

# Security

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Use this guide to reduce risk and mitigate threats to PingGateway security.



## **Threats**

Understand and address security threats.



## **Operating systems**

Secure your operating systems.



## **Connections**

Secure network connections.



## **Access**

Remove non-essential access and features, update patches, and manage cookies.



## **Keys and Secrets**

Manage keys and secrets.



## **Audit Trails**

Audit events in your deployment.

# Access

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The following sections describe how to prevent unwanted access to your deployment, and reduce the amount of non-essential information that it provides.

## Use a PingGateway service account

Install and run PingGateway from a dedicated service account. This is optional when evaluating PingGateway, but essential in production installations. For more information, refer to [Create a PingGateway service account](#).

## Remove non-essential access

Make sure only authorized people can access your servers and applications through the appropriate network, using the appropriate ports, and by presenting strong-enough credentials.

Apply the principle of least privilege to PingGateway logs and configuration directories. For more information, refer to [Configuration location](#).

Make sure that users connect to systems through the latest versions of TLS, and audit system access periodically.

Restrict access to your monitoring data by protecting the Prometheus Scrape Endpoint and Common REST Monitoring Endpoint (deprecated). Learn more from [Protecting the monitoring endpoints](#).

Prevent PingGateway from scanning for changes to routes. For information, see `scanInterval` in [Router](#).

Disable administration endpoints and Studio by setting the PingGateway run mode to `production`. For information, refer to [Operating modes](#).

## Remove non-essential features

The more features you have turned on, the greater the attack surface. If something isn't used, uninstall it, disable it, or protect access to it.

## Update patches

Prevent the exploitation of security vulnerabilities by using up-to-date versions of PingGateway and third-party software.

Review and follow the Ping Identity security advisories.

Follow similar lists from all of your vendors.


## Manage sessions

## *Expire PingOne Advanced Identity Cloud and AM sessions*

To minimize the time an attacker can attack an active session, set expiration timeouts for every PingOne Advanced Identity Cloud and AM session. Set timeouts according to context of the deployment, balancing security and usability so that the user can complete operations without the session frequently expiring.

Learn more in OWASP's [Session Management Cheat Sheet](#)<sup>↗</sup>.

### *Set a maximum session lifetime and idle time in PingOne Advanced Identity Cloud:*

- In the PingOne Advanced Identity Cloud admin UI, select  **Native Consoles** > **Access Management**.
- In the AM admin UI, select **Services** > **Add a Service** and add a **Session** service.
- Specify the following properties in minutes:
  - **Maximum Session Time**
  - **Maximum Idle Time**

### *Set a maximum session lifetime and idle time in PingAM:*

- In the AM admin UI, select **Services** > **Add a Service** and add a **Session** service.
- Specify the following properties in minutes:
  - **Maximum Session Time**
  - **Maximum Idle Time**

## *Validate the signature of PingOne Advanced Identity Cloud and AM session cookies*

Always configure `verificationSecretId` in the [CrossDomainSingleSignOnFilter](#).

When `verificationSecretId` is not configured, PingGateway doesn't verify the signature of AM session tokens, increasing the risk of CDSSO token tampering.

## Manage cookies

Increase the security of cookies generated by PingGateway or the protected application in the following ways:

- Change the default name of cookies to prevent them from being easily associated with an application.
- Create cookies with the `secure` flag to ensure that browsers cannot transmit the cookie over non-SSL.

When cookies have the `secure` flag, the first hop of the connection between the user agent and protected application must be secure (over HTTPS); subsequent

hops don't have to be secure. In this example, the first hop from the user agent to NGINX is secure, the subsequent hop to PingGateway is not secure:

```
User agent -> NGINX (https://acme.com) -> PingGateway
(http://gateway:8080)-> protected application
(https://internal.app:8081)
```

- Create cookies with the `httpOnly` flag, to ensure that the cookie cannot be accessed through client-side scripts, and to mitigate any cross-site scripting attacks.

Cookies are `httpOnly` by default in `admin.json`, `InMemorySessionManager`, `JwtSessionManager`, `CrossDomainSingleSignOnFilter`, and `FragmentFilter`.

- Set the `samesite` attribute of cookies to `STRICT` or `LAX`. Learn more in [SameSite cookies](#)<sup>↗</sup>.
- Set a timeout for cookies to strike a good compromise between security and usability.

