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1 Installation

Reflection for Secure IT, Client and Server for UNIX provides secure connections between computers. Use Reflection for Secure IT for secure file transfer, secure remote administration of computers, and to tunnel application traffic securely across a network. Both client and server installation packages are available. The server package installs all client features in addition to the server features.

Reflection for Secure IT Client features

- ssh (Secure Shell client)
- ssh2_config (client configuration file)
- sftp (secure file transfer)
- scp (secure file copy)
- ssh-keygen (key generation utility)
- ssh-agent (key agent)
- ssh-add (add identities to the agent)
- ssh-askpass (X11 passphrase utility)
- ssh-certtool (certificate management utility)
- ssh-certview (certificate viewing utility)

By default, client executables are installed to /usr/bin. (On Linux ssh-askpass is installed to /usr/libexec.) The global client configuration file is installed to /etc/ssh2/.

Reflection for Secure IT Server features

The Reflection for Secure IT server includes all of the client features listed above plus the following Secure Shell server features.

- ssdh (Secure Shell daemon)
- ssdh2_config (server configuration file)
- A host public/private key pair (see note below)
- sftp-server (file transfer subsystem used by the server)

By default, the ssdh server is installed to /usr/sbin. The sftp-server is installed to /usr/bin. (On Linux sftp-server is installed to /usr/libexec.) The server configuration file is installed to /etc/ssh2.

NOTE: The server installation package checks to see if an existing host key pair is already present. If no host key is found, the package creates a new host key pair and the server uses this pair for host authentication. If a host key already exists in /etc/ssh2, Reflection for Secure IT uses this key. If an OpenSSH host key is found in /etc/ssh, Reflection for Secure IT migrates the key to the correct format and location and uses the migrated key.

In this Chapter

- "Which Package do I Need?" on page 8
- "Replace an Earlier Version or other Existing Secure Shell Program" on page 9
- “Install and Uninstall on Linux” on page 10
- “Set up High Availability Red Hat Clusters” on page 11
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- “Install Reflection PKI Services Manager” on page 20

Which Package do I Need?

The following table provides the name of the server installation file required for each of the supported platforms.

NOTE: The server packages listed here install both the client and server features (page 7). Replace “server” with “client” in the installation package name to install just the client features.

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<td>rsit-server-&lt;build&gt;-powerpc-aix6.1.bff.Z</td>
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<td>HP-UX 11i v2, v3 (Itanium)</td>
<td>rsit-server-&lt;build&gt;-ia64-hpux-11.23.depot.Z</td>
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<td>HP-UX 11i v2 (PA-RISC)</td>
<td>rsit-server-&lt;build&gt;-parisc-hpux-11.23.depot.Z</td>
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<td>Red Hat Enterprise Linux 5, 6 (Intel 86)</td>
<td>rsit-server-&lt;build&gt;-i386-rhel.rpm</td>
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<td>rsit-server-&lt;build&gt;-i586-sles.rpm</td>
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<td>SUSE Linux Enterprise Server 10, 11 (x86_64)</td>
<td>rsit-server-&lt;build&gt;-x86_64-sles.rpm</td>
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<td>Oracle Solaris 10 (x86-64)</td>
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<td>Oracle Solaris 11 (SPARC)</td>
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<td>Oracle Solaris 11 (x86-64)</td>
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Replace an Earlier Version or other Existing Secure Shell Program

If you're installing on a system that is already running a Secure Shell client or server, you must uninstall the prior version before you install Reflection for Secure IT. This requirement applies to earlier versions of Reflection for Secure IT, as well as F-Secure SSH, OpenSSH, and other Secure Shell implementations.

To install on a system that is currently running Secure Shell

1. Log in as root.
2. (Server only) Stop the **sshd** service.
3. Uninstall your existing Secure Shell product.
4. (AIX only) Check for the existence of a hidden .toc file in the directory from which you ran **installp** to uninstall your previous version. If this file is present, remove or rename it.
5. Install the Reflection for Secure IT client or server.
6. If you use public key authentication, ensure that your files and directories are configured with correct permissions. This release of Reflection for Secure IT requires a greater degree of security than was required prior to version 7.2. If files and directories are not sufficiently protected, public key authentication will fail. For details, see “File and Directory Permissions” on page 130.

**NOTE:** The **StrictModes** setting affects the level of protection required for files and directories used for public key authentication. To ensure enforcement of a satisfactory level of security, this setting is now enabled by default. Some file and directory permissions are enforced even when this setting is disabled.

7. (Optional) If you had configured a non-default client or server configuration file, you will find a backup copy of your file in the configuration file directory. (For details see the note below.) Use these backup files to merge your non-default settings to the new configuration file.

**NOTE**

- The server installation package checks to see if an existing host key pair is already present. If no host key is found, the package creates a new host key pair and the server uses this pair for host authentication. If a host key already exists in /etc/ssh2, Reflection for Secure IT uses this key. If an OpenSSH host key is found in /etc/ssh, Reflection for Secure IT migrates the key to the correct format and location and uses the migrated key.
- The details of how backup configuration files are created vary with the associated operating system.
  - On all platforms except AIX, if you have made any changes to the default client and/or server configuration file, the installer backs up the file when you uninstall. (The file extension added to this backup depends on the native installer.)
  - On AIX, no backup file is created when you uninstall; instead, a backup file is created if a non-default configuration file is present when you install Reflection for Secure IT.
- Key pairs created with previous Reflection for Secure IT versions are compatible with the current version. No conversion is necessary.
- The **StrictModes** default value is now "yes" for both the client and server.
If `/etc/pam.d/ssh` exists, it is backed up and a new file is put in place.

Subconfiguration files, if present, are not touched.

## Install and Uninstall on Linux

### To install Reflection for Secure IT on Linux

1. Log in as root.
2. Copy the installation package file (page 8) to your computer and navigate to the directory that contains this file.
3. Use `rpm` to install the package:

   ```bash
   rpm -ivh package_name.rpm
   
   For example:
   
   rpm -ivh rsit-server-8.0.2.999-x86_64-rhel.rpm
   ```

### Changing the Installation Location

You can use the `rpm --relocate` option to specify new target locations for installed files. Two modifications are supported.

- Specify a new target location for configuration files and keys that are installed by default to `/etc/ssh2`.
- Specify a new target location for binaries and man pages that are installed by default to `/usr`.

The following installed items are not relocated: startup and shutdown scripts, the cryptographic module, and the PKI client library.

### To install to a non-default location

1. Create the target directories.
2. Use the `rpm --relocate` option to specify your target directories. The general syntax is:

   ```bash
   rpm --install --relocate /usr=PrefixDir --relocate /etc/ssh2=SysConfDir package_file.rpm
   
   For example
   
   rpm --install --relocate /usr=/opt/rsit --relocate /etc/ssh2=/opt/rsit/etc
   rsit-server-8.0.2.999-1386-rhel.rpm
   ```

### NOTE

- Use `--relocate` modifications to the installation only as described above. Using other modifications will likely result in an unusable installation.
- To provide access to binaries and man pages after installing to a non-default location, modify the system PATH and MANPATH variables.

