Getting Started
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Preface

About This Manual

This guide provides information about getting started with Ping Identity’s PingFederate to deploy a secure cloud-identity platform, including single sign-on (SSO) based on the latest security and e-business standards.

Overview

This document consists of:

- **Chapter 1 “Introduction”** — A high-level view of federated identity, secure Web SSO, and PingFederate features.

- **Chapter 2, “Installation”** — How to install PingFederate and run the administrative console for the first time.

- **Chapter 3 “Console Navigation”** — A primer on using the administrative console and configuration screens.

- **Chapter 4, “Supported Standards”** — An overview of industry standards that PingFederate supports, including the Security Assertion Markup Language (SAML) and WS-Federation.

- **Appendix A “Using the Thales nShield Connect HSM”** — How to install and configure PingFederate with the Thales nShield Connect Hardware Security Module as part of compliance with the Federal Information Processing Standard (FIPS) 140-2.

Preface

Intended Audience

This manual is intended for security and network administrators and other IT professionals responsible for identity management among business entities, both internal and external.

Text Conventions

This document uses the text conventions identified below.

<table>
<thead>
<tr>
<th>Convention</th>
<th>Description</th>
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<tbody>
<tr>
<td>Fixed Width</td>
<td>Indicates text that must be typed exactly as shown in the instructions. Also used to represent program code, file names, and directory paths.</td>
</tr>
<tr>
<td>Blue text</td>
<td>Indicates hypertext links.</td>
</tr>
<tr>
<td>Italic</td>
<td>Used for emphasis and document titles.</td>
</tr>
<tr>
<td>▶ [text]</td>
<td>Used for procedures where only one step is required.</td>
</tr>
<tr>
<td>Sans serif</td>
<td>Identifies descriptive text on a user-interface screen. Example: “Print Document dialog”</td>
</tr>
<tr>
<td>Sans serif bold</td>
<td>Identifies menu items, navigational links, or buttons. For example: Click Save.</td>
</tr>
</tbody>
</table>

Other Documentation

The documents listed below are available under Product Documentation at pingidentity.com.

Tip: PingFederate provides context-sensitive Help. Click Help in the upper-right portion of the administrative console for immediate, relevant guidance and links to related information.

Administrator’s Manual – Provides key concepts as well as detailed instructions for using the PingFederate administrative console—also connection-endpoint and other Web-application developer information, a glossary, and a list of common acronyms.

Quick-Start Guide – Provides instructions for deploying a preconfigured PingFederate server to run with demonstration Web applications. Newcomers to PingFederate may wish to follow this Guide as a first step to establishing a simple SSO identity federation between two Web applications and to become familiar with PingFederate. The Guide is contained in a separate quick-start package available for download on the Ping Identity Web site.
Integration Overview – A high-level description of options available for integrating identity-management systems and applications with PingFederate.

Server Clustering Guide – Describes how to deploy PingFederate in a cluster to increase throughput and availability.

SDK Developer’s Guide – Provides technical guidance for using the Java Software Developer Kit for PingFederate.

Web Resources – Ping Identity continually updates its Resource Center (www.pingidentity.com/resource-center) with general and technical information in the form of white papers, demonstrations, webinars, and other resources.

Note: If you encounter any difficulties with configuration or deployment, please look for help at the Ping Identity Support Center (www.pingidentity.com/support).

PingFederate documents may include hypertext links to third-party Web sites that provide installation instructions, file downloads, and reference documentation. These links were tested prior to publication, but they may not remain current throughout the life of these documents. Please contact Ping Identity Support (www.pingidentity.com/support) if you encounter a problem.

About Identity Federation and SSO

Federated identity management (or “identity federation”) enables enterprises to exchange identity information securely across domains, providing browser-based SSO. Federation is also used to integrate access to applications across distinct business units within a single organization. As organizations grow through acquisitions, or when business units maintain separate user repositories and authentication mechanisms across applications, a federated solution to browser-based SSO is desirable.

This cross-domain, identity-management solution provides numerous benefits, ranging from increased end-user satisfaction and enhanced customer relations to reduced cost and greater security and accountability.

For complete information about identity federation and the standards that support it, see “Supported Standards” on page 31.

Service Providers and Identity Providers

Identity federation standards identify two operational roles in an SSO transaction: the identity provider (IdP) and the service provider (SP). An IdP, for example, might be an enterprise that manages accounts for a large number of users who may need secure access to the Web-based applications or services of
customers, suppliers, and business partners. An SP might be a SaaS provider or a business-process outsourcing (BPO) vendor wanting to simplify client access to its services.

Identity federation allows both types of organizations to define a trust relationship whereby the SP provides access to users from the IdP. The IdP continues to manage its users, and the SP trusts the IdP to authenticate them.

PingFederate provides complete support for both roles. Note that business processes of a single organization might encompass both SP and IdP use cases; this scenario can be handled by a single instance of PingFederate.

**Security Token Service**

The PingFederate WS-Trust Security Token Service (STS) allows organizations to extend SSO identity management to Web Services. (For information about WS-Trust and the role of an STS, see “Web Services Standards” on page 57.)

The STS shares the core functionality of PingFederate, including console administration, identity and attribute mapping, and certificate security management. With PingFederate, Web Services can securely identify the end user who has initiated a transaction across domains, providing enhanced service while simultaneously ensuring appropriate information access and regulatory accountability.

PingFederate can be used in many different scenarios to address different identity and security problems as they relate to Web Services, service-oriented architecture (SOA), and Enterprise Service Buses. All of these scenarios share a recommended architectural approach that uses a SAML assertion as the standard security token shared between security domains. (For more information, see “About WS-Trust STS” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.)
PingFederate can act as an OAuth Authorization Server (OAuth AS), allowing a resource owner to grant authorization to a client requesting access to resources protected by a Resource Server. The OAuth AS issues tokens to clients on behalf of a resource for use in authenticating a subsequent API call—typically, but not exclusively a Representational State Transfer (REST) API. The PingFederate OAuth AS issues tokens to clients in several different scenarios, including:

- A web application wants access to a protected resource associated with a user and needs the user’s consent.
- A native application client on a mobile device or tablet wants to connect to a user’s online account and needs the user’s consent.
- An enterprise application client wants to access a protected resource hosted by a business partner, customer, or SaaS provider.

(For information about OAuth and the role of an AS, see “OAuth 2.0” on page 60.)

The PingFederate OAuth AS can be configured independently or in conjunction with STS and browser-based SSO for either an IdP or an SP deployment. For more information, see “About OAuth” in the “Key Concepts” chapter of the PingFederate Administrator's Manual.

>Note: OAuth AS capabilities may require additional licenses. For more information, please contact sales@pingidentity.com.

User Account Management

In an identity federation, accounts are maintained for users at the IdP site. However, an SP will often have its own set of user accounts, some of which may correspond to IdP users. The SP may also need to establish and maintain parallel
accounts for remote SSO users to enforce authorization policy, customize user experience, comply with regulations, or a combination of such purposes.

To facilitate cross-domain account management, PingFederate provides two kinds of user provisioning for browser-based SSO, one designed for an IdP and one for an SP:

- At an IdP site, an administrator can automatically provision and maintain user accounts for partner SPs who have implemented the System for Cross-domain Identity Management (SCIM) or, when optional plug-in SaaS Connectors are used, for selected hosted-software providers.
- At an SP site, an administrator can provision accounts within the organization automatically from SCIM-enable IdPs or use information from SAML assertions received during SSO events.

For more information, see “User Provisioning” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.

Enterprise Deployment Architecture

With PingFederate’s enterprise-deployment architecture, all protocol definitions, public key infrastructure (PKI) keys, policies, profiles, etc., are managed in a single location, eliminating the need to maintain redundant copies of these configurations and trust relationships. Furthermore, when new protocols, profiles, or use cases need to be added, you only have to configure them once to make them available to your entire organization.

PingFederate also improves security by creating a single “doorway” in your perimeter through which all identity information must travel. Using PingFederate, all of your internal users who sign on to external applications exit through this doorway, while all external users who sign on to your internal systems enter through the same doorway.

The single-doorway approach also provides 100 percent visibility to all federation activities. The extensive auditing and logging capabilities of PingFederate enable you to satisfy all of your logging-related compliance and service-level requirements from a single location, as opposed to having to acquire and consolidate disparate logs from throughout your organization.

Use Case Configuration

By providing a single configuration paradigm supporting different protocols, PingFederate reduces complexity and learning curves. Furthermore, the step-by-step administrative console minimizes the potential for errors by guiding administrators through configuration steps applicable only to the business use cases they need to support.

Tip: For IdPs, connection templates that automatically configure many steps in the administrative console are available for several use cases, including setting up SSO connections to selected SaaS vendors. (For more information, see “Outbound Provisioning for IdPs” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.)
PingFederate’s lightweight, stand-alone architecture means you can receive the benefits of standards-based SSO and API security integration without the cost and complexity of deploying a complete identity management (IdM) system. The PingFederate server integrates and coexists with existing home-grown and commercial IdM systems and applications, using these key features available separately from Ping Identity:

- **Integration Kits** – These tailored kits simplify integration with existing applications while minimizing impacts on existing infrastructure.
- **Token Translators** – These specialized plug-ins connect the STS with Web Service Providers and Clients to enable access to identity-enabled Web Services, which may require a range of different token types.
- **SaaS Connectors** – These plug-ins provide quick-connection templates and automated user provisioning and deprovisioning for selected SaaS providers, including Salesforce and Google Apps.
- **Cloud Identity Connectors** – These plug-ins allow cloud identity providers such as Facebook, Yahoo!, Google and Salesforce to authenticate and connect users to SSO-enabled applications.

### Integration Kits

PingFederate provides a suite of integration kits to complete the first- and last-mile integration with your existing IdM systems and Web applications. PingFederate integration kits are available for download from the Ping Identity Web site, take only minutes to install, and are configured from within the PingFederate administrative console.

Integration kits enable rapid session integration with both existing authentication services and target applications. In addition, PingFederate includes a Software Development Kit for creating custom integrations.

For more information, see “SSO Integration Kits and Adapters” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.
Chapter 1

Introduction

Token Translators

Ping Identity offers special Token Processors (for an IdP) and Token Generators (for an SP) to enable the WS-Trust STS to validate and issue a variety of token types. These plug-ins, which supplement built-in SAML token processing and generation, are designed to handle local identity tokens required in a variety of security contexts.