Harden a PingGateway configuration by configuring the following objects:

- Configure the `cookie` property of the [InMemorySessionManager](#) (stateful sessions) or [JwtSessionManager](#) (stateless sessions).
- For authentication results, configure the `authCookie` property of the [CrossDomainSingleSignOnFilter](#).
- For the fragment part of a URI when a request triggers a login redirect, configure the `cookie` property of [FragmentFilter](#).

## Threats

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The following sections describe some of the possible threats to PingGateway, which you can mitigate by following the instructions in this guide.

### Out-of-date software

Prevent the exploitation of security vulnerabilities by using up-to-date versions of PingGateway and third-party software.

Review and follow the Ping Identity security advisories.

Follow similar lists from all of your vendors.

### Reconnaissance

The initial phase of an attack sequence is often reconnaissance. Limit the amount of information available to attackers during reconnaissance, as follows:

- Avoid using words that help to identify PingGateway in error messages, such as those produced by the entity in a `StaticResponseHandler`. For information, see [StaticResponseHandler](#).
- Use the lowest level of logging necessary. For example, consider logging at the `ERROR` or `WARNING` level, instead of `TRACE` or `MESSAGE`. For information, refer to [Changing the global log level](#).

## Cross-site scripting

When using a `StaticResponseHandler`, secure responses from cross-site scripting attacks, as follows:

- Sanitize any external input, such as the request, before incorporating it in the response.
- Specify `Content-Type` in the `headers` property of `StaticResponseHandler` when an entity is used. (Required by default, from PingGateway 7.)
- Set the response header `X-Content-Type-Options: nosniff` to prevent the user agent from interpreting the response entity as a different content type. (Set by default, from PingGateway 7.)
- Set a restrictive value in the `Cache-Control` response header. For example, setting `Cache-Control: private` indicates that all or part of the response message is intended for a single user and **MUST NOT** be cached by a shared cache.

## Compromised passwords

Despite efforts to improve how people manage passwords, users have more passwords than ever before, and many use weak passwords. You are strongly encouraged to use a password manager to generate secure passwords. You can use identity and access management services to avoid password proliferation, and you can ensure the safety of passwords that you cannot eliminate.

Manage passwords for server administration securely. Passwords supplied to PingGateway can be provided in files, through environment variables, or as system property values. Choose the approach that is most appropriate and secure for your deployment.

## Misconfiguration

Misconfiguration can arise from bad or mistaken configuration decisions, and from poor change management. Depending on the configuration error, features can stop working in obvious or subtle ways, and potentially introduce security vulnerabilities.

The following behaviour can be caused by misconfiguration:

- Routes fail to load, or succeed in loading but cause unexpected behaviour.

For example, if a configuration change prevents the server from making HTTPS connections, many applications can no longer connect, and the problem is detected immediately. However, if a configuration change allows insecure TLS protocol versions or cipher suites for HTTPS connections, some applications negotiate insecure TLS, but appear to continue to work properly.

- Access policy is not correctly enforced.

Incorrect parameters for secure connections and incorrect Access Control Instructions (ACI) can lead to overly permissive access to data, and potentially to a security breach.

- The server fails to restart.

Although failure to start a server is not directly a threat to security, it can affect service availability.

To guard against bad configuration decisions, implement good change management:

- For all enabled features, document why they are enabled and what your configuration choices mean. This implies a review of configuration settings, including default settings that you accept.
- Validate configuration decisions with thorough testing.
- Maintain a record of your configurations and the changes applied.

For example, use a filtered audit log. Use version control software for any configuration scripts and to record changes to configuration files.

- Maintain a record of external changes to the system, such as changes to operating system configuration, and updates to software, such as the JVM that introduces security changes.

## Unauthorized access

Data theft can occur when access policies are too permissive, and when the credentials to gain access are too easily cracked. It can also occur when the data is not protected, when administrative roles are too permissive, and when administrative credentials are poorly managed.

## Poor risk management

Threats can arise when plans fail to account for outside risks. To mitigate risk, develop appropriate answers to at least the following questions:


- What happens when a server or an entire data center becomes unavailable?
- How do you remedy a serious security issue in the service, either in the PingGateway software or the connected systems?
- How do you validate mitigation plans and remedial actions?
- How do client applications work when the PingGateway offline?

If client applications require always-on services, how do your operations ensure high availability, even when a server goes offline?

For critical services, test expected operation and disaster recovery operation.

