setting up failover. If one server becomes unavailable, another server in the pool can take its place. The benefit of failover is that a server failure can be invisible to client applications.

IG saves state information in the following ways:

- By using a handler, such as a custom `ScriptableHandler`, that can store information in the context. Most handlers depend on information in the context, some of which is first stored by IG.
- By using filters, such as `AssignmentFilters`, `HeaderFilters`, `AuthorizationCodeOAuth2ClientFilters`, `OAuth2ResourceServerFilters`, `ScriptableFilters`, `SqlAttributesFilters`, and `StaticRequestFilters`, that can store information in the context. Most filters depend on information in the request, response, or context, some of which is first stored by IG.

IG retrieves information locally in the following ways:

- By using filters and handlers, such as `FileAttributesFilters`, `ScriptableFilters`, `ScriptableHandlers`, and `SqlAttributesFilters`, that depend on local system files or container configuration.

By default, the context data, including storage of the default session implementation, resides in memory. For information about whether to store session data on the user agent instead, refer to [JwtSession](#).

When using `JwtSession` with a cookie domain, share the encryption keys and the signature symmetric secret across all IG configurations so that any server can read or update JWT cookies from any other server in the same cookie domain.

If your data does not fit in an HTTP cookie, for example, because when encrypted it is larger than 4 KB, consider storing a reference in the cookie, and then retrieve the data by using another filter. IG logs warning messages if the `JwtSession` cookie is too large. Using a reference can also work when a server becomes unavailable, and the load balancer must fail requests over to another server in the pool.

If some data attached to a context must be stored on the server-side, then you have additional configuration steps to perform for session stickiness and for session replication. Session stickiness means that the load balancer sends all requests from the same client session to the same server. Session stickiness helps to ensure that a client request goes to the server holding the original session data. Session replication involves writing session data either to other servers or to a data store, so that if one server goes down, other servers can read the session data and continue processing. Session replication helps when one server fails, allowing another server to take its place without having to start the session over again. If you set up session stickiness but not session replication, when a server crashes, the client session information for that server is lost, and the client must start again with a new session.

Secure connections

IG is often deployed to replay credentials or other security information. In a real world deployment, that information must be communicated over a secure connection using HTTPS, meaning in effect HTTP over encrypted Transport Layer Security (TLS). Never send real credentials, bearer tokens, or other security information unprotected over HTTP.

When IG is acting as a server, the TLS connection is configured in `admin.json`.

When IG is acting as a client, the TLS connection is configured in the `ReverseProxyHandler`. For information, refer to [Configure IG For HTTPS \(client-side\)](#) and [ReverseProxyHandler](#).

TLS depends on the use of digital certificates (public keys). In typical use of TLS, the client authenticates the server by its X.509 digital certificate as the first step to establishing communication. Once trust is established, then the client and server can set up a symmetric key to encrypt communications.

In order for the client to trust the server certificate, the client needs first to trust the certificate of the party who signed the server's certificate. This means that either the client

has a trusted copy of the signer's certificate, or the client has a trusted copy of the certificate of the party who signed the signer's certificate.

Certificate Authorities (CAs) are trusted signers with well-known certificates. Browsers generally ship with many well-known CA certificates. Java distributions also ship with many well-known CA certificates. Getting a certificate signed by a well-known CA is often expensive.

It is also possible for you to self-sign certificates. The trade-off is that although there is no monetary expense, the certificate is not trusted by any clients until they have a copy. Whereas it is often enough to install a certificate signed by a well-known CA in the server keystore as the basis of trust for HTTPS connections, self-signed certificates must also be installed in all clients.

Like self-signed certificates, the signing certificates of less well-known CAs are also unlikely to be found in the default truststore. You might therefore need to install those signing certificates on the client-side as well.

This guide describes how to install self-signed certificates, that are suitable for trying out the software, or for deployments where you manage all clients that access IG. For information about how to use well-known CA-signed certificates, refer to the documentation for the Java Virtual Machine (JVM).

After certificates are properly installed to allow client-server trust, consider the cipher suites configured for use. The cipher suite determines the security settings for the communication. Initial TLS negotiations bring the client and server to agreement on which cipher suite to use. Basically the client and server share their preferred cipher suites to compare and to choose. If you therefore have a preference concerning the cipher suites to use, you must set up your deployment to use only your preferred cipher suites. IG inherits the list of cipher suites from the underlying Java environment.

The Java Secure Socket Extension (JSSE), part of the Java environment, provides security services that IG uses to secure connections. You can set security and system properties to configure the JSSE. For a list of properties you can use to customize the JSSE in Oracle Java, refer to the *Customization* section of the [JSSE Reference guide](#)[↗].