For more information, see “Token Processors and Generators” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.

SaaS Connectors

SaaS Connectors offer a streamlined approach for browser-based SSO to selected SaaS providers—including automatic user provisioning and deprovisioning (see “Outbound Provisioning for IdPs” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual). The Connector packages (available separately) include quick-connection templates, which automatically configure endpoints and other connection information for each provider.

Cloud Identity Connectors

Ping Identity offers social identity integration with social networking sites. The OpenID cloud-identity connector leverages OpenID 2.0 social networking providers (including Google and Yahoo!) for registration and access to cloud-based applications. Connectors for Twitter, LinkedIn, Windows Live, and Facebook leverage user logins for registration and access to cloud-based applications.

About PingOne

PingOne is Ping Identity’s multi-tenant, identity-as-a-service solution. PingOne enables browser-based SSO and user provisioning for Identity Providers, and provides application providers with a rapid-deployment SSO capability. PingOne can be used together with PingFederate to provide a powerful solution coupling the benefits of an on-premise deployment with the flexibility of a cloud solution. For more information on PingOne, please visit http://www.pingone.com.

Services and Support

With years of experience, hundreds of implementations and a 99% satisfaction rating from our customers, PingEnable delivers a customized and comprehensive suite of services, including an interactive support center, client services and both online and classroom training.

Ping Identity is dedicated to helping customers achieve quick, cost-effective and secure cloud-identity management. For more information on PingEnable services, please visit https://www.pingidentity.com/products/pingenable.
Chapter 2

Installation

PingFederate is packaged as a stand-alone server based on J2EE application server technology.

This chapter covers:

- “System Requirements” on page 12
- “Installing the JDK” on page 15
- “Installing PingFederate” on page 16
- “Running PingFederate for the First Time” on page 17
- “Deployment Options” on page 18
- “Running PingFederate as a Service” on page 21
- “Uninstalling PingFederate” on page 24
System Requirements

PingFederate is supported for deployment and configuration with the minimum system specifications defined in the following sections.

Operating Systems

Note: PingFederate has been tested with default configurations of operating-system components. If your organization has customized implementations or has installed third-party plug-ins, deployment of the PingFederate server may be affected.

Windows
- Microsoft Windows Server 2008 R2 with Service Pack 1
- Microsoft Windows Server 2012 Standard
- Microsoft Windows Server 2012 R2 Standard

Linux/Unix
- Red Hat Enterprise Linux ES 5.10 and 6.5
- SUSE Linux Enterprise 11 with Service Pack 3
- Solaris 10
- Oracle Enterprise Linux 6.5 (Red Hat Compatible Kernel)

Virtual Systems

Although Ping Identity does not qualify or recommend any specific virtual-machine (VM) products, PingFederate has been shown to run well on several, including VMWare, Xen, and Windows Hyper-V.

Note: This list of products is provided for example purposes only—we view all products in this category equally. Ping Identity accepts no responsibility for the performance of any specific virtualization software and in no way guarantees the performance and/or interoperability of any VM software with its products.

Minimum Hardware Requirements

- Intel Pentium 4, 1.8 GHz processor
- 1 GB of RAM
- 250 MB of available hard drive space

Minimum Hardware Recommendations

- Multi-core Intel Xeon processor or higher (Windows/Linux)
  - 4 CPU/Cores recommended
- Multi-core SPARC processor (Solaris)
  - 4 CPU/Cores recommended
System Requirements

- 4 GB of RAM
  - 1.5 GB available to PingFederate
- 500 MB of available hard drive space

Supported Browsers

For the PingFederate administrative console:
- Chrome
- Firefox
- Internet Explorer (version 9 and higher)

For end-user:
- Chrome
- Firefox
- Internet Explorer (version 9 and higher)
- Safari

Data Store Integration

Note: The following lists include data stores tested against specific PingFederate use cases. However, comparable data stores for each feature may potentially include any LDAP v3-compliant directory service or JDBC-compatible database.

For user-attribute lookup:
- Active Directory (2008 R2 and 2012)
- Oracle Directory Server Enterprise Edition 11g
- Oracle (10g, and 11g R2)
- MySQL 5.6

For Outbound Provisioning:
- Provisioning Channel Data Source
  - Active Directory (2008 R2 and 2012)
  - Oracle Directory Server Enterprise Edition 11g
- Provisioning Internal Data Store
  - Oracle 11g R2
  - MS SQL Server (2008 and 2012)
  - MySQL 5.6
For Inbound Provisioning:
- Active Directory (2008 R2 and 2012)

For Just-in-Time Provisioning (external target database):
- MS SQL Server (2008 and 2012)

**Note:** For information about types of provisioning, see “User Provisioning” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual

For OAuth Persistent Grants & Client Configuration:
- Oracle 11g R2
- MS SQL Server (2008 and 2012)
- MySQL 5.6

**Java Environment**

The PingFederate server requires installation of either the Java SE Development Kit (JDK) 7 (64-bit) update 60 (or higher) or JDK 8 (64-bit) update 5 (or higher). For more information, see “Installing the JDK” on page 15.

**Hardware Security Module (Optional)**

- Luna SA version 5.3 (or higher)
  - Client Driver Version: 5.3 (or higher)
  - For information see “Using the SafeNet Luna HSM” on page 69.
- Thales nShield Connect version 2.51.10 (or higher)
  - Client Driver Version: 11.70
  - For information see “Using the Thales nShield Connect HSM” on page 65.
Installing the JDK

The 64-bit version of JDK 7 (update 60 or higher) or JDK 8 (update 5 or higher) provides the supported environment for PingFederate.

**Important:** You must install the JDK before running PingFederate.

**Tip:** Due to import control restrictions, the standard JDK distribution supports strong but not unlimited encryption. Stronger encryption is optional in several PingFederate and plug-in configurations. To use the strongest encryption, when permissible, after installing the JDK, download and install the appropriate version of “Java Cryptography Extension (JCE) Unlimited Strength Jurisdiction Policy Files” from the Oracle download Web site (www.oracle.com/technetwork/java/javase/downloads/index.html).

For an example configuration where stronger encryption may be desirable, see “Selecting an Encryption Certificate (SAML)” in the “Identity Provider SSO Configuration” chapter of the PingFederate Administrator’s Manual.

**To install the JDK for Windows and Linux:**

1. Download and install the JDK from: www.oracle.com/technetwork/java/javase/downloads.

2. Set the `JAVA_HOME` environment variable to the JDK installation directory path and add the `/bin` directory to the `PATH` variable for your platform. Set the variables at either the system or user level.

**Note:** If you are running PingFederate as a service, you must set `JAVA_HOME` at the system level.
Chapter 2
Installation

Installing PingFederate

You install PingFederate by extracting the distribution ZIP file.

Note: If your site requires compliance with FIPS 140-2, see either “Using the Thales nShield Connect HSM” on page 65 or “Using the SafeNet Luna HSM” on page 69 for additional installation information.

Important: On Unix or Linux you must install and run PingFederate under a local user account.

To install PingFederate:

1. Ensure you are logged on to your system with appropriate privileges to install and run an application.
2. Verify that the JDK is installed and that environment and PATH variables are set correctly (see “Installing the JDK” on page 15).
3. Extract the distribution ZIP file into an installation directory.

Note: To avoid future problems with automated upgrades, do not rename the installed pingfederate subdirectory. If you are installing multiple instances of PingFederate on the same machine (for example, in certain server-clustering scenarios), either install each instance in a different location or rename the higher level directory (pingfederate-6.x.x) to install a parallel file structure in the same location.

4. Request a license key via the Ping Identity licensing Web page (www.pingidentity.com/support-and-downloads/licensing.cfm).
5. Save the license key file in the directory:
   <pf_install>/pingfederate/server/default/conf
   Ensure the file is named:
   pingfederate.lic

Tip: Alternatively, you can start PingFederate and import and validate the license prior to logging on (see “Running PingFederate for the First Time” on page 17).

Note: If you are deploying PingFederate in a cluster configuration, install the license key only on the administrative-console server—the license is retrieved by other servers automatically. (For more information about clustering, see the PingFederate Server Clustering Guide.)
Running PingFederate for the First Time

The first time you run the PingFederate administrative console, if you have not already installed a license from Ping Identity, you are asked to import it. After a license is installed, log on with the default username and password supplied with the distribution.

Tip: Later, depending on your network configuration and requirements, you can set up alternative means of console authentication (see "Alternative Console Authentication" in the "System Administration" chapter of the PingFederate Administrator’s Manual).

After launching the administrative console and logging on, you must change the default password. After that, “welcome” screens guide you through an initial setup process.

When the initial installation process is complete, the Main Menu opens (see “Using the Main Menu” on page 25).

Note: You can change the installation setup via menu choices under My Server on the Main Menu (see “Managing Server Settings” in the “System Settings” chapter of the PingFederate Administrator’s Manual).

To run PingFederate for the first time:

1. Start the PingFederate server by running the following script:
   (Windows) \pf_install\pingfederate\bin\run.bat
   (Unix/Linux) \pf_install\pingfederate\bin\run.sh
   Wait for the script to finish the startup—the server is deployed when this message appears near the end of the sequence:
   PingFederate started in xx:yy

2. If you have not yet installed a PingFederate license, on the Import License screen locate and import the license file needed for this instance of PingFederate.
   The license is validated and the file renamed correctly (if necessary) during the process. (For more information, see “Installing a New License Key” in the “System Administration” chapter of the PingFederate Administrator’s Manual.)

3. Launch your browser and go to:
   https://<DNS_NAME>:9999/pingfederate/app
   where <DNS_NAME> is the fully qualified name of the machine running the PingFederate server.

Note: The port number 9999 is set by default. For information on changing this setting, see “Changing Configuration Parameters” in the “System Administration” chapter of the PingFederate Administrator’s Manual.
4. Enter Username and Password.
   Username: Administrator
   Password: 2Federate

5. Change your password on the Change Password screen and click **Save**.

   **Note:** The new password must be at least six characters and contain at least one uppercase, one lowercase, and one numeric character.

   **Important:** Take steps to ensure that you do not forget the new password. For more information about passwords and user management, see “Account Management” in the “System Administration” chapter of the PingFederate Administrator’s Manual.