## Operating systems

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When you deploy PingGateway, familiarize yourself with the recommendations for the host operating systems that you use. For comprehensive information about securing operating systems, refer to the [CIS Benchmark](#)  documentation.

## System updates

Over the lifetime of a deployment, the operating system might be subject to vulnerabilities. Some vulnerabilities require system upgrades, whereas others require only configuration changes. All updates require proactive planning and careful testing.

For the operating systems used in production, put a plan in place for avoiding and resolving security issues. The plan should answer the following questions:

- How does your organization become aware of system security issues early?

This could involve following bug reports, mailing lists, forums, and other sources of information.

- How do you test security fixes, including configuration changes, patches, service packs, and system updates?

Validate the changes first in development, then in one or more test environments, then in production in the same way you would validate other changes to the deployment.

- How do you roll out solutions for security issues?

In some cases, fixes might involve both changes to the service, and specific actions by those who use the service.

- What must you communicate about security issues?
- How must you respond to security issues?

Software providers often don't communicate what they know about a vulnerability until they have a way to mitigate or fix the problem. Once they do communicate about security issues, the information is likely to become public knowledge quickly. Make sure you can expedite resolution of security issues.

To resolve security issues quickly, make sure you are ready to validate any changes that must be made. When you validate a change, check that the fix resolves the security issue. Validate that the system and PingGateway software continue to function as expected in all the ways they are used.

## System audits

System audit logs make it possible to uncover system-level security policy violations that aren't recorded in PingGateway, such as unauthorized access to PingGateway files. Such violations aren't recorded in PingGateway logs or monitoring information.

Also consider how to prevent or at least detect tampering. A malicious user violating security policy is likely to try to remove evidence of how security was compromised.

## Unused features

By default, operating systems include many features, accounts, and services that PingGateway software doesn't require. Each optional feature, account, and service on the system brings a risk of additional vulnerabilities. To reduce the surface of attack, enable only required features, system accounts, and services. Disable or remove those that aren't needed for the deployment.

The features needed to run and manage PingGateway software securely include the following:

- A Java runtime environment, required to run PingGateway software.
- Software to secure access to service management tools; in particular, when administrators access the system remotely.
- Software to secure access for remote transfer of software updates, backup files, and log files.
- Software to manage system-level authentication, authorization, and accounts.
- Firewall software, intrusion-detection/intrusion-prevention software.
- Software to allow auditing access to the system.
- System update software to allow updates that you have validated previously.
- If required for the deployment, system access management software such as SELinux.
- Any other software that is clearly indispensable to the deployment.



Consider the minimal installation options for your operating system, and the options to turn off features.

Consider configuration options for system hardening to further limit access even to required services.

For each account used to run a necessary service, limit the access granted to the account to what is required. This reduces the risk that a vulnerability in access to one account affects multiple services across the system.

Make sure you validate the operating system behavior every time you deploy new or changed software. When preparing the deployment and when testing changes, maintain a full operating system with PingGateway software that is not used for any publicly available services, but only for troubleshooting problems that might stem from the system being *too* minimally configured.

## Network connections

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Protect network traffic by using HTTPS where possible, and secure communications during stateless sessions by signing and/or encrypting JWTs. For information about configuring PingGateway for HTTPS client-side and HTTPS server-side, refer to the [Installation guide](#).

### *Recommendations for incoming connections (from clients to PingGateway).*

Protocol	Recommendations
HTTP	<p>HTTP connections that aren't protected by SSL/TLS use cleartext messages. When you permit insecure connections, you cannot prevent client applications from sending sensitive data. For example, a client could send unprotected credentials in an HTTP Authorization header. Even if the server were to reject the request, the credentials would already be leaked to any eavesdroppers.</p> <p>Always use HTTPS for connections up to a load-balancer or proxy in front of the web application or server.</p>

Protocol	Recommendations
HTTPS	<p>Follow industry-standard TLS recommendations for <a href="#">Security/Server Side TLS</a>.</p> <p>Use a secure version of TLS/SSL to connect to TLS-protected endpoints with HTTP connection handlers, such as <a href="#">ClientHandler</a> and <a href="#">ReverseProxyHandler</a>. TLS protocols below 1.2 aren't considered secure.</p> <p>Some client applications require a higher level of trust, such as clients with additional privileges or access. Client application deployers might find it easier to manage public keys as credentials than to manage user name/password credentials. Client applications can use SSL client authentication.</p> <p>When using PingGateway REST to LDAP gateway, use HTTPS to protect client connections.</p>
JMX	Secure JMX access with the SSL/TLS-related properties, such as <code>use-ssl</code> and others.
SSH	<p>PingGateway administration tools can connect securely.</p> <p>Administrators should use SSH when changing the PingGateway configuration or binaries.</p> <p>The user account for running PingGateway should not be the same user account for connecting remotely.</p> <p>Secure Copy (SCP) uses SSH to transfer files securely. SCP is an appropriate protocol for copying backup data, for example.</p>