### To uninstall

1. Log in as root.
2 Enter one of the following commands.

For                     Use

server         rpm -e --nodeps rsit-server
client         rpm -e --nodeps rsit-client

Related Topics

* "Replace an Earlier Version or other Existing Secure Shell Program" on page 9
* "Migrate Settings from Existing Configuration Files" on page 18
* "Set up High Availability Red Hat Clusters" on page 11
* "Install Reflection PKI Services Manager" on page 20
* "Troubleshooting Systems Running SELinux" on page 99

Set up High Availability Red Hat Clusters

Red Hat High Availability allows you to connect a group of computers (called nodes) to work together as a cluster. Starting with version 8.0 SP2, Reflection for Secure IT is supported in a Red Hat Enterprise Linux 7 Cluster environment. Refer to Red Hat documentation for information about setting up and configuring the cluster. Review the following information to install and setup Reflection for Secure IT to run in the cluster.

Before you begin

Review the files used by the Reflection for Secure IT server to determine which files are required by your configuration. For a list of these files, see Files Used by the Server (page 103). Make a plan for where these files will be located in your cluster environment. For example:

* If you plan on keeping all server files on the nodes, you will need to copy required files (such as the host key and files required for user public key authentication) to each node to ensure a seamless transition to a new node.
* If you plan on locating some files on a shared file server, you can modify settings in \texttt{sshd2\_config} (such as HostKeyFile and UserConfigDirectory) to point to the shared location.

To install Reflection for Secure IT in a Red Hat Cluster

1 Install Reflection for Secure IT on each node.

2 Copy required server files to each node. For example, if you have left the default value for HostKeyFile keyword, copy an identical host key file to the default location \texttt{(/etc/ssh2/hostkey)} on each node. If you have modified \texttt{sshd2\_config}, copy the modified file to each node.

3 Disable the Reflection for Secure IT server from automatically starting at reboot. The cluster will manage starting the server. For example:

$ sudo chkconfig --del sshd

4 List the LSB agents and confirm that sshd is there. For example:

$ sudo crm\_resource --list\_agents lsb
netconsole
network
rhnsd
Sshd
5 Create a pcs resource for sshd as an lsb agent. For example:
   $ sudo pcs resource create sshd_svc lsb:sshd op monitor interval=30s

6 List out the defined resource and confirm that the new sshd_svc is listed. For example:

   $ sudo crm_resource --list
   dummy_svc (ocf::heartbeat:Dummy):Started
   sshd_svc (lsb:sshd):Started

7 Stop the sshd service on each node. For example:
   $ /etc/init.d/sshd stop

---

**Install and Uninstall on Oracle Solaris 10**

**To install Reflection for Secure IT on Solaris 10**

1 Log in as root.

2 Uninstall any existing SSH product. To uninstall Reflection for Secure IT, see the uninstall procedure below. To uninstall Oracle SSH, use `pkgrm` to remove all SSH components. For example:

   pkgrm SUNWsshu
   pkgrm SUNWsshr
   pkgrm SUNWsshdr
   pkgrm SUNWsshdu
   pkgrm SUNWsshcu

3 Copy the installation package file (page 8) to your computer and navigate to the directory that contains this file.

4 Use `uncompress` to unpack the package.

   uncompress package_name.pkg.Z

   For example:

   uncompress rsit-client-8.0.2.999-sparc-solaris10.pkg.Z

5 Use `pkgadd` to install the package.

   pkgadd -d package_name.pkg

   For example:

   pkgadd -d rsit-client-8.0.1.999-sparc-solaris10.pkg

**NOTE:** On systems running Solaris 10, you can use zones to partition a single Solaris instance into isolated application environments. For information about installing Reflection for Secure IT in a zones environment, refer to Technical Note 2254 (http://support.attachmate.com/techdocs/2254.html).
Changing the Installation Location (Solaris 10)

To install Reflection for Secure IT to a non-default location, you can create a response file (a text file that provides information to the installer package) and use the PREFIX variable to identify the target directory for the installation, as described in the next procedure. The PREFIX variable has the following effects:

- Configuration files and keys that are installed by default to /etc/ssh2 are relocated to $PREFIX/etc/ssh2.
- Binaries and man pages that are installed by default to /usr are relocated to $PREFIX.

The following installed items are not relocated: startup and shutdown scripts, the cryptographic module, and the PKI client library.

To install to a non-default location

1. Create the target directory.
2. Create a response file (rsp in this example) that redirects the installation to your target directory (/opt/rsit in this example).
   
   ```bash
   echo "PREFIX=/opt/rsit" > rsp
   ```
3. Use the `pkgadd -r` option to provide the relocation information during the installation. For example:

   ```bash
   pkgadd -r rsp -d rsit-server-8.0.1.999-x64-solaris10.pkg
   ```

**NOTE:** To provide access to binaries and man pages after installing to a non-default location, modify the system PATH and MANPATH variables.

To uninstall

1. Log in as root.
2. Use the `pkgrm` command to remove the package:

   ```bash
   server:   pkgrm RSITsshs
   client:   pkgrm RSITsshc
   ```

Related Topics

- "Replace an Earlier Version or other Existing Secure Shell Program" on page 9
- "Migrate Settings from Existing Configuration Files" on page 18
- "Install Reflection PKI Services Manager" on page 20

Install and Uninstall on Oracle Solaris 11

On Solaris 11, Reflection for Secure IT installation uses the Image Packaging System (IPS).

To install Reflection for Secure IT on Solaris 11

1. Log in as root.
2 Uninstall any existing SSH product. To uninstall Reflection for Secure IT, see the uninstall procedure below. To uninstall Oracle SSH, use `pkg uninstall` to remove all SSH components. For example:

```bash
pkg uninstall service/network/ssh
pkg uninstall gnu-tar //Required in global zone only
pkg uninstall network/ssh
pkg uninstall ssh-key
```

3 Create an IPS repository and set the publisher to "microfocus." The repository name shown in this example is a recommendation, not a requirement. Setting the publisher name to "microfocus" is required. For example:

```bash
pkgrepo create microfocus-repository
pkgrepo -s microfocus-repository set publisher/prefix=microfocus
```

4 Copy the installation package file (page 8) to your computer and navigate to the directory that contains this file.

5 Extract the package:

```bash
server: tar xvfo rsit-server-<n.n.nn>-sparc-solaris11.tar.gz
client: tar xvfo rsit-client-<n.n.nn>-sparc-solaris11.tar.gz
```

6 Publish the package. Note that both the package directory and manifest names are different for server and client installs.

```bash
server: pkgsend -s microfocus-repository publish -d pkgs sshdmanifest
client: pkgsend -s microfocus-repository publish -d pkgc sshmanifest
```

7 Add the publisher in the repository you created ("microfocus-repository" in this example) to the configured publishers:

```bash
pkg set-publisher -p microfocus-repository
```

8 Install the package:

```bash
server: pkg install RSITsshs
client: pkg install RSITsshc
```

### Changing the installation location (Solaris 11)

Reflection for Secure IT installs a `pkgmogrify` input file called `relocate.mog` that supports installation to a non-default location using the following two configurable options:

- Use `sysconfdir` to specify an alternate location for configuration files and keys (installed by default to `/etc/ssh2`).
- Use `prefix` to specify an alternate location for binaries and man pages (installed by default to `/usr`).