6. Complete the steps in the Configuring My Server screens.
   For more information, refer to the context-sensitive **Help** pages or see sections under “Managing Server Settings” in the “System Settings” chapter of the PingFederate Administrator’s Manual.

**Deployment Options**

There are many options for deploying PingFederate in your network environment, depending on your needs and infrastructure capabilities.

For example, you can choose a stand-alone or proxy configuration, as described in this section. Or you can deploy multiple PingFederate servers in a cluster configuration for high availability, server redundancy, and failover recovery (see the PingFederate Server Clustering Guide).

Figure 4 illustrates PingFederate installed in the DMZ:
In this configuration, users access PingFederate via a Web application server (and/or an Enterprise Identity Management system). PingFederate may, in turn, retrieve information from a data store to use in processing the transaction.

**Figure 4:** Stand-alone Deployment Example
You can also deploy PingFederate with a proxy server. Figure 5 depicts a proxy-server configuration in which the proxy is accessed by users and Web browsers. The proxy, in turn, communicates with PingFederate to request SSO.

Figure 5: Proxy Deployment Example
Running PingFederate as a Service

You can set up PingFederate to run in the background as a service on either Windows or Linux.

**Note:** Before performing this procedure, ensure that PingFederate runs normally by manually starting the server (see “Running PingFederate for the First Time” on page 17).

**Important:** For Linux, when you start the server manually, you must run the startup script under the same user account that the service will use (see the procedure under “(Linux)” on page 22).

**(Windows)**

This installation enables PingFederate to start automatically when Windows is started or rebooted.

**Note:** If you are upgrading to a 64-bit service, you must first uninstall the previous PingFederate service (see “Uninstalling Services” on page 24).

**To run PingFederate as a Windows service:**

1. Complete the steps under “Installing PingFederate” on page 16.

   **Note:** Ensure JAVA_HOME and PATH are set as system variables (see “Installing the JDK” on page 15).

2. Ensure you are logged on with full Administrator privileges.
3. Start PowerShell or Command Prompt as an Administrator.
4. In PowerShell or Command Prompt, run the install-service.bat file to install the service on one of the following platforms:
   
   On a 64-bit Windows x86 platform, run install-service.bat from the directory:
   
   `<pf_install>\pingfederate\sbin\win-x86-64`
   
   Or:
   
   On a 64-bit Windows Itanium platform, run install-service.bat from the directory:
   
   `<pf_install>\pingfederate\sbin\win-itanium-64`

6. Right-click PingFederate Service from the list of available services and select Start.

   The service starts immediately and will restart automatically on reboot. (You can change the default Start type setting in the Properties dialog.)
To run PingFederate as a service on Linux, you must place a script in the system initialization directory.

Note: If you are not using RedHat, you may need to modify references to the system initialization directory in this procedure—for example, Debian uses /etc/init.d/ instead of /etc/rc.d/init.d/.

To run PingFederate as a Linux service (RedHat):
1. Complete the steps under “Installing PingFederate” on page 16.
2. Log on as root.
3. Create a new user account for the service.
   For this procedure, the variable <pf_user> is used to refer to this account.

   Note: Ensure the environment variable JAVA_HOME is set and the PATH variable updated for <pf_user> (see “Installing the JDK” on page 15).

4. Change the PingFederate installation directory (<pf_install>) ownership and ensure its read/write property:
   ```
   chown -R <pf_user> <pf_install>
   chmod -R 775 <pf_install>
   ```

5. Place the code below into a file called <pf_user> in the directory:
   ```
   /etc/rc.d/init.d/
   ```

   Note: Replace instances of <pf_user> and <pf_install> in the script below, and in the commands that follow, with their respective values.

   ```
   #! /bin/sh
   
   start(){
     echo "starting PingFederate.."
     su - <pf_user> \
     -c '"<pf_install>/pingfederate/sbin/pingfederate-run.sh \\
       > /dev/null 2> /dev/null' 
   }
   
   stop(){
     echo "stopping PingFederate.."
     su - <pf_user> \
     -c '"<pf_install>/pingfederate/sbin/pingfederate-shutdown.sh' 
   }
   ```
restart(){
    stop
    # padding time to stop before restart
    sleep 60
    # To protect against any services that are not stopped,
    # uncomment the following command.
    # (Warning: this kills all Java instances running as
    # <pf_user>.)
    #   su - <pf_user> -c 'killall java'
    start
}

case *$1* in
    start)
        start
        ;;
    stop)
        stop
        ;;
    restart)
        restart
        ;;
    *)
        echo "Usage: <pf_user> {start|stop|restart}"
        exit 1
esac
exit 0

6. Create symbolic links using commands listed below.
The links specify the order in which the PingFederate Server starts and stops.
ln -s /etc/rc.d/init.d/<pf_user> /etc/rc3.d/S84<pf_user>
ln -s /etc/rc.d/init.d/<pf_user> /etc/rc5.d/S84<pf_user>
ln -s /etc/rc.d/init.d/<pf_user> /etc/rc4.d/S84<pf_user>
ln -s /etc/rc.d/init.d/<pf_user> /etc/rc6.d/K15<pf_user>
ln -s /etc/rc.d/init.d/<pf_user> /etc/rc0.d/K15<pf_user>
ln -s /etc/rc.d/init.d/<pf_user> /etc/rc1.d/K15<pf_user>
ln -s /etc/rc.d/init.d/<pf_user> /etc/rc2.d/K15<pf_user>

7. Make the script executable (as root):
chmod 755 /etc/rc.d/init.d/<pf_user>

8. Test the script by entering:
service <pf_user> start
   and then:
   service <pf_user> stop

9. To start the service, enter:
service <pf_user> start
Uninstalling PingFederate

To uninstall PingFederate (on Windows or Linux):

1. If PingFederate is installed as a service, follow the platform-specific procedure in the next section, “Uninstalling Services”.
2. Delete the PingFederate installation directory.

Uninstalling Services

(Windows)

To uninstall PingFederate as a Windows Service:

1. Access the Windows Control Panel > Administrative Tools and double-click Services.
2. Right-click PingFederate or PingFederate Service from the list of available services and select Properties.
3. Click Stop under the General tab in the Properties dialog window.
4. Run uninstall-service.bat from the <pf_install>\pingfederate\sbin subdirectory that corresponds to your platform processor.

(Linux)

To uninstall PingFederate as a Linux Service:

1. Log on as root.
2. Stop the service with the command:
   
   service <pf_user> stop
   
   where <pf_user> is the PingFederate service user account (see “Running PingFederate as a Service” on page 21).
3. Remove symbolic links:
   
   rm /etc/rc3.d/S84<pf_user>
   rm /etc/rc4.d/S84<pf_user>
   rm /etc/rc5.d/S84<pf_user>
   rm /etc/rc0.d/K15<pf_user>
   rm /etc/rc1.d/K15<pf_user>
   rm /etc/rc2.d/K15<pf_user>
   rm /etc/rc6.d/K15<pf_user>

4. (Optional) Delete the script used to start and stop the service (see “Running PingFederate as a Service” on page 21).
The PingFederate administrator's user interface, the *administrative console*, is built around a system of wizard-like control screens, which are accessed from a top-level portal, the Main Menu.

This chapter covers:

- “Using the Main Menu” on page 25
- “Navigating the Administrative Console” on page 28

**Note:** This information is presented from the viewpoint of an administrative user with full permissions to configure local server settings and partner connections (see “Account Management” in the “System Administration” chapter of the PingFederate *Administrator’s Manual*).

## Using the Main Menu

When you log on to PingFederate, you reach the Main Menu, from which you can modify your local server settings or access configuration screens to set up or modify connections with partners (see Figure 6 on page 26).
Chapter 3
Console Navigation

Figure 6: Main Menu (Example)

Note that Main Menu selections depend on your federation role (IdP, SP, or both) and which protocol(s) you are using (see “Choosing Roles and Protocols” in the “System Settings” chapter of the PingFederate Administrator’s Manual). Selections also depend on your system permissions (see “Account Management” in the “System Administration” chapter of the PingFederate Administrator’s Manual).

Depending on your permissions, you can use the Main Menu to:

- Modify or add to system settings after installation—see the “System Settings” chapter in the PingFederate Administrator’s Manual
- Handle system administration functions—see the “System Administration” chapter in the PingFederate Administrator’s Manual
- Configure settings for using PingFederate as an OAuth Authorization Server (see the “OAuth Configuration” chapter in the PingFederate Administrator’s Manual)
- Manage security certificates, authentication for applications, and protocol authentication validation—see the “Security Management” chapter in the PingFederate Administrator’s Manual
• Configure connections and other IdP or SP settings—see the “Identity Provider SSO Configuration” or the “Service Provider SSO Configuration” chapters, respectively, in the PingFederate Administrator’s Manual.
Chapter 3
Console Navigation

Navigating the Administrative Console

PingFederate’s configuration screens are designed to guide you through the process of setting up and maintaining your server. This configuration design provides three major benefits:

First, given the complicated security considerations and elaborate requirements under the SAML specifications, setting up an identity federation is complex. The PingFederate setup screens provide a step-by-step mechanism that minimizes the chance of overlooking critical settings.

Second, setting up a federation involves many choices based on your agreement with your partner (see “Federation Planning Checklist” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual). PingFederate presents these choices in an organized way and then takes you along the right path, presenting only the steps you need to take based on previous choices.

Finally, like most complex network configurations, federation setup involves many interdependencies. PingFederate keeps track of these for you: when you make a change, the system finds related changes and takes you to the relevant screens.

![Caution: Do not use the browser’s Back, Refresh, or Forward buttons. Instead, use the navigation buttons in the lower right portion of the configuration screens (see “Console Buttons” on page 29).]

About Tasks and Steps

Each broad configuration area is broken down into a series of tasks. Each task consists of a sequence of steps. The tasks and steps appear in the top portion of the screen, as shown in Figure 7.

![Figure 7: Tasks and Steps (Example)]

Notice that steps you have not yet reached are grayed out. After you complete a step, you can click it to go back. When all the steps are completed, you can click any of them to review your work or make changes.

![Important: Be sure to click Save (if available) when you reach the last step of a task (if you want to save changes), or if you have finished editing a step.]