*Recommendations for outgoing connections (from PingGateway to another service.)*

Client	Recommendations
Common Audit event handlers	Configure ForgeRock Common Audit event handlers to use HTTPS when connecting to external log services.

Client	Recommendations
OAuth 2.0-based HTTP authorization mechanisms	<p>HTTP authorization can be based on OAuth 2.0, where PingGateway servers act as resource servers, and make requests to resolve OAuth 2.0 tokens.</p> <p>Use HTTPS to protect the connections to OAuth2ResourceServerFilter and AuthorizationCodeOAuth2ClientFilter. For information, refer to <a href="#">OAuth2ResourceServerFilter</a> and <a href="#">AuthorizationCodeOAuth2ClientFilter</a>.</p>

## Message-level security

Server protocols such as HTTP and JMX rely on TLS to protect connections. To enforce secure communication, configure TLS as follows:

- HTTPS server-side: Configure [admin.json](#), [Configure PingGateway for TLS \(server-side\)](#).
- HTTPS client-side: Configure trust managers and key managers, as described in [Configure PingGateway for TLS \(client-side\)](#).

When negotiating connection security, the server and client must use a common security protocol and cipher suite. In ClientTlsOptions and ServerTlsOptions, define lists of security protocols and cipher suites. For security, use the most recent protocols and ciphers that the client supports. Clients with older TLS implementations might not support the most recent protocols and ciphers.

## Keys and secrets

PingGateway uses cryptographic keys for encryption, signing, and securing network connections, and passwords. The following sections describe how to secure keys and secrets in your deployment.

### About secrets

PingGateway uses the Commons Secrets API to manage secrets, such as passwords and cryptographic keys.

Repositories of secrets are managed through secret stores, provided to the configuration by the `SecretsProvider` object or `secrets` object.

Learn more from:

- Secrets
- SecretsProvider

## *Secret types*

PingGateway uses the following secret types:

### ***GenericSecret***

An opaque blob of bytes, such as a password or API key, without any metadata.

A `GenericSecret` cannot be used to perform cryptographic operations.

### ***CryptoKey***

A secret that contains either a private or shared key, and/or a public certificate. A `CryptoKey` contains the secret material itself and its metadata; for example, the associated algorithm or key type.

This secret type can be used for cryptographic operations. For example:

- A `Base64EncodedSecretStore` can only serve secrets of the `GenericSecret` type.
- An `HsmSecretStore` can only server secrets of the `CryptoKey` type.
- A `FileSystemSecretStore` can serve secrets of both types.

## *Secret terminology*

PingGateway uses the following terms to describe secrets:

### ***Secret ID***

A label to indicate the purpose of a secret. A secret ID is generally associated with one or more aliases of a key in a keystore or HSM.

### ***Stable ID***

A label to identify a secret. The stable ID corresponds to the following values in each type of secret store:

- `Base64EncodedSecretStore`: The value of `secret-id` in the `"secret-id": "string"` pair.
- `FileSystemSecretStore`: The filename of a file in the specified directory, without the prefix/suffix defined in the store configuration.
- `HsmSecretStore`: The value of an `alias` in a `secret-id / aliases` mapping.
- `JwkSetSecretStore`: The value of the `kid` of a JWK stored in a `JwkSetSecretStore`.
- `KeyStoreSecretStore`: The value of an `alias` in a `secret-id / aliases` mapping.

- `SystemAndEnvSecretStore`: The name of a system property or environment variable

### ***Valid secret***

A secret whose purpose matches the secret ID **and** any purpose constraints. Constraints can include requirements for the following:

- Secret type, such as signing key or encryption key
- Cryptographic algorithm, such as Diffie-Hellman and RSA
- Signature algorithm, such as ES256 and ES384

Constraints are defined when the secret is generated, and cannot be added after.