To install to a non-default location

1 Download and extract the distribution package.
2 From the directory that contains the extracted files, run the `pkgmogrify` command using the syntax shown here.

- Replace the sample paths for `sysconfdir` and `prefix` with the installation directories of your choice.
- If you are installing the client, replace `sshdmanifest` with `sshmanifest` and replace `pkgs` with `pkgc`.

```
# pkgmogrify -D prefix=/opt/usr -D sysconfdir=/opt/etc/ssh2
-P pkgs/etc/rsit.conf sshdmanifest relocate.mog | pkgfmt > sshdmanifest.relocate
```

**NOTE:** This command creates a new manifest file (`sshdmanifest.relocate` in this example) that you will use when you publish the package. You must use this new manifest (not the original `sshdmanifest`). If you decide after running the `pkgmogrify` command that you want to install using defaults, or you decide to use an alternate relocation path, delete the expanded file set and run `tar xvfo <pkg_name>.tar.gz` again to restore all files to the original version.

1 Publish the package using the new manifest you created in the previous step. (For a client installation, replace "pkgs" with "pkgc"). For example:

```
pkgsend -s microfocus-repository publish -d pkgs sshdmanifest.relocate
```

2 Specify the repository and install the package. (For a client installation, replace "RSITsshs" with "RSITsshc").

```
pkg set-publisher -p microfocus-repository
pkg install RSITsshs
```

**NOTE**

- To provide access to binaries and man pages after installing to a non-default location, modify the system PATH and MANPATH variables.
- The following installed items are not relocated: startup and shutdown scripts, the cryptographic module, and the PKI client library.

### Installing to a non-global zone

When you run the `pkg install` command in the global zone, the package is installed only to the global zone; it is not propagated to any other zones. Two approaches are available to install Reflection for Secure IT to a non-global zone:

- Create the repository in the global zone and use this repository to install in the non-global zone. Publisher configuration changes made to the global zone are seen immediately by all non-global zones via the system repository.
- Create a repository in the non-global zone.

**NOTE:** Before you use either approach, first remove the Oracle SSH package as described above.

### To install in a non-global zone using the system repository

1 Create the repository in the global zone.

2 From the non-global zone, use `pkg publisher` to confirm that the "microfocus" publisher is available, as shown here:
# pkg publisher

PUBLISHER                     TYPE     STATUS P LOCATION
solaris        (syspub)     origin online T <system-repository>
microfocus     (syspub)     origin online F <system-repository>

## Execute the pkg install command as the zone administrator. (For a client installation, replace "RSITsshs" with "RSITsshc".)

```
# pkg install RSITsshs
```

### To install using a repository in the non-global zone

1. If you created a repository in the global zone, disable the "microfocus" publisher in the global zone:

   ```
   pkg set-publisher --disable microfocus
   ```

2. Log in as root in the non-global zone.

3. Use `pkg publisher` to confirm that the "microfocus" publisher is no longer available, as shown here:

   ```
   # pkg publisher
   PUBLISHER                     TYPE     STATUS P LOCATION
   solaris        (syspub)     origin online T <system-repository>
   ```

4. Create a repository in the non-global zone. This example configures a server installation.

   ```
   # tar xvfo rsit-server-8.0.1.99--sparc-solaris11.tar.gz
   # pkgrepo create zone-repository
   # pkgrepo -s zone-repository set publisher/prefix=microfocus
   # pkgsend -s zone-repository publish -d pkgs sshdmanifest
   # pkg set-publisher -p zone-repository
   # pkg publisher
   PUBLISHER                     TYPE     STATUS P LOCATION
   solaris        (syspub)     origin online T <system-repository>
   microfocus                  origin online F file:///export/zone-repository/
   ```

5. Install the package. (For a client installation, replace "RSITsshs" with "RSITsshc".)

   ```
   # pkg install RSITsshs
   ```

### Package Update

You can use the `pkg update` command (without a list of packages) to keep all zones synchronized with the global zone:

```
# pkg update
```

If you specify a list of packages, the update is performed only in the current zone. The following command when run in the global zone will update only the global zone. When run in a non-global zone, it will update only the non-global zone.

```
# pkg update RSITsshs
```

### To uninstall

1. Log in as root.
2 Use `pkg uninstall` to remove the package:

   server:     pkg uninstall RSITsshs
   client:     pkg uninstall RSITsshc

Related Topics

- “Replace an Earlier Version or other Existing Secure Shell Program” on page 9
- “Migrate Settings from Existing Configuration Files” on page 18
- “Install Reflection PKI Services Manager” on page 20

Install and Uninstall on HP-UX

To install Reflection for Secure IT on HP-UX

1 Log in as root.
2 Copy the installation package file (page 8) to your computer and navigate to the directory that contains this file.
3 Use `uncompress` to unpack the package.

   `uncompress package_name.depot.Z`

   For example:

   `uncompress rsit-client-8.0.2.999-ia64-hpux-11.23.depot.Z`

4 Use `swinstall` to install the unpacked package.

   `swinstall -s full_path_and_package_name.depot RSIT`

   For example:

   `swinstall -s /rsit/rsit-server-8.0.2.999-ia64-hpux-11.23.depot RSIT`

To uninstall

1 Log in as root.
2 (Server only) Use the server script to stop the `sshd` service.

   `/sbin/init.d/sshd2 stop`

3 Use `swremove` to uninstall the package.

   `swremove RSIT`

**NOTE:** Installing to non-standard locations is not supported on HP-UX.

Install and Uninstall on IBM AIX

To install Reflection for Secure IT on IBM AIX

1 Log in as root.
2 Copy the installation package file (page 8) to your computer and navigate to the directory that contains this file.

3 Use the `uncompress` command to unpack the package.

   `uncompress package_name.bff.Z`

   For example:

   `uncompress rsit-server-8.0.2.999-powerpc-aix6.1.bff.Z`

4 Use the `installp` command to install the package.

   `installp -d. RSIT.ssh`

To uninstall

1 Log in as root.

2 (Server only) Use the server script to stop the `sshd` service.