As you traverse steps for each task, you will notice that some provide buttons that branch to dependent, multi-step tasks. In addition, on some screens buttons provide shortcuts to supporting tasks, typically those used for global settings—for
example, as you set up a connection to a partner, you might need to import a certificate into your trusted store (see “Trusted Certificate Authorities” in the “Security Management” chapter of the PingFederate Administrator’s Manual).

In either case, when you change tasks, the transitional step or related global task appears as the current task, and the steps change accordingly.

**Caution:** Clicking **Cancel** on any screen discards all new unsaved entries or changes for all steps shown for the current task and returns you to the screen from which you accessed the task.

### Console Buttons

The navigational and control buttons at the bottom of the administrative console screen change depending on where you are in the configuration process. The following table describes the behavior of these buttons.

**Table 2:** Administrative Console Buttons

<table>
<thead>
<tr>
<th>Button</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Save</strong></td>
<td>Stores information for all steps completed for the current task or any changes made for the current step; returns to the screen from which the task or step was accessed (see “About Tasks and Steps” on page 28). This button is available only when the Save operation is valid within the current context.</td>
</tr>
<tr>
<td><strong>Done</strong></td>
<td>Marks as complete all steps for a current task, but does not save the configuration (because further tasks or steps are necessary); to save entries or changes, continue the configuration until you see a <strong>Save</strong> button or click <strong>Save Draft</strong> (see below).</td>
</tr>
<tr>
<td><strong>Save Draft</strong></td>
<td>Stores a new connection configuration for all steps completed up to the current screen in the configuration flow. To return to the draft, click <strong>Manage All [IdP or SP]</strong> under [IdP or SP] Connections on the Main Menu and then select the draft from the connection list.</td>
</tr>
<tr>
<td><strong>Cancel</strong></td>
<td>Returns to the screen from which the current task was accessed; discards any information newly entered or modified for all steps in the task (see “About Tasks and Steps” on page 28).</td>
</tr>
<tr>
<td><strong>Previous</strong></td>
<td>Returns to the previous step (when applicable).</td>
</tr>
<tr>
<td><strong>Next</strong></td>
<td>Moves display forward to the next step (when applicable), if all required information is complete in the current step.</td>
</tr>
</tbody>
</table>
PingFederate provides flexible, integrated support for all versions of the Security Assertion Markup Language (SAML) protocol, from 1.0 through 2.0, OAuth, and for WS-Trust, which underlies the PingFederate STS for Web Services. In addition, PingFederate supports the WS-Federation browser-based, “passive” protocol using SAML assertions as SSO-enabling security tokens.

This chapter describes:

- “Federation Roles” on page 31
- “Terminology” on page 32
- “SAML 1.x Profiles” on page 34
- “SAML 2.0 Profiles” on page 38
- “WS-Federation” on page 53
- “About Account Linking” on page 55
- “Web Services Standards” on page 57
- “OAuth 2.0” on page 60
- “System for Cross-domain Identity Management (SCIM)” on page 63
- “Transport and Message Security” on page 63

### Federation Roles

The most recent sets of standards, SAML 2.0 and WS-Federation, define two roles in an identity federation partnership: an Identity Provider (IdP) and a Service Provider (SP).

**Note:** Earlier SAML 1.x specifications used the terms Asserting Party (for IdP) and Relying Party (for SP). For consistency and clarity, however, PingFederate adopts the later terms IdP and SP across all specifications.
A third role, defined in the specifications and available in PingFederate, is that of an IdP Discovery provider.

**Identity Provider**

An IdP, also called the “SAML authority,” is a system entity that authenticates a user, or “SAML subject,” and transmits referential identity information based on that authentication.

*Note:* The SAML subject may be a person, a Web application, or a Web server. Since the subject is often a person, the term “user” is generally employed throughout this manual.

**Service Provider**

An SP is the consumer of identity information provided by the IdP. Based on trust, technical agreements, and verification of adherence to protocols, SP applications and systems determine whether (or how) to use information contained in a SAML assertion.

**IdP Discovery Provider**

This role provides an IdP look-up service that can be incorporated into the implementation of either an IdP or an SP, or it can be employed as a stand-alone server (see “IdP Discovery” on page 52).

**Terminology**

The SAML specifications provide a system of building blocks and support components for achieving secure data exchange in an identity federation. These include:

- Assertions
- Bindings
- Profiles
- Metadata
- Authentication Context

**Assertions**

Assertions are XML documents sent from an IdP to an SP. Each assertion contains identifying information about a user who has initiated an SSO request.

**Bindings**

A SAML binding describes the way messages are exchanged using transport protocols. PingFederate supports the following bindings:

- **HTTP POST** – Describes how SAML messages are transported in HTML form-control content, which uses a base-64 format.
- **HTTP Artifact** – Describes how to use an artifact to represent a SAML message. The artifact can be transported via an HTML form control or a query string in the URL.
• **HTTP Redirect (SAML 2.0)** – Describes how SAML messages are transported using HTTP 302 status-code response messages.

• **SOAP (SAML 2.0)** – Describes how SAML messages are to be transferred across the back channel (Simple Object Access Protocol).

### Profiles

Profiles describe processes and message flows combining assertions, request/response message specifications, and bindings to achieve a specific desired functionality or use case. Because profiles define the application of the specifications and therefore play a large part in PingFederate, most of the rest of this chapter is devoted to them, starting with “SAML 1.x Profiles” on page 34.

### Metadata

SAML 2.0 defines an XML schema to standardize metadata to facilitate the exchange of configuration information among federation partners. This information includes, for example, profile and binding support, connection endpoints, and certificate information. (See “Exporting Metadata” in the “System Administration” chapter of the PingFederate Administrator’s Manual.)

Whether you are exporting or importing a metadata file, PingFederate supports the use of XML digital signatures to ensure the integrity of the data (see “Signing XML Files” in the “System Administration” chapter of the PingFederate Administrator’s Manual).

### Authentication Context

Before allowing access to a protected resource, an SP may want information surrounding how the user was originally authenticated by the IdP, in addition to the assertion itself. The SP may use this information for an access control decision or to provide an audit trail for regulatory or security-policy compliance.

The SAML 2.0 specification provides an XML schema whereby partners can create authentication-context declarations. Partners may choose to reference a URI to implement a set of classes provided by the specification to help categorize and simplify context interpretation (see the OASIS document: saml-authn-context-2.0-os.pdf). However, it is up to partners to decide if additional authentication context is required and if these classes supply an adequate description. For SAML 1.x, the authentication context (called “AuthenticationMethod”), if used, must be specified as a URI (see, for example, oasis-sttc-saml-core-1.1.pdf).

An administrator can configure PingFederate, acting as an IdP, to include authentication context in assertions. For information about this configuration, see “Creating an Attribute Contract” in the “Identity Provider SSO Configuration” chapter of the PingFederate Administrator’s Manual or “Defining an STS Attribute Contract” in the “WS-Trust STS Configuration” chapter.

Alternatively, several PingFederate integration kits provide methods that can be used by the developer to insert authentication context from external IdP applications into the assertion (see “SSO Integration Kits and Adapters” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual). Conversely, the SP developer can call methods for extracting authentication context from an assertion. It is up to the SP developer and application to create access control or other processing based on the context.

Check the User Guide for your integration kit to see if this feature is supported.
For more information on configuring authentication context for an adapter instance, see “Selecting an Authentication Context” in the “Identity Provider SSO Configuration” chapter of the PingFederate Administrator’s Manual.

**Browser-based SSO**

Browser-based SSO includes SAML 1.x, 2.0, and WS-Federation and provides standards-based SSO, Single Logout, Attribute Query and XASP, and the WS-Federation Passive Requestor Profile for SP-initiated SSO.

**SAML 1.x Profiles**

SAML 1.0 and 1.1 profiles provide for browser-based SSO, initiated by an IdP, using either the POST or artifact bindings.

In addition, the specifications provide for a non-normative SP-initiated scenario (called “destination-first”), which allows Web developers to create applications that enable a user to initiate SSO from the SP site.

**SSO--Browser-Post**

In this scenario, a user is logged on to the IdP and attempts to access a resource on a remote SP server. The SAML assertion is transported to the SP via HTTP POST.

**Figure 8: Browser/POST Profile**
**Processing Steps:**

1. A user has logged on to the IdP.
   (If a user has not yet logged on for some reason, he or she is challenged to do so at step 2).
2. The user clicks a link or otherwise requests access to a protected SP resource.
3. Optionally, the IdP retrieves attributes from the user data source.
4. The IdP’s SSO service returns an HTML form to the browser with a SAML response containing the authentication assertion and any additional attributes. The browser automatically posts the HTML form back to the SP.

   **Note:** SAML specifications require that POST responses be digitally signed.

5. (Not shown) If the signature and assertion are valid, the SP establishes a session for the user and redirects the browser to the target resource.

**SSO--Browser-Artifact**

In this scenario, the IdP sends a SAML artifact to the SP via either HTTP POST or a redirect (shown in diagram). The SP uses the artifact to obtain the associated SAML response from the IdP.

---

**Figure 9:** SSO: Browser/Artifact Profile
Processing Steps:
1. A user has logged on to the IdP.
   (If a user has not yet logged on for some reason, he or she is challenged to do so at step 2).
2. The user clicks a link or otherwise requests access to a protected SP resource.
3. Optionally, the IdP retrieves attributes from the user data store.
4. The IdP federation server generates an assertion, creates an artifact, and sends an HTTP redirect containing the artifact through the browser to the SP’s Assertion Consumer Service (ACS).
5. The ACS extracts the Source ID from the SAML artifact and sends an artifact-resolve message to the identity federation server’s Artifact Resolution Service (ARS).
6. The ARS sends a SAML artifact response message containing the previously generated assertion.
7. (Not shown) If a valid assertion is received, the SP establishes a session and redirects the browser to the target resource.

SP-Initiated (“Destination-First”) SSO

In an SP-initiated (a.k.a. “destination-first”) transaction the user is connected to an SP site and attempts to access a protected resource in the SP domain. The user might have an account at the SP site but according to federation agreement, authentication is managed by the IdP. The SP sends an authentication request to the IdP.
**Processing Steps:**

1. The user requests access to a protected SP resource. The request is redirected to the federation server (e.g., PingFederate) to handle authentication.