### ***Named secret***

A valid secret that a secret store can find by using a secret ID and stable ID.

### ***Active secret***

A valid secrets that's considered eligible at the time of use. The way that the active secret is chosen is determined by the type of secret store. For more information, refer to [Secrets](#),

## About keys and certificates

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

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

Integrate CA certificates by using secret stores:

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

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

Note the following points about using secrets:

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

keystore is changed.

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

## Validate the signature of signed tokens

PingGateway validates the signature of signed tokens as described here.

### *Named secret resolution*

If a JWT contains a `kid`, PingGateway queries the secret stores declared in `secretsProvider` or `secrets` to find a named secret, identified by a secret ID and stable ID.

If a named secret is found, PingGateway then uses the named secret to try to validate the signature. If the named secret can't validate the signature, the token is considered as invalid.

If a named secret isn't found, PingGateway tries valid secret resolution.

### *Valid secret resolution*

PingGateway uses the value of `verificationSecretId` as the secret ID, and queries the declared secret stores to find all secrets that match the provided secret ID.

All matching secrets are returned as valid secrets, in the order that the secret stores are declared, and for `KeyStoreSecretStore` and `HsmSecretStore`, in the order defined by the mappings.

PingGateway tries to verify the signature with each valid secret, starting with the first valid secret, and stopping when it succeeds.

If no valid secrets are returned, or if none of the valid secrets can verify the signature, the token is considered as invalid.

For examples where a `StatelessAccessTokenResolver` uses a secret store to validate the signature of signed tokens, refer to the example sections of [JwkSetSecretStore](#) and [KeyStoreSecretStore](#).

## Algorithms for elliptic curve digital signatures

When the Elliptic Curve Digital Signature Algorithm (ECDSA) is used for signing, and both of the following conditions are met, JWTs are signed with a deterministic ECDSA:

- Bouncy Castle is installed.

- The system property `org.forgerock.secrets.preferDeterministicEcdsa` is `true`, which is its default value.

Otherwise, when ECDSA is used for signing, JWTs are signed with a non-deterministic ECDSA.

A non-deterministic ECDSA signature can be verified by the equivalent deterministic algorithm.

For information about deterministic ECDSA, refer to [RFC 6979](#). For information about Bouncy Castle, refer to [The Legion of the Bouncy Castle](#).

## Update cryptography

Different algorithms and methods are discovered and tested over time, and communities of experts decide which are the most secure for different uses. Use up-to-date cryptographic methods and algorithms to generate keys.

### WARNING

Legacy keystore types such as JKS and JCEKS are supported but aren't secure. Consider using the PKCS#12 keystore type.

## Use strong keys

Small keys are easily compromised. Use at least the [recommended key size](#).

In JVM, the default ephemeral Diffie-Hellman (DH) key size is 1024 bits. To support stronger ephemeral DH keys, and protect against weak keys, consider setting the following system property to increase the DH key size:

```
jdk.tls.ephemeralDHKeySize=2048.
```

For more information, refer to [Customizing size of ephemeral Diffie-Hellman keys](#).

## Rotate keys

Rotate keys regularly to:

- Limit the amount of data protected by a single key.
- Reduce dependence on specific keys, making it easier to migrate to stronger algorithms.
- Prepare for when a key is compromised. The first time you try key rotation shouldn't be during a real-time recovery.
- Conform to internal business compliance requirements.

For more information, refer to [Rotate keys](#).

# Audits and logs

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## Audit trails

Audits in PingGateway record access to a route. Audit logs in operating systems detect system login attempts and changes to the software.

The PingGateway audit logging service adheres to the log structure common across the Ping Identity Platform. For information, refer to [Audit the deployment](#).

Prevent logging of sensitive data for audit events by excluding fields from the audit logs. For information, refer to [Including or excluding audit event fields in logs](#).

## Log files

Logs in PingGateway contain informational, error, and warning events, to troubleshoot and debug transactions and events that take place within the PingGateway instance.

Protect logs from unauthorised access, and make sure they contain a minimum of sensitive or personally identifiable information that could be used in attacks.

When using a `CaptureDecorator`, mask captured header and attribute values to avoid disclosing information, such as token values or passwords. For information, refer to [CaptureDecorator](#).

Limit the number of repeat log messages to prevent log flow attacks, by adding a custom `logback.xml` with a `DuplicateMessageFilter`. For information, refer to [Limit repetitive log messages](#).

Was this helpful?  