   `/etc/rc.d/init.d/sshd stop`

3 Use the `installp` command to uninstall the package.

   `installp -u RSIT.ssh`

4 Remove the hidden `.toc` file in the directory from which you ran `installp` in step 3.

**NOTE:** Installing to non-standard locations is not supported on IBM AIX.

**Related Topics**

- “Replace an Earlier Version or other Existing Secure Shell Program” on page 9
- “Migrate Settings from Existing Configuration Files” on page 18
- “Install Reflection PKI Services Manager” on page 20

**Migrate Settings from Existing Configuration Files**

A migration script is installed with Reflection for Secure IT, which you can use to migrate settings configured using any of the following products:

- F-Secure UNIX clients and servers
- Reflection for Secure IT 6.x UNIX clients and servers
- Reflection for Secure IT 7.x UNIX clients and servers.

The migration script is installed to:

   `/etc/ssh2/migrate.sh`

The script examines your configuration files to determine if setting changes are required. If changes are needed, you are prompted to confirm that you want to apply these changes. After you confirm the migration, new configuration files are created with the required updates along with backups of your original files. All operations are detailed in the script's output and log files. The log files document which settings have been migrated and which cannot be migrated. Log files are created in the same directory as the converted file and have names based on the converted filename (for example, `sshd2_config_migration.log`).
To migrate global configuration files

NOTE: When you run the migration script with no arguments, it migrates files located in the /etc/ssh2 directory. If /etc/ssh2/sshd2_config and /etc/ssh2/ssh2_config contain non-default settings, you are asked if you want to migrate these files. If these settings contain default values (which is the expected state after you uninstall the prior version and then install the current version), the script looks for the most recent backup files (for example *.rpmsave, *.save or *.backup) and asks if you want to migrate settings in the backup files.

1. Log in as root.
2. Uninstall the prior version.
3. Install the new version.
4. Run the migration script with no arguments:
   
   /etc/ssh2/migrate.sh

5. Respond to the prompts.
6. Review the migrated settings and the migration log and, where required, merge settings from the migrated backup files into sshd2_config and ssh2_config.

To migrate a user configuration file

1. Log in as root.
2. Run the migration script and specify the file you want to migrate. For example:
   
   /etc/ssh2/migrate.sh client ~/.ssh2/ssh2_config

To migrate PKI settings

You can use the following procedure to migrate certificate settings if Reflection PKI Services Manager is installed on a computer that has Reflection for Secure IT 6.x or F-Secure configuration files.

1. Log in as root.
2. Use pkid with the -m option to migrate settings from your prior version configuration files. For example:
   
   To migrate PKI settings in sshd2_config and ssh2_config files located in /etc/ssh2/ and migrate these settings to pki_config and pki_map files in the PKI Services Manager configuration folder:
   
   /usr/local/sbin/pkid -m /etc/ssh2/

   To migrate PKI settings in sshd2_config.backup and create new PKI Services Manager configuration files in the specified output directory:
   
   /usr/local/sbin/pkid -b /output/path/ -m /etc/ssh2/sshd2_config.backup

3. Review the migration log, which is created in the logs directory located in the PKI Services Manager data directory (page 176). (By default, this log records at a level of "info". The level can be elevated using -d.)

NOTE: If the pki_config file in the destination folder already has a trust anchor configured, no migration occurs. This helps ensure that the migration won't overwrite modifications you have already configured.
Install Reflection PKI Services Manager

Reflection PKI Services Manager is a service that provides X.509 certificate validation services. If you need support for user or server certificate authentication, you'll need to download and install this application. It is available at no additional charge.

To install Reflection PKI Services Manager

1. Log in as root.
2. Copy the installation package file (page 8) to your computer and navigate to the directory that contains this file.
3. Use gzip to unzip the package:
   ```
gzip -d package_name.tar.gz
   ```
   For example:
   ```
gzip -d pkid_1.3.0.999-i386-solaris.gz
   ```
4. Use tar to expand the file:
   ```
tar -xf package_name.tar
   ```
   This creates a directory based on the package name. For example:
   ```
   pkid_1.3.0.999--i386-solaris/
   ```
5. Change to this directory. For example:
   ```
cd pkid_1.3.0.999-i386-solaris
   ```
6. Run the install script:
   ```
   ./install.sh
   ```
7. You are prompted to specify installation locations. To accept the default locations (recommended), press Enter in response to these prompts.

**NOTE**

- On UNIX the install script automatically starts the service.
- Before Reflection PKI Services Manager can validate certificates you need to edit the default configuration and map files.

To uninstall

1. Log in as root.
2. Run the uninstall script. This script is installed to the bin directory in the PKI Services Manager data folder.
   ```
   /opt/attachmate -or- microfocus/pkid/bin/uninstall.sh
   ```

**NOTE:** The uninstall script renames your existing configuration directory using a name based on the current date, and time. For example, config.20140101143755. Your local-store directory and any certificates you have added to this directory remain unchanged.

Related Topics

- “Server Certificate Authentication Overview” on page 42
• “Configure Server Certificate Authentication” on page 44
• “Configure Certificate Authentication for Users” on page 57
Getting Started

In this Chapter

- “Start and Stop the Server” on page 23
- “Make an SSH Connection” on page 24
- “Transfer Files Using sftp” on page 25
- “Transfer Files Using scp” on page 26
- “Understanding Secure Shell” on page 27

Start and Stop the Server

The sshd service starts automatically after installation.

A script is installed, which you can use to start, stop, and restart the sshd service. The name and location of the script varies, depending on your operating system. When you use the script to start the server, the following sshd command is invoked.

sshd -oPidFile=sshd_PidFile_keyword_value

**NOTE:** Do not use inetd to launch sshd. This is not a supported configuration. Attempting this configuration in FIPS mode results in extremely long connection times for each user connection; this is because sshd needs to run required self tests for each connection.

To run the sshd service directly

1. Log in as root.
2. Include full path information:

   /usr/sbin/sshd options

To run the server script on Linux

**NOTE:** The following commands work on all Linux platforms, although in some cases the actual script file is installed to a different location.