2. The federation server sends a SAML request for authentication to the IdP's SSO service (also called the Intersite Transfer Service).

3. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.

4. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see "About Attributes" in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.)

5. The IdP's Intersite Transfer Service returns an artifact, representing the SAML response, to the SP.

6. The SP's artifact handling service sends a SOAP request with the artifact to the IdP's artifact resolver endpoint.

7. The IdP resolves the artifact and returns the corresponding SAML response with the SSO assertion.

8. (Not shown) If the assertion is valid, the SP establishes a session for the user and redirects the browser to the target resource.

**SAML 2.0 Profiles**

PingFederate supports these major profiles defined under the SAML 2.0 standard:

- Single Sign-on
- Single Logout
- Attribute Query and XASP
- IdP Discovery

**Single Sign-on**

SAML 2.0 substantially increases the number of possible SSO profile variations by fully enabling SP-initiated transactions. When SP- and IdP-initiated protocols are paired with transport binding specifications, the combinations result in eight practical SSO scenarios:

- SP-Initiated SSO--POST-POST
- SP-Initiated SSO--Redirect-POST
- SP-Initiated SSO--Artifact-POST
- SP-Initiated SSO--POST-Artifact
- SP-Initiated SSO--Redirect-Artifact
- SP-Initiated SSO--Artifact-Artifact
- IdP-Initiated SSO--POST
- IdP-Initiated SSO--Artifact
**SP-Initiated SSO--POST**

In this scenario a user attempts to access a protected resource directly on an SP Web site without being logged on. The user does not have an account on the SP site, but does have a federated account managed by a third-party IdP. The SP sends an authentication request to the IdP. Both the request and the returned SAML assertion are sent through the user's browser via HTTP POST.

**Figure 11: SP-Initiated SSO: POST/POST**

**Processing Steps:**

1. The user requests access to a protected SP resource. The request is redirected to the federation server to handle authentication.

2. The federation server sends an HTML form back to the browser with a SAML request for authentication from the IdP. The HTML form is automatically posted to the IdP's SSO service.

3. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.

4. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see "About Attributes" in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.)
5. The IdP’s SSO service returns an HTML form to the browser with a SAML response containing the authentication assertion and any additional attributes. The browser automatically posts the HTML form back to the SP.

**Note:** SAML specifications require that POST responses be digitally signed.

6. (Not shown) If the signature and assertion are valid, the SP establishes a session for the user and redirects the browser to the target resource.

**SP-Initiated SSO--Redirect-POST**

In this scenario, the SP sends an HTTP redirect message to the IdP containing an authentication request. The IdP returns a SAML response with an assertion to the SP via HTTP POST.

---

**Figure 12:** SP-Initiated SSO: Redirect/POST

**Processing Steps:**

1. A user requests access to a protected SP resource. The user is not logged on to the site. The request is redirected to the federation server to handle authentication.

2. The SP returns an HTTP redirect (code 302 or 303) containing a SAML request for authentication through the user's browser to the IdP's SSO service.

3. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.
4. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see “About Attributes” in the “Key Concepts” chapter of the PingFederate Administrator's Manual.)

5. The IdP’s SSO service returns an HTML form to the browser with a SAML response containing the authentication assertion and any additional attributes. The browser automatically posts the HTML form back to the SP.

   **Note:** SAML specifications require that POST responses be digitally signed.

6. (Not shown) If the signature and assertion are valid, the SP establishes a session for the user and redirects the browser to the target resource.

**SP-Initiated SSO--Artifact-POST**

In this scenario, the SP sends a SAML artifact to the IdP via an HTTP redirect. The IdP uses the artifact to obtain an authentication request from the SP's SAML artifact resolution service. The IdP returns a SAML response to the SP via HTTP POST.

**Figure 13:** SP-Initiated SSO: Artifact/POST

**Processing Steps:**

1. A user requests access to a protected SP resource. The user is not logged on to the site. The request is redirected to the federation server to handle authentication.
2. The SP generates an authentication request and creates an artifact. The SP sends an HTTP redirect containing the artifact through the user's browser to the IdP's SSO service.

**Note:** The artifact contains the source ID of the SP's artifact resolution service and a reference to the authentication.

3. The SSO service extracts a source ID from the SAML artifact and sends a SAML artifact-resolve message over SOAP containing the artifact to the SP's Artifact Resolution Service (ARS).

**Note:** The SP and IdP's source IDs and remote artifact resolution services are mapped according to the federation agreement made prior to this action.

4. The SP's ARS returns a SAML message containing the previously generated authentication request.

5. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.

6. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see “About Attributes” in the “Key Concepts” chapter of the PingFederate Administrator's Manual.)

7. The IdP's SSO service returns an HTML form to the browser with a SAML response containing the authentication assertion and any additional attributes. The browser automatically posts the HTML form back to the SP.

**Note:** SAML specifications require that POST responses be digitally signed.

8. (Not shown) If the signature and assertion are valid, the SP establishes a session for the user and redirects the browser to the target resource.
SP-Initiated SSO--POST-Artifact

In this scenario, the SP sends an authentication request to the IdP via HTTP POST. The returned SAML assertion is redirected through the user’s browser. The response contains a SAML artifact.

**Processing Steps:**

1. A user requests access to a protected SP resource. The user is not logged on to the site. The request is redirected to the federation server to handle authentication.

2. The federation server sends an HTML form back to the browser with a SAML request for authentication from the IdP. The HTML form is automatically posted to the IdP’s SSO service.

3. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.

4. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see “About Attributes” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.)

5. The IdP federation server generates an assertion, creates an artifact, and sends an HTTP redirect containing the artifact through the browser to the SP’s Assertion Consumer Service (ACS).

**Figure 14:** SP-Initiated SSO: POST/Artifact
6. The ACS extracts the source ID from the SAML artifact and sends an artifact-resolve message to the federation server’s Artifact Resolution Service (ARS).

7. The ARS sends a SAML artifact response message containing the previously generated assertion.

8. (Not shown) If a valid assertion is received, a session is established on the SP and the browser is redirected to the target resource.

**SP-Initiated SSO--Redirect-Artifact**

In this scenario, the SP sends an HTTP redirect message to the IdP containing a request for authentication. The IdP returns an artifact via HTTP redirect. The SP uses the artifact to obtain the SAML response.

---

**Figure 15:** SP-Initiated SSO: Redirect/Artifact

**Processing Steps:**

1. A user requests access to a protected SP resource. The user is not logged on to the site. The request is redirected to the federation server to handle authentication.

2. The SP returns an HTTP redirect (code 302 or 303) containing a SAML request for authentication through the user’s browser to the IdP’s SSO service.

3. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.

4. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see “About
Attributes” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.)

5. The IdP federation server generates an assertion, creates an artifact, and sends an HTTP redirect containing the artifact through the browser to the SP’s Assertion Consumer Service (ACS).

6. The ACS extracts the Source ID from the SAML artifact and sends an artifact-resolve message to the identity federation server’s Artifact Resolution Service (ARS).

7. The ARS sends a SAML artifact response message containing the previously generated assertion.

8. (Not shown) If a valid assertion is received, the SP establishes a session and redirects the browser to the target resource.

**SP-Initiated SSO--Artifact-Artifact**

In this scenario, the SP sends a SAML artifact to the IdP via an HTTP redirect. The IdP uses the artifact to obtain an authentication request from the SP. Then the IdP sends another artifact to the SP, which the SP uses to obtain the SAML response.

**Figure 16: SP-Initiated SSO: Artifact/Artifact**

**Processing Steps:**

1. A user requests access to a protected SP resource. The user is not logged on to the site. The request is redirected to the federation server to handle authentication.
2. The ACS generates an authentication request and creates an artifact. It sends an HTTP redirect containing the artifact through the user's browser to the IdP's SSO service.

   **Note:** The artifact contains the source ID of the SP's artifact resolution service and a reference to the authentication request.

3. The SSO service extracts the source ID from the SAML artifact and sends a SAML artifact resolve message containing the artifact to the SP's artifact resolution service.

   **Note:** The SP and IdP's source IDs and remote artifact resolution services are mapped according to the federation agreement prior to this action.

4. The SP's artifact resolution service sends back a SAML artifact response message containing the previously generated authentication request.

5. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.

6. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see “About Attributes” in the “Key Concepts” chapter of the PingFederate Administrator's Manual.)

7. The IdP federation server generates an assertion, creates an artifact, and sends an HTTP redirect containing the artifact through the browser to the SP's Assertion Consumer Service (ACS).

8. The ACS extracts the Source ID from the SAML artifact and sends an artifact-resolve message to the identity federation server's Artifact Resolution Service (ARS).

9. The ARS sends a SAML artifact response message containing the previously generated assertion.

10. (Not shown) If a valid assertion is received, the SP establishes a session and redirects the browser to the target resource.

**IdP-Initiated SSO--POST**

In this scenario, a user is logged on to the IdP and attempts to access a resource on a remote SP server. The SAML assertion is transported to the SP via HTTP POST.
Processed Steps:

1. A user has logged on to the IdP.
   (If a user has not yet logged on for some reason, he or she is challenged to do so at step 2).

2. The user clicks a link or otherwise requests access to a protected SP resource.

3. Optionally, the IdP retrieves attributes from the user data store.

4. The IdP's SSO service returns an HTML form to the browser with a SAML response containing the authentication assertion and any additional attributes. The browser automatically posts the HTML form back to the SP.

   **Note:** SAML specifications require that POST responses be digitally signed.

5. (Not shown) If the signature and assertion are valid, the SP establishes a session for the user and redirects the browser to the target resource.
IdP-Initiated SSO--Artifact

In this scenario, the IdP sends a SAML artifact to the SP via an HTTP redirect. The SP uses the artifact to obtain the associated SAML response from the IdP.

Processing Steps:
1. A user has logged on to the IdP.
   (If a user has not yet logged on for some reason, he or she is challenged to do so at step 2).
2. The user clicks a link or otherwise requests access to a protected SP resource.
3. Optionally, the IdP retrieves attributes from the user data store.
4. The IdP federation server generates an assertion, creates an artifact, and sends an HTTP redirect containing the artifact through the browser to the SP’s Assertion Consumer Service (ACS).
5. The ACS extracts the Source ID from the SAML artifact and sends an artifact-resolve message to the identity federation server’s Artifact Resolution Service (ARS).
6. The ARS sends a SAML artifact response message containing the previously generated assertion.
7. (Not shown) If a valid assertion is received, the SP establishes a session and redirects the browser to the target resource.
Single Logout

The single logout (SLO) profile enables a user to log out of all participating sites in a federated session nearly simultaneously. The user may log out globally from any site, whether SP or IdP, as determined by respective Web applications. The associated IdP federation deployment handles all logout requests and responses for participating sites.

The logout messages may be transported using any combination of bindings described for SSO (POST, artifact, or redirect). Refer to the diagrams under “Single Sign-on” on page 38 for illustrations of these message flows.

About Session Clean-up

When an SP receives an SLO request from an IdP, the session creation adapter(s) you are using must handle any session clean-up with respect to the local application. For more information about adapters, see “SSO Integration Kits and Adapters” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.

Attribute Query and XASP

The SAML 2.0 Attribute Query profile allows an SP to request user attributes from an IdP in a secure transaction separate from SSO. The IdP, acting as an Attribute Authority, accepts Attribute Queries, performs a data-store lookup into a user repository such as an LDAP directory, provides values to the requested attributes, and generates an Attribute Response back to the originating SP requester. The SP then returns the attributes to the requesting application.

Since Web SSO is distinct from the Attribute Query use case, you can configure PingFederate servers to implement either or both of these profiles without regard to the other.

The X.509 Attribute Sharing Profile (XASP) defines a specialized extension of the general Attribute Query profile. The XASP specification enables organizations with an investment in PKI (Public Key Infrastructure) to issue and receive Attribute Queries based on user-certificate authentication.

Under XASP a user authenticates directly with an SP application by providing his or her X.509 certificate (see “Authentication” in the “Security Management” chapter of the PingFederate Administrator’s Manual). Once the user is authenticated, the SP application requests additional user attributes by contacting the SP PingFederate server. A portion of the user's X.509 certificate is included in the request and may be used to determine the correct IdP to use as the source of the requested attributes (see “Attribute Requester Mapping” in the “Service Provider SSO Configuration” chapter of the PingFederate Administrator’s Manual). Finally, the SP generates an Attribute Query and transmits it to the IdP over the SOAP back channel.

Because the user arrives at the SP server already authenticated, note that no PingFederate adapter is used in this case (see “SSO Integration Kits and Adapters” in the “Key Concepts” chapter of the PingFederate Administrator's Manual).
IdP Discovery

SAML 2.0 IdP Discovery provides a cookie-based look-up mechanism used to identify a user's IdP dynamically during an SP-initiated SSO event, when the IdP is not otherwise specified. This mechanism can be helpful, in particular, in cases where an SP might be a hub for several IdPs in an identity federation.

**Tip:** In addition to supporting standard IdP Discovery, PingFederate provides a cross-protocol, proprietary mechanism allowing an SP server to write a persistent browser cookie. The cookie contains a reference to the IdP partner with whom the user previously authenticated for SSO. For more information, see “IdP Discovery Using a Persistent Cookie” in the “System Settings” chapter of the PingFederate Administrator's Manual.

In the standard scenario, when a user requests access to a protected resource on the SP, common-domain browser cookies are used to determine where a user has authenticated in the past. Using this information, a PingFederate server can determine which IdP connection to use for sending an authentication request.

As an IdP Discovery provider, PingFederate can serve in up to three different roles:

- **Common domain server**
- **Common domain cookie writer**
- **Common domain cookie reader**

Each of these roles is necessary to support IdP Discovery. The roles may be distributed across multiple servers at different sites.

**Common domain server** In this role the PingFederate server hosts a domain that its federation partners share in common. The common domain server allows partners to manipulate browser cookies that exist within that common domain. PingFederate can serve in this role exclusively or as part of either an IdP or an SP federation role, or both.

**Common domain cookie writer** When PingFederate is acting in an IdP role and authenticates a user, it can write an entry in the common domain cookie, including its federation entity ID. An SP can look up this information on the common domain (not the same location as the common domain server described above).

**Common domain cookie reader** When PingFederate is acting as an SP and needs to determine the IdPs with whom the user has authenticated in the past, it reads the common domain cookie. Based on the information contained in the cookie, PingFederate can then initiate an SSO authentication request using the correct IdP connection.

WS-Federation

PingFederate supports the WS-Federation Passive Requestor Profile for SP-initiated SSO, enabling interoperability with Microsoft's Active Directory Federation Service (ADFS). This profile provides for straightforward redirects and HTTP GET and
POST methods to transport SAML assertions as security tokens for SSO and logout request and response messages for SLO.

**Note:** Unlike SAML, WS-Federation consolidates the endpoints for SLO and SSO. So when you set up a WS-Federation connection in PingFederate, both types of transactions are available to an SP Web application that supports them both.

For more information about WS-Federation and the Passive Requestor Profile, see [Web Services Federation Languages](http://www.ibm.com/developerworks/library/specification/ws-fedworld/).

**Passive Requestor Profile**

This profile permits a user’s browser (the passive requestor) to request a security token from an IDP when the user requests access to a protected Web service or other resource at an SP.

Figure 20 illustrates message processing for SSO using WS-Federation.

**Figure 19:** WS-Federation SSO

**Processing Steps:**

1. A user requests access to a protected SP resource. The user is not logged on to the site. The request is redirected to the federation server to handle authentication.

2. The SP generates a security token request and redirects the browser to the identity provider's WS-Federation implementation.
3. If the user is not already logged on to the IdP site or if re-authentication is required, the IdP asks for credentials (e.g., ID and password) and the user logs on.

4. Additional information about the user may be retrieved from the user data store for inclusion in the SAML response. (These attributes are predetermined as part of the federation agreement between the IdP and the SP—see “About Attributes” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.)

5. The federation server creates a response containing a signed SAML assertion and returns it to the SP via POST.

6. (Not shown) If the signature and assertion are valid, the SP establishes a session for the user and redirects the browser to the target resource.

Single logout using WS-Federation is handled in much the same way as with SAML (see “Single Logout” on page 51); however, HTTP GET/POST is always used as the transport mechanism.

**About Account Linking**

Account linking provides a means for a user to log on to disparate sites with just one authentication, when the user has established accounts and credentials at each site. This method of effectively interconnecting accounts across domains is supported by all protocols.

Account linking involves a persistent name identifier associated with accounts at each participating site. The name identifier, which may be an opaque pseudonym, is conveyed in the assertion. Once established locally, the SP can use the account link to look up the user and provide access without re-authentication.

For more information about account linking, see “Account Linking” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual.
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Figure 20: Account Linking

Processing Steps:
1. David Smith logs on to Site A as davidsmith. He then decides to access his account on Site B via Site A.
2. Optionally, the federation server looks up additional attributes from the data store.
3. The Site A federation server sends a persistent name identifier (possibly a pseudonym) to Site B, along with any other attributes.
   If a pseudonym is used and other attributes are sent, care must be taken not to send attributes that could be used to identify the subject.
4. The federation server on Site B uses the information to associate the pseudonym with the existing account of dsmith. (Optionally, David is asked to provide consent to the linking.)
   Once the link has been established, it is stored so that David only has to log on to Site A to have access to Site B.

Web Services Standards

The PingFederate WS-Trust STS is designed to interoperate with many different Web Service environments that support varying standards. PingFederate supports multiple versions of SOAP and WS-Trust specifications, and can freely operate with any combinations of these standards simultaneously.

PingFederate supports namespace aliasing to eliminate common trailing-slash inconsistencies for WS-Trust 1.3. (The server does not support namespace aliasing for WS-Trust 2005.)
Supported SOAP/WS-Trust versions and corresponding namespaces are listed in following table:

<table>
<thead>
<tr>
<th>Spec.</th>
<th>Version</th>
<th>Namespace</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOAP</td>
<td>1.1</td>
<td><a href="http://schemas.xmlsoap.org/soap/envelope/">http://schemas.xmlsoap.org/soap/envelope/</a></td>
</tr>
<tr>
<td></td>
<td>1.2</td>
<td><a href="http://www.w3.org/2003/05/soap-envelope">http://www.w3.org/2003/05/soap-envelope</a></td>
</tr>
<tr>
<td></td>
<td>1.3</td>
<td><a href="http://docs.oasis-open.org/ws-sx/ws-trust/200512/">http://docs.oasis-open.org/ws-sx/ws-trust/200512/</a></td>
</tr>
</tbody>
</table>

**Table 3 SOAP/WS-Trust Versions**

Web Services Security

Web Services Security (WSS, also WSSE) is a set of specifications defined by the Web Services Security Technical Committee (see [www.oasis-open.org/committees/tc_home.php?wg_abbrev=wss](http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=wss)) at the OASIS standards organization. WSS defines the XML extensions that can be used to secure Web Service invocations, providing a standard way for partners to add message integrity and confidentiality to their Web Service interactions (see Figure 22). The WSS-defined token profiles describe standard ways of binding security tokens to these messages, enabling a variety of additional capabilities. The WSS technical committee has defined profiles for using SAML assertions, Username, Kerberos, X.509, and other existing security tokens. SSL/TLS is often used in conjunction with deployments of WSS.

**Note:** The implementation of WSS in the deployment of Web Services identity federations is outside the scope of PingFederate, which provides a standalone, standard means of handling the tokens needed for such federations (see “WS-Trust” below).

![Figure 21: WSS Token Transfer](image)

**WS-Trust**

WS-Trust comprises a protocol for systems and applications to use when requesting a service to issue, validate, and exchange security tokens. Organizations can leverage this protocol to centralize their security-token processing.
The WS-Trust specification also defines the role of a Security Token Service as the entity responsible for responding to requests using the protocol. In this role, the STS creates new security tokens, validates existing security tokens, and/or exchanges security tokens of one type for those of another (see Figure 23 on page 59).

WS-Trust was created by a consortium of leading platform and security vendors who have contributed the protocol to the OASIS standards organization, where it is managed by the WS-SX (Secure Exchange) technical committee. (See http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=ws-sx.)