1. Log in as root.
2. Use the following commands to start, stop, and restart the sshd service:

   /etc/init.d/sshd start
   /etc/init.d/sshd stop
   /etc/init.d/sshd restart

To run the server script or service on Oracle Solaris

1. Log in as root.
2. Use the following to start, stop, and restart the sshd service:
   - On Solaris 8 and 9 use the following commands to start, stop, and restart the sshd service:
/etc/init.d/sshd2 start
/etc/init.d/sshd2 stop
/etc/init.d/sshd2 restart

- On Solaris 10 use the following service options to start, stop, restart, and check the state of the service:

  svcadm enable network/ssh
  svcadm disable network/ssh
  svcadm restart network/ssh
  svcs -l network/ssh

- On Solaris 11 use the following service options to start, stop, restart, and check the state of the service:

  svcadm enable network/RSITsshs
  svcadm disable network/RSITsshs
  svcadm restart network/RSITsshs
  svcs -l network/RSITsshs

To run the server script on HP-UX

1. Log in as root.
2. Use the following commands to start, stop, and restart the sshd service:

   /sbin/init.d/sshd2 start
   /sbin/init.d/sshd2 stop
   /sbin/init.d/sshd2 restart

To run the server script on IBM AIX

1. Log in as root.
2. Use the following commands to start, stop, and restart the sshd service:

   /etc/rc.d/init.d/sshd start
   /etc/rc.d/init.d/sshd stop
   /etc/rc.d/init.d/sshd restart

Make an SSH Connection

In most cases, you can connect to your host and log in using your password without making any changes to the default settings. Use ssh to connect to the remote server. The syntax is:

ssh [options] [user@]hostname[#port] [remote_command [arguments] ...]

When no user is specified, the client connects using your current login name. When no port is specified, the client uses the default port (which is 22 unless this has been changed in the client configuration file).

When no command is specified, ssh creates a new session on the remote host. When a command is specified, the command is executed on the host and then ssh exits. When no user is specified, the current user name is used.

To open a terminal session to a remote server using defaults

1. Use ssh to connect to the server. For example:

   ssh joe@myhost
The first time you connect to a host, you see a prompt asking you to confirm the authenticity of the host. For example:

Host key not found in hostkeys database.
Key fingerprint:
xesem-cyvic-puhen-dugid-kxipf-tizyh-behen-gymum-fozyb-cuxex
You can get a public key's fingerprint by running
% ssh-keygen -F publickey.pub
on the keyfile.
Are you sure you want to continue connecting (yes/no)?

You can confirm the validity of the host key by contacting the system administrator for that host. (For the procedure administrators can use to get this information, see “Display the Fingerprint of the Host Public Key” on page 42.)

3 Enter yes in response to the prompt to accept the connection to this host. This adds the host key to your known host key list (in `~/.ssh2/hostkeys`). Hosts whose key you hold are trusted hosts, and you will not see the unknown host prompt in subsequent connections.

4 Enter your password to complete the connection.

**NOTE:** To simplify initial connections and eliminate the risk created by allowing users to accept unknown keys, administrators can manually add the host key to a user-specific or global known hosts list. For details, see Add a Key to the Client Known Hosts List. (page 41)

### Related Topics

- “Display the Fingerprint of the Host Public Key” on page 42

### Transfer Files Using sftp

Use sftp to transfer files securely between the local computer and a remote host. You can also perform other file management commands, such as creating directories and changing file permissions. You can use sftp interactively or in combination with batch files to automate actions. For detailed information about command line options, see “sftp Command Line Options” on page 143. For an sftp command reference, see “Supported sftp Commands” on page 146.

#### To open an interactive sftp session

1 Connect to a remote host. For example:

```bash
sftp joe@myhost.com
```

**NOTE:** You can omit the user name if your name on the Secure Shell server is the same as your current user name.

After a successful connection is established, the following prompt appears:

```
sftp>
```
2 Do any of the following:

<table>
<thead>
<tr>
<th>To</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>View a list of supported commands</td>
<td><strong>help</strong>; for example:</td>
</tr>
<tr>
<td></td>
<td>sftp&gt; help</td>
</tr>
<tr>
<td>Learn more about supported commands</td>
<td><strong>help command</strong>; for example:</td>
</tr>
<tr>
<td></td>
<td>sftp&gt; help put</td>
</tr>
<tr>
<td>Transfer and manage files</td>
<td><strong>Supported commands</strong> (page 146); for example, to transfer the file demo from the local working directory to the remote working directory:</td>
</tr>
<tr>
<td></td>
<td>sftp&gt; put demo</td>
</tr>
<tr>
<td>End the session</td>
<td><strong>quit</strong>; for example:</td>
</tr>
<tr>
<td></td>
<td>sftp&gt; quit</td>
</tr>
</tbody>
</table>

**NOTE:** The first time you connect to a host, you may see a prompt asking you to confirm the authenticity of the host. For more information, see Make a Client Connection (page 24).

**Related Topics**

- “Secure File Transfer (sftp)” on page 65
- “Run sftp Batch Files” on page 66
- “Supported sftp Commands” on page 146

## Transfer Files Using scp

Use `scp` to copy files securely between the local computer and a remote host, or to transfer files securely between two remote hosts. The basic syntax is:

```bash
scp [[user@]host[#port]:]source [[user@]host[#port]:]destination
```

Both source and destination file names can include host and user specification to indicate that files are to be copied to or from that host.

**To copy a local file to the default remote directory**

- Use the following example to get started:
  ```bash
  scp file_src joe@myhost.com:
  ```

**To copy remote files to the local working directory**

- Use the following example to get started:
  ```bash
  scp joe@myhost:/demo*.htm .
  ```

For additional examples, see Secure File Copy (page 68). For detailed information about command line options, see “scp Command Line Options” on page 140.
Understanding Secure Shell

This diagram outlines the basic steps involved in creating a Secure Shell tunnel and using it to transmit data securely.

1. **Establish the secure connection.**
   
   The client and server negotiate to establish a shared key and cipher to use for session encryption, and a hash to use for data integrity checking. For additional information, see Data Protection (page 35).

2. **Authenticate the server.**
   
   Server authentication enables the client to confirm the identity of the server. The server has only one chance to authenticate to the client during the authentication process. If this authentication fails, the connection fails. For additional information, see “Server Authentication” on page 39.

3. **Authenticate the client.**
   
   Client authentication enables the server to confirm the identity of the client user. By default, the client is allowed multiple authentication attempts. The server and client negotiate to agree on one or more authentication methods. For additional information, see Client Authentication (page 51).

4. **Send data through the encrypted session.**
   
   Once the encrypted session is established, all data exchanged between the Secure Shell server and client is encrypted. Users now have secure remote access to the server and can execute commands and transfer files securely through the secure channel. For additional information, see “Secure File Transfer” on page 65.
5. **Use port forwarding to secure communications between other clients and servers.**

Port forwarding, also known as tunneling, provides a way to redirect communications through the Secure Shell channel of an active session. When port forwarding is configured, all data sent to a specified port is redirected through the secure channel. For additional information, see “Port Forwarding” on page 75.
3 Configuration Files

In this Chapter

- “Client Configuration Files” on page 29
- “Configuration File Format” on page 30
- “Host Stanzas” on page 30
- “Command Line Options” on page 31
- “Server Configuration Files” on page 31
- “Server Subconfiguration Files” on page 32
- “Subconfiguration File Samples” on page 33

Client Configuration Files

Reflection for Secure IT configuration files control connections made using ssh. The settings in the client configuration files also control scp and sftp connections. The default, global, configuration file is:

/etc/ssh2/ssh2_config

This file is installed when you install Reflection for Secure IT. The installed file contains commented out lines showing default values for the client settings. A duplicate copy of this file is installed to /etc/ssh2/ssh2_config.example.

In addition, you can create configuration files for individual users in:

~/.ssh2/ssh2_config

The ssh client processes settings cumulatively in the following order. If a setting is configured in more than one place, the last value processed overrides any previous value of the same setting.

1. System-wide configuration file: /etc/ssh2/ssh2_config
2. User-specific configuration file: ~/.ssh2/ssh2_config
3. Optional user configuration file specified using the -F switch on the ssh command line.
4. Command line options used with ssh, scp, and sftp.

For detailed information about client configuration file keywords, see “Client Configuration Keywords” on page 105.

Related Topics

- “Files Used by the Client” on page 101
- “Configuration File Format” on page 30
- “Host Stanzas” on page 30
- “Command Line Options” on page 31
Configuration File Format

The configuration file consists of keywords followed by values. You can use optional host stanzas to configure settings specific to individual hosts or groups of hosts. If a setting is configured in more than one place in the file, the value configured further down the list overrides the previous value.

Any line starting with a number sign (#) is a comment. Any empty line is ignored.

Regular Expressions

Regular expressions are evaluated using POSIX-Extended syntax. For details about regular expression rules, see:

http://www.opengroup.org/onlinepubs/7990989775/xbd/re.html

Keyword Syntax

Every keyword requires a value. The value can be separated from the keyword by spaces, or optional spaces and exactly one "=". Enclose the value in quotation marks (single or double) if it includes spaces. For example:

key value
key=value
key="value with spaces"
key=value1, value2

Keywords are not case sensitive.

Host Stanzas

Host stanzas are supported in client configuration files.

Use host stanzas to apply different settings to different hosts. To create a host stanza, use a regular expression that identifies an individual host or a group of hosts. Place this at the beginning of a new line, followed by a colon (:). This line cannot contain white space. When you initiate a connection, the client matches host stanza expressions against the host name you specify for that connection. If the host stanza expression matches your specified host, values within that stanza are applied to the connection. The client continues to search for matching host stanzas and applies any relevant settings until the end of the file is reached. Because the last value of a keyword overrides any previous value for the same keyword, you need to place global settings above host-specific settings. Settings outside of any stanza apply to all connections, but can be superseded by subsequent settings placed within a stanza.

You can configure global settings by creating a stanza labeled with ".:*". Settings in this stanza apply to any host you specify on the command line.

NOTE: Global settings configured in this stanza do not apply to a connection in which no host is specified. To make a successful connection without specifying a host, you must use a configuration file in which the Host keyword appears outside of a host stanza.

The following example sets the default user name to 'joe', and changes the user name to 'guy' for connections to samplehost.

.::*:
    user=joe
samplehost:
    user=guy
Command Line Options

You can configure client and server connections using command-line options in addition to, or instead of, using configuration files. Command line options override configuration file settings. Any option that can be configured in a configuration file, can also be set on the command line using the \(-o\) option. Syntax alternatives are shown below. Use quotation marks to contain expressions that include spaces.

\[-o key1=value\]
\[-o key1="sample value"\]
\[-o "key1 value"\]

To configure multiple options, use multiple \(-o\) switches.

\[-o key1=value -o key2=value\]

The following command lines show two equivalent ways to specify an identification file.

```
ssh -i testfile myname@myserver
ssh -o IdentificationFile=testfile myname@myserver
```

Server Configuration Files

Reflection for Secure IT server configuration files contain configuration settings for the sshd server. The default global configuration file is \(/etc/ssh2/sshd2_config\). You can specify an alternate file using the \(-f\) option on the sshd command line. You can also create and use optional subconfiguration files for specific client hosts or users.

A sample configuration file is installed to \(/etc/ssh2/sshd2_config\). This file includes commented lines that show all available settings and their default values. A duplicate copy of this file is installed to \(/etc/ssh2/sshd2_config.example\).

The basic format of the server configuration file is the same as the client configuration file. For details, see "Configuration File Format" on page 30.

Changes you make to the main server configuration file affect new connections immediately; you do not need to restart the server. Existing connections remain active using their original settings; subsequent connections use the new settings.

**NOTE:** Changes to Port, **ListenAddress** and FipsMode require a restart.

The server processes settings cumulatively in the following order. If a setting is configured in more than one place, the last value processed overrides any previous value of the same setting.

1. The global configuration file, or an alternate file specified on the sshd command line using \(-f\).
2. Any host-specific subconfiguration file(s) that you have created and identified using the HostSpecificConfig keyword.
3. Any user-specific subconfiguration file(s) that you have created and identified using the UserSpecificConfig keyword.
4. Command line options used with sshd.

Related Topics

- “Server Subconfiguration Files” on page 32
Server Subconfiguration Files

You can create and use optional subconfiguration files to configure settings that you want to apply to a subset of users or client hosts. Subconfiguration files are read by the process forked for each new connection. These files are read at runtime; any changes you make affect all subsequent connections.

User-specific Subconfiguration Files

Use the UserSpecificConfig keyword to configure user-specific subconfiguration files. The syntax for this keyword is:

UserSpecificConfig user_expression subconfig_file

If the user expression (page 87) matches the user attempting a connection, the server uses the specified subconfiguration file. An example file is installed to:

/etc/ssh2/subconfig/user.example

The user.example file includes a list of keywords that are supported in user-specific subconfiguration files.

NOTE: Security Note: If you configure a user-specific list for RequiredAuthentications that is different from the global allowed or required list, a malicious user attempting to authenticate can compare the client/server authentication negotiations of various accounts and use differences in the list of allowed authentications to determine that an account is valid on this system and different from other accounts on the system.

Host-specific Subconfiguration Files

Use the HostSpecificConfig keyword to configure settings to apply to a subset of client hosts. The syntax for this keyword is:

HostSpecificConfig host_expression subconfig_file

If the host expression (page 88) matches the client host, the server uses the specified subconfiguration file. An example file is installed to:

/etc/ssh2/subconfig/host.example

The host.example file includes a list of keywords that are supported in host-specific subconfiguration files.

Related Topics

- “Subconfiguration File Samples” on page 33
- “Server Configuration Files” on page 31
- “Access Control Settings” on page 85
- “Configuring User and Group Access” on page 87
- “Configuring Client Host Access” on page 88
Subconfiguration File Samples

The following sample files provide an example of how subconfiguration files might be used to apply connection settings to particular hosts and users. In the sample server configuration file, a host subconfiguration file is specified using the `HostSpecificConfig` keyword. In this example, settings in the host subconfiguration file apply to all users connecting from the acme.com domain. The host subconfiguration file uses the `UserSpecificConfig` keyword to specify a user subconfiguration file, whose settings apply only to connections from the user named joe, connecting from the acme.com domain.