Request Types

The WS-Trust protocol defines two request types that are particularly useful in securing Web Services: “Issue” and “Validate,” often associated with the Web Service Client (WSC) and Web Service Provider (WSP), respectively. The WSC requests that an STS issue a SAML token to convey information between the WSC and the WSP. The WSP sends the STS a request to validate the incoming token. Optionally, the WSP can request that the STS issue a local token for the SP domain.

When issuing and validating security tokens, PingFederate enforces security policies, defined by administrators, generating the token types that are required for a Web Service request to pass between two security domains (whether these domains are within the same organization or in separate organizations).

The following illustration shows an example of a token exchange, using PingFederate to obtain a SAML assertion to be used in the WSS-secured Web Service call.

Figure 22: Token Exchange (Example)

Processing Steps:
1. A user requests content from an application.
2. The application acts as a WSC to respond to the user’s request. The application calls PingFederate, passing the existing user security token to exchange it for the appropriate SAML assertion.

3. PingFederate verifies the existing security token, creates a new SAML assertion representing the user, and returns it to the requesting application.

4. The application sends a Web Service request to the WSP, including the SAML assertion in a WSS header.

5. The WSP retrieves the SAML assertion from the WSS header in the incoming request and sends a message to its own deployment of PingFederate to determine if the assertion is valid.

6. PingFederate validates the SAML assertion, creates a new security token for the local domain, and returns the new token to the WSP.

7. The WSP responds to the request according to its policy for the user.

8. The Web application returns an HTML page to the user.

Note: This example shows PingFederate deployed in both the Client and Provider sides of the interaction. However, other deployment options are also supported.

OAuth 2.0

OAuth 2.0 defines a protocol for securing application access to protected resources by issuing access tokens to clients of Representational State Transfer (REST) APIs (and non-REST APIs). Rather than the client directly authenticating to the API using credentials, or the credentials of a user, OAuth enables the client to authenticate by presenting a previously obtained token. The token represents (or contains) a set of attributes and/or policies appropriate to the client and the user. These tokens present less of a security and privacy risk than using secrets (or passwords) directly on the API call. The attributes are used by the API to authenticate the call and authorize access.

There are three primary participants in the OAuth process flow:

- **Client** – Wants access to a resource protected by a Resource Server and interacts with an Authorization Server to obtain access tokens
- **Resource Server (RS)** – Hosts and protects resources and makes them available to properly authenticated and authorized clients
- **Authorization Server (AS)** – Issues access tokens and refresh tokens to clients on behalf of Resource Servers

**Tokens**

- **Access Token** – Allows clients to authenticate to a resource server and claim authorizations for accessing particular resources. Access tokens have specific authorization scope and duration.
- **Refresh Token** – Allows clients to obtain a fresh access token without re-obtaining authorization from the resource owner. It is a long-lived token that a client can trade in to an authorization server to obtain a new access token (with the same attached authorizations as the existing access token).
The OAuth AS in PingFederate supports a wide variety of different interaction models appropriate for different types of clients such as a server, a desktop application, or an application on a phone or a tablet.

**Note:** The PingFederate OAuth AS implementation is based on the Internet Engineering Task Force (IETF) OAuth 2.0 Authorization Framework (http://tools.ietf.org/html/rfc6749).

The following section describes the **Web Redirect Flow**, which is the primary scenario for OAuth transactions.

**Web Redirect Flow**

In this scenario, a user attempts to access a protected resource through a third-party Web server client. The client sends an authorization request to the resource server and receives a code back via an HTTP redirect. The client trades the code for an access token, and then uses the token in a API call to obtain data.

![Diagram of Web Redirect Flow](image)

**Figure 23:** Web Redirect

**Processing Steps**

1. User navigates to an OAuth client Web site (the requesting site) and requests access to protected resources from another Web site.
2. The browser is redirected to the PingFederate OAuth AS with a request for authorization.

   If the user is not already logged on, the OAuth AS challenges the user to authenticate. The OAuth AS authenticates the user and provides a consent page for the user to authorize the sharing of information. Once the user
authorizes, the OAuth AS redirects the browser to the requesting site with an authorization code.

If the user does not authenticate, an error is returned rather than the authorization code.

3. The requesting site makes an HTTPS request to the OAuth AS to exchange the authorization code for an access token. OAuth AS validates the grant and user data associated with the code and then returns an access token.

4. The requesting site uses the access token in an API call to request user data.

5. The Resource Server asks PingFederate for verification that the token is valid and has not expired. PingFederate returns data about the user, the granted scope, and the client ID.

6. Once verified, the Resource Server returns the requested data to the requesting site.

7. Not shown. The requesting site displays data from the API call to the user.

**SAML 2.0 Profile for OAuth 2.0 Authorization Grants**

In this scenario, a client obtains a SAML 2.0 bearer assertion and makes an HTTP request to the PingFederate OAuth AS to exchange the SAML assertion for an access token. The AS validates the assertion and returns an access token. The client uses the token in an API call to the Resource Server to obtain data.

**Processing Steps**

1. Some user-initiated or client-initiated event (for example, a mobile application or a scheduled task) requests access to Software as a Service (SaaS) protected resources from an OAuth client application.
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2. The client application obtains a SAML 2.0 bearer assertion from a local Identity Provider (IdP) for example, PingFederate.

3. The client makes an HTTP request to the PingFederate OAuth AS to exchange the SAML assertion for an access token. The AS validates the assertion and returns the access token. For more information on how the AS performs the validation, see the specification (http://tools.ietf.org/html/draft-ietf-oauth-saml2-bearer).

4. The client application adds the access token to its API call to the Resource Server. The Resource Server returns the requested data to the client.

OpenID Connect Support

As an extension of OAuth, PingFederate also supports Basic and Implicit Profiles defined for OpenID Connect, an emerging standard. For more information, see the OpenID Connect Web site (openid.net/connect).

System for Cross-domain Identity Management (SCIM)

PingFederate supports the SCIM 1.1 protocol for outbound as well as inbound provisioning. At an IdP (outbound) site, you can automatically provision and maintain user accounts at service-provider sites that have implemented SCIM. When PingFederate is configured as an SP (inbound), you can provision and manage user accounts for your own organization automatically using the standard SCIM protocol.

For more information regarding outbound provisioning for IdPs and inbound provisioning for SPs, see “User Provisioning” in the “Key Concepts” chapter of the PingFederate Administrator’s Manual. For detailed information about SCIM, see the Web site www.simplecloud.info.

Transport and Message Security

The standards generally define two main ways of securing interactions: Secure Sockets Layer with Transport Level Security (SSL/TLS) and digital signatures. SSL/TLS is used in environments where both message confidentiality and integrity are required. For SAML messaging, digital signatures are used to ensure the identity of both parties involved in the transaction and to validate that a message was received from a particular partner.

With PingFederate you can also choose to encrypt SAML 2.0 messages, including SAML metadata files, as well as WS-Trust STS assertions to achieve increased privacy.

Using the Thales nShield Connect HSM

For optimal security, PingFederate can be configured to use a hardware security module (HSM) for cryptographic material storage and operations. Standards such as the Federal Information Processing Standard (FIPS) 140-2 require the storage and processing of all keys and certificates on a certified cryptographic module.

PingFederate is engineered and tested with the standard-compliant Thales nShield Connect (formerly nCipher Connect) HSM. The first step is to install and configure the Thales nShield Connect HSM according to the manufacturer's documentation. Once installed, use the information in the following sections to configure PingFederate to interact with the HSM for key generation, storage, and operation.

HSM Operational Notes

Some restrictions apply to the operation of PingFederate when using an HSM:

- Private keys are not exportable. When configured for use with the HSM, administrative-console options for this feature are disabled. Only the public portion of generated keys is exportable.

- When running in FIPS 140-2 level 3 compliance (also known as strict FIPS mode) private keys can not be imported. In this case administrative-console options for this feature are disabled.

- Not all cipher suites in a standard Java configuration are available. They are limited to those listed in the file named `com.pingidentity.crypto.NcipherJCEManager.xml` located in
  the `<pf_install>/pingfederate/server/default/data/config-store` directory.

- When using the Configuration Archive feature, any keys, certificates, or objects generated and stored on the HSM prior to saving a configuration archive must continue to exist unaltered when the archive is restored (see
Using the Thales nShield Connect HSM

“Using the Configuration Archive Utility” in the “System Administration” chapter of the PingFederate Administrator’s Manual). In other words, any deletion or creation of objects on the HSM not executed via the PingFederate user interface will not be recognized or operational.

For example, during the course of normal PingFederate operation you create and save objects A, B and C to the HSM and create a data archive that contains references to those objects. If you then delete object C and attempt to recover it via the data archive, PingFederate will fail, producing various exceptions. Because the data archive contains a reference to the object and the object has been deleted from the HSM, it is not possible to use that data archive again.

nShield Installation and Configuration

To use PingFederate with the nShield Connect HSM:

1. Install and configure the nShield Connect HSM client software.

   As part of the installation, install the optional Java Support (including KeySafe) and nCipherKM JCA/JCE provider classes components).

   During installation, disregard any message about noncompliant Java versions. JDK 7 is required. Accept the remaining defaults when prompted by the installer.

2. After your installation, refer to the Thales nShield documentation to see how to make your PingFederate server a client of an HSM server.

   **Note:** PingFederate currently supports only Operator Card Set (OCS) protected keys. Note the password used for the OCS; you will need the password for your installation of PingFederate.

3. If you have not already done so, download and install the (JCE) Unlimited Strength Jurisdiction Policy Files 6 (jce_policy-6.zip).

   Follow instructions in the readme to install the Policy Files.

4. To enable the Java interface, copy the nCipherKM.jar file from the \NFAST_HOME\java\classes folder into your JAVA_HOME\jre\lib\ext folder.