Server Configuration File

Sample content for `/etc/ssh2/sshd2_config`.

```
Port=2222
RequireReverseMapping=yes
ResolveClientHostname=yes
# Specify a host-specific file for the users from acme.com
HostSpecificConfig=.*acme\.com /root/hostsubconfig
# Limit forwarding to user joe and constrain his forwarding rights
ForwardACL=allow remote joe .* peak.acme.com
```

Host Subconfiguration File

Sample content for `/root/hostsubconfig`.

```
AllowedAuthentications=publickey,password
Ciphers=aes128-cbc
# Allow sftp access only
SessionRestricted=subsystem
# Specify a user-specific file for user joe
UserSpecificConfig=joe /root/joesubconfig
```

User Subconfiguration File

Sample content for `/root/joesubconfig`.

```
RequiredAuthentications=publickey
# Allow both shell and sftp access
SessionRestricted=shell,subsystem
```
Supported Cryptographic Algorithms

In this Chapter

- “Encryption” on page 35
- “Data Integrity” on page 35
- “Digital Signatures” on page 36
- “Configuring Ciphers and MACs” on page 36
- “FIPS Mode” on page 37

Encryption

Encryption protects the confidentiality of data in transit. This protection is accomplished by encrypting the data before it is sent using a secret key and cipher. The received data must be decrypted using the same key and cipher. The cipher used for a given session is the cipher highest in the client's order of preference that is also supported by the server.

Reflection for Secure IT supports the following data encryption standards:

- Arcfour, Arcfour128, and Arcfour256 (stream mode)
- TripleDES (168-bit) CBC mode
- Cast (128-bit) CBC mode
- Blowfish (128-bit) CBC mode
- AES, also known as Rijndael (128-, 192-, or 256-bit) CBC mode and CTR mode

Related Topics

- “Configuring Ciphers and MACs” on page 36

Data Integrity

Data integrity ensures that data is not altered in transit.

Secure Shell connections use MACs (message authentication codes) to ensure data integrity. The client and server independently compute a hash for each packet of transferred data. If the message has changed in transit, the hash values are different and the packet is rejected. The MAC used for a given session is the MAC highest in the client's order of preference that is also supported by the server.

Reflection for Secure IT supports the following MAC standards:

- hmac-sha1
- hmac-md5
- hmac-sha1-96
- hmac-md5-96
- hmac-ripemd-160
• hmac-sha256
• hmac-sha2-256
• hmac-sha512
• hmac-sha2-512

Related Topics
• “Configuring Ciphers and MACs” on page 36

Digital Signatures

Digital signatures are used for public key authentication (including certificate authentication). The authenticating party uses the digital signature to confirm that the party being authenticated holds the correct private key. The Secure Shell client uses a digital signature to authenticate the host. The Secure Shell server uses a digital signature to authenticate the client when public key authentication is configured.

Reflection for Secure IT, Client and Server for UNIX supports the following digital signature algorithms:
• x509v3-rsa2048-sha256
• x509v3-sign-rsa
• x509v3-sign-dss
• ssh-rsa-sha2-256@attache.com
• ssh-rsa
• ssh-dss

Configuring Ciphers and MACs

The client and server support the same keywords for configuring ciphers and MACs. Configure client keywords in ssh2_config. Configure server keywords in sshd2_config.
Supported Cryptographic Algorithms

Ciphers can also be configured on the ssh, scp, and sftp command line using -c. For example:

```bash
ssh -c blowfish-cbc joe@remote.com
```

MACs can also be configured on the ssh and sftp command line using -m. For example:

```bash
sftp -m hmac-md5 joe@remote.com
```

**FIPS Mode**

The United States Government's Federal Information Processing Standard (FIPS) 140-2 specifies security requirements for cryptographic modules. Cryptographic products are validated against a specific set of requirements and tested in 11 categories by independent, U.S. Government-certified testing laboratories. This validation is then submitted to the National Institute of Standards and Technology (NIST), which reviews the validation and issues a certificate. In addition, cryptographic algorithms may also be validated and certified based on other FIPS specifications. The list of validated products and the vendor's stated security policy (the definition of what the module has been certified to do) can be found at: [http://csrc.nist.gov/groups/STM/cmvp/validation.htm](http://csrc.nist.gov/groups/STM/cmvp/validation.htm).

To configure Reflection for Secure IT to run in FIPS mode, use the `FipsMode` keyword. This keyword is supported for both the client and server.

**NOTE:** If you change the `FipsMode` setting on the server, you need to restart the server for the change to take full effect. A SIGHUP signal puts new sessions into FIPS-mode, but does not affect existing connections.

Enabling FIPS Mode has the following effects:

- All connections must be made using algorithms that meet FIPS 140-2 standards. Algorithms that don't meet these standards are not available, except where these algorithms are allowed by NIST for legacy compatibility.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ciphers</td>
<td>Allowed values are 'aes128-ctr', 'aes128-cbc', 'aes192-ctr', 'aes192-cbc', 'aes256-ctr', 'aes256-cbc', 'blowfish-cbc', 'arcfour', 'arcfour128', 'arcfour256', 'cast128-cbc', and '3des-cbc'. You can also set this value to 'one'. When 'none' is the agreed on cipher, data is not encrypted. Note that this method provides no confidentiality protection, and is not recommended. The following values are provided for convenience: 'aes' (all supported aes ciphers), 'blowfish' (equivalent to 'blowfish-cbc'), 'cast' (equivalent to 'cast128-cbc'), '3des' (equivalent to '3des-cbc'), 'Any' or 'AnyStd' (all available ciphers plus 'none'), and 'AnyCipher' or 'AnyStdCipher' (all available ciphers). The default is 'AnyStdCipher'.</td>
</tr>
<tr>
<td>MACs</td>
<td>Allowed values are 'hmac-sha256', 'hmac-sha1', 'hmac-sha1-96', 'hmac-md5', 'hmac-md5-96', 'hmac-sha512', and 'hmac-ripemd160'. Use 'AnyMac' to support all of these. Use 'AnyStdMac' to specify 'hmac-sha256', hmac-sha1,hmac-sha1-96,hmac-md5,hmac-md5-96, hmac-sha512'. Specifying hmac-sha256 also enables hmac-sha2-256. Specifying hmac-sha512 also enables hmac-sha2-512. Multiple MACs can also be specified as a comma-separated list. Additional options are 'none', 'any' (equivalent to AnyMac plus 'none'), and 'AnyStd' (equivalent to 'AnyStdMac' plus 'none'). When 'none' is the agreed on MAC, no message authentication code is used. Because this provides no data integrity protection, options that include 'none' are not recommended.</td>
</tr>
</tbody>
</table>
The minimum public key size allowed for authenticating for both users and hosts is reset from the default of 512 bits up to 1024 bits.