   Thales provides some sample Java applications that may be run to ensure that the Java/HSM interface is working properly prior to installing PingFederate. Please refer to Thales documentation for more information.
5. In your Java SDK directory, open the file `java.security` in the `jre/lib/security` directory and add the **boldface** line below to the list of security providers, after all Sun providers:

   # List of providers and their preference orders (see above):
   security.provider.1=sun.security.provider.Sun
   security.provider.2=sun.security.rsa.SunRsaSign
   security.provider.3=com.sun.net.ssl.internal.ssl.Provider
   security.provider.4=com.sun.crypto.provider.SunJCE
   security.provider.5=sun.security.jgss.SunProvider
   security.provider.6=com.sun.security.sasl.Provider
   security.provider.7=org.jcp.xml.dsig.internal.dom.XMLDSigRI
   security.provider.8=sun.security.smartcardio.SunPCSC
   security.provider.9=sun.security.mscapi.SunMSCAPI
   security.provider.10=com.ncipher.provider.km.nCipherKM

6. Save and close the `java.security` file.

7. Install PingFederate on the network interconnected to the HSM (see “Installation” on page 11).

8. In the `<pf_install>/pingfederate/server/default/data` directory, delete files with the extension `.jks`, specifically:
   - ping-dsig.jks
   - ping-ssl-server.jks
   - ping-ssl.jks
   - ping-trust.jks

9. In the `hivemodule.xml` file in the `<pf_install>/pingfederate/server/default/conf/META-INF` directory, in the Crypto provider section, change the value of the construct class, as shown below in **bold**:

   ```xml
   <construct
class="com.pingidentity.crypto.NcipherJCEManager"/>
   ```

10. Below the code in the previous step, change the value of the construct class to indicate that nShield is used as the Certificate Service service point as shown below in **bold**:

   ```xml
   <construct
class="com.pingidentity.crypto.NcipherCertificateServiceImpl"/>
   ```

11. Save and close the `hivemodule.xml` file.

12. In the `run.properties` file found in the `<pf_install>/pingfederate/bin` directory, change the value of the `pf.hsm.mode` property near the end of this file from OFF to NCIPHER, as shown below:

   ```properties
   pf.hsm.mode=NCIPHER
   ```

13. Save and close the `run.properties` file.
14. From the `<pf_install>/pingfederate/bin` directory, run the `hsmpass.bat` batch file for Windows or the `hsmpass.sh` script for UNIX/Linux.

Enter the Operator Card Set password when prompted (see Step 2).

This procedure sets and securely stores the password for communication to the HSM from PingFederate.

15. For clustered-server installations, see the next section.

This completes the steps required to configure PingFederate for use with nShield Connect. You may start the PingFederate server in the normal way and proceed as you would for any other installation (see “Running PingFederate for the First Time” on page 17).

**Additional Steps for Server Clusters**

If your PingFederate installation is configured in a clustered environment, use these steps to replicate nShield data to other connected nodes in the cluster.

1. In the administrative-console installation, locate the directory `<pf_install>/pingfederate/server/default/data` and create a directory named `ncipher-kmdata-local`.

2. Copy into `ncipher-kmdata-local` all files from the `NFAST_KMDATA\local` directory, where `NFAST_KMDATA` is an environment variable created during the nShield Connect installation.

   For example, `NFAST_KMDATA` could be set to `C:\ProgramData\nCipher\Key Management Data`.

3. Create a new environment variable named `NFAST_KMLOCAL` and set it to `<pf_install>/pingfederate/server/default/data/ncipher-kmdata-local`.

   **Note:** Perform this step on all servers within the cluster.

4. Restart the nShield Connect hardserver on all PingFederate servers in the cluster. (See the Thales documentation for instructions on restarting the hardserver.)

5. Use the administrative console to replicate the new configuration (see the PingFederate Server Clustering Guide).
For optimal security, PingFederate can be configured to use a hardware security module (HSM) for cryptographic material storage and operations. Standards such as the Federal Information Processing Standard (FIPS) 140-2 require the storage and processing of all keys and certificates on a certified cryptographic module.

PingFederate is engineered and tested with the standard-compliant SafeNet Luna SA HSM. The first step is to install and configure the Luna SA HSM according to the manufacturer's documentation. Once installed, use the information in the following sections to configure PingFederate to interact with the HSM for key generation, storage, and operation.

Operational Notes

Some restrictions apply to PingFederate operations when using a Luna SA HSM:

- Private keys are not exportable. When configured for use with the HSM, administrative-console options for this feature are disabled. Only the public portion of generated keys is exportable.

- Not all cipher suites in a standard Java configuration are available. They are limited to those listed in the file named com.pingidentity.crypto.LunaJCEManager.xml located in the <pf_install>/pingfederate/server/default/data/config-store directory.

- When using the Configuration Archive feature, any keys, certificates, or objects generated and stored on the HSM prior to saving a configuration archive must continue to exist unaltered when the archive is restored (see “Using the
Configuration Archive Utility” in the “System Administration” chapter of the PingFederate Administrator’s Manual).

For example, during the course of normal PingFederate operation you create and save objects A, B, and C to the HSM and create a data archive that contains references to those objects. If you then delete object C and attempt to recover it via the data archive, PingFederate fails, producing various exceptions. Because the data archive contains a reference to the object and the object has been deleted from the HSM, it is not possible to use that data archive again.

Installation and Configuration

To use PingFederate with the Luna SA HSM:

1. Install and configure your SafeNet Luna SA HSM, including the optional package for Java (referred to as the JSP), according to SafeNet's instructions. This includes the creation of a partition, creation of a Network Trust Link (NTL), and assignment of a client to a partition. Ensure that you can perform the vt1 verify command indicating that you are communicating securely and properly to the HSM.

Delete any unnecessary keys or objects that may have been created while testing communication to the HSM from the host that runs PingFederate.

Note the password used to open communication to the HSM via the NTL. You need this for your PingFederate installation.

2. To enable the Java interface, copy the following files to your Java installation:

   For Windows:
   - Copy the LunaAPI.dll file either to an arbitrary folder and add the folder's path as a system variable or to the Windows system folder in the C:\Windows\System32 directory.
   - Copy these files from LUNA_HOME\jsp\lib into your JAVA_HOME\jre\lib\ext folder:
     - Luna 4.x: LunaJCASP.jar and LunaJCESP.jar
     - Luna 5.x: LunaProvider.jar

   For UNIX/Linux:
   - Copy these files from LUNA_HOME/jsp/lib into your JAVA_HOME/jre/lib/ext folder:
     - libLunaAPI.so
     - Luna 4.x: LunaJCASP.jar and LunaJCESP.jar
     - Luna 5.x: LunaProvider.jar

SafeNet provides some sample Java applications that may be run to ensure that the Java/HSM interface is working properly prior to installing PingFederate. Please contact SafeNet support for more information.

3. In your Java SDK directory, open the file java.security in the jre/lib/security directory and add the line in boldface below to the list of security providers, after all Sun providers:

   Luna 4.x:
   
   # List of providers and their preference orders (see above):
   security.provider.1=sun.security.provider.Sun
   security.provider.2=sun.security.rsa.SunRsaSign
   security.provider.3=com.sun.net.ssl.internal.ssl.Provider
   security.provider.4=LunaProvider
security.provider.4=com.sun.crypto.provider.SunJCE
security.provider.5=sun.security.jgss.SunProvider
security.provider.6=com.sun.security.sasl.Provider
security.provider.7=org.jcp.xml.dsig.internal.dom.XMLDSigRI
security.provider.8=sun.security.smartcardio.SunPCSC
security.provider.9=sun.security.mscapi.SunMSCAPI
security.provider.10=com.chrysalisits.crypto.LunaJCAProvider
security.provider.11=com.chrysalisits.cryptox.LunaJCEProvider

Luna 5.x:
   # List of providers and their preference orders (see above):
security.provider.1=sun.security.provider.Sun
security.provider.2=sun.security.rsa.SunRsaSign
security.provider.3=com.sun.net.ssl.internal.ssl.Provider
security.provider.4=com.sun.crypto.provider.SunJCE
security.provider.5=sun.security.jgss.SunProvider
security.provider.6=com.sun.security.sasl.Provider
security.provider.7=org.jcp.xml.dsig.internal.dom.XMLDSigRI
security.provider.8=sun.security.smartcardio.SunPCSC
security.provider.9=sun.security.mscapi.SunMSCAPI
security.provider.10=com.safenetinc.luna.provider.LunaProvider

4. Save and close the java.security file.
5. Install PingFederate on the network interconnected to the HSM (see “Installation” on page 11).
6. In the <pf_install>/pingfederate/server/default/data directory, delete files with the extension .jks, specifically:
   - ping-dsig.jks
   - ping-dsig-cert.jks
   - ping-ssl-server.jks
   - ping-ssl-server-cert.jks
   - ping-ssl.jks
   - ping-trust.jks
   - ping-ssl-client-trust-cas.jks
7. In the hivemodule.xml file in the <pf_install>/pingfederate/server/default/conf/META-INF directory, in the Crypto provider section, change the value of the construct class, as shown below in bold:
   Luna 4.x:
   <construct class="com.pingidentity.crypto.LunaJCEManager"/>
   Luna 5.x:
   <construct class="com.pingidentity.crypto.LunaJCEManager5"/>
8. Below the code in the previous step, change the value of the construct class to indicate that Luna is used as the Certificate Service service point, as shown below in bold:
   
   Luna 4.x:
   
   `<construct class="com.pingidentity.crypto.LunaCertificateServiceImpl"/>
   
   Luna 5.x:
   
   `<construct class="com.pingidentity.crypto.LunaCertificateServiceImpl5"/>
   
9. Save and close the `hivemodule.xml` file.

10. In the `run.properties` file found in the `<pf_install>/pingfederate/bin` directory, change the value of the `pf.hsm.mode` property near the end of this file from OFF to LUNA, as shown below in bold:
    
    `pf.hsm.mode=LUNA`

11. Save and close the `run.properties` file.

12. From the `<pf_install>/pingfederate/bin` directory, run the `hsmpass.bat` batch file for Windows or the `hsmpass.sh` script for UNIX/Linux.
   
   Enter the NTL password when prompted (see Step 1).
   
   This procedure sets and securely stores the password for NTL communication to the HSM from PingFederate.

   **Note:** The Luna SA HSM may be configured in a high-availability group—to do so, please refer to the SafeNet distributed-installation instructions. To properly synchronize data, ensure that the `HAOnly` property is enabled using this command:
   
   `vtl haAdmin –HAOnly –enable`

This completes the steps required to configure PingFederate for use with the Luna SA. You may start the PingFederate server in the normal way and proceed as you would for any other installation (see “Running PingFederate for the First Time” on page 17).

**Important:** To ensure expected behavior, SafeNet recommends restarting dependent processes such as PingFederate (including all server nodes in a cluster) whenever the Luna HSM is restarted.