Because Reflection for Secure IT cannot verify the FIPS status of SecurID, GSSAPI, and RADIUS binaries, these authentication methods need to be manually disabled by the system administrator if they are not FIPS validated. To ensure that you have disabled all PAM authentication methods that are not FIPS validated, disable PAM (UsePAM=no) in the server configuration file (/etc/ssh2/sshd2_config).
Public Key Authentication Overview

Reflection for Secure IT uses public key host authentication by default. The server automatically generates a new host key (or migrates an existing host key) during installation. The default key is an RSA 2048-bit key.

Public key cryptography uses a mathematical algorithm with a public/private key pair to encrypt and decrypt data. One of the keys is a public key, which can be freely distributed to communicating parties, and the other is a private key, which should be kept secure by the owner of the key. Data encrypted with the private key can be decrypted only with the public key; and data encrypted with the public key can be decrypted only with the private key.

When keys are used for authentication, the party being authenticated creates a digital signature using the private key of a public/private key pair. The recipient must use the corresponding public key to verify the authenticity of the digital signature. This means that the recipient must have a copy of the other party’s public key and trust in the authenticity of that key.

How it Works

When public key authentication is used for host authentication, the following sequence of events takes place.

1. The Secure Shell client initiates a connection.
2. The server sends its public key to the client.
3. The client looks for this key in its trusted host key store.
### If the client

<table>
<thead>
<tr>
<th>Finds the host key, and the client copy matches the key sent by the server</th>
<th>This occurs</th>
</tr>
</thead>
<tbody>
<tr>
<td>The client displays a message that the host is unknown and provides a fingerprint of the host key. If the client is configured to allow the user to accept unknown keys (the default), the user can accept the key, and authentication proceeds to the next step.</td>
<td></td>
</tr>
<tr>
<td>If strict host key checking is enforced, the client ends the connection.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Does not find the host key</th>
</tr>
</thead>
<tbody>
<tr>
<td>The client displays a warning that the key doesn't match the existing key and displays the fingerprint of the key sent by the server. If the client is configured to allow the user to accept unknown keys (the default), the user can accept the new key.</td>
</tr>
<tr>
<td>If strict host key checking is enforced, the client ends the connection.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Finds a host key, and the client copy doesn't match the key sent by the server</th>
</tr>
</thead>
<tbody>
<tr>
<td>The client displays a warning that the key doesn't match the existing key and displays the fingerprint of the key sent by the server. If the client is configured to allow the user to accept unknown keys (the default), the user can accept the new key.</td>
</tr>
<tr>
<td>If strict host key checking is enforced, the client ends the connection.</td>
</tr>
</tbody>
</table>

4. To confirm that the server actually holds the private key that corresponds to the received public key, the client sends a challenge (an arbitrary message) to the server and computes a "hash" on page 175 based on this message text.

5. The server creates a digital signature based on the challenge message. To do this, the server independently computes the message hash, and then encrypts the computed hash using its private key. The server attaches this digital signature to the original challenge and returns this signed message to the client.

6. The client decrypts the signature using the public key and compares the hash with its own computed hash. If the values match, host authentication is successful.

---

### Create a New Host Key

In most cases, you do not need to make any changes to the default server host key. The server installation package checks to see if an existing host key pair is already present. If no host key is found, the package creates a new host key pair and the server uses this pair for host authentication. If a host key already exists in /etc/ssh2, Reflection for Secure IT uses this key. If an OpenSSH host key is found in /etc/ssh, Reflection for Secure IT migrates the key to the correct format and location and uses the migrated key.

To create and use a new host key

1. Log in as root.
2. Terminate any instances of sshd using the server script. (For additional information, see “Start and Stop the Server” on page 23.)
3. Use ssh-keygen to generate a new host key. For example:

   ```
   ssh-keygen -P /etc/ssh2/hostkey2
   ```

   **NOTE:** The -P option creates a key with no passphrase protection, which is required for host keys.
4 (Optional) If you use a new host key name and/or location, edit the server configuration file (/etc/ssh2/sshd2_config). Use the HostKeyFile keyword to specify the new name and location:

```
HostKeyFile=/etc/ssh2/hostkey2
```

This step is not required if you continue to use the default host key name (/etc/ssh2/hostkey).

5 Restart the service.

### Add a Key to the Client Known Hosts List

By default, the first time a client attempts to connect to the server, the user sees a message indicating that this is an unknown host. This message includes a fingerprint that identifies the host key. To be sure that this is actually the correct host key, the user should contact the host system administrator who can confirm that this is the correct fingerprint. Without this verification, the client is at risk of a "man-in-the-middle" attack. To simplify initial connections and eliminate the risk created by allowing users to accept unknown keys, you can manually add the host key to the client known hosts list.

**To add the server key to the client known hosts list**

**NOTE:** You will need a correctly named copy of the server's public host key. Client copies of known host keys use the following file name format:

```
key_port_host,IP.pub
```

Where `port` is the port used for the ssh connection, `host` is the host name, and `IP` is the host IP address. (Earlier versions used `key_port_host.pub`, and this format is still supported.)

An easy way to obtain a correctly named key is to make an initial connection to the server and allow the client to accept and name the host key. You can then distribute this copy of the host key. This is the technique used in the following procedure.

1 From your server, use `ssh-keygen` to display the fingerprint of the server’s public host key:

   ```
   ssh-keygen -F /etc/ssh2/hostkey.pub
   ```

2 From a client that has not yet connected to this host, initiate a connection to your server:

   ```
   ssh myname@myserver
   ```

   You'll see a message saying that the host key is not in the host key database.

3 Confirm that the host key fingerprint in this message matches the actual host key fingerprint, and enter 'yes' to accept the host key.

   You will see a message identifying the name and location of the host key you just accepted. For example:

   ```
   Host key saved to /home/joe/.ssh2/hostkeys/key_22_myserver,10.10.1.123.pub
   ```

4 Copy this key to the known host list of your client computers:

   - To add this host key for all users of the client computer, copy the host public key file to /etc/ssh2/hostkeys.
   - or-
   - To add this host key for an individual user, copy the host public key file to ~/.ssh2/hostkeys.
5 (Optional) Enable **StrictHostKeyChecking** so that users cannot accept unknown host keys. You can add the following line to a system-wide configuration file (`/etc/ssh2/ssh2_config`), or a user-specific configuration file (`~/.ssh2/ssh2_config`).

```plaintext
StrictHostKeyChecking=yes
```

**Display the Fingerprint of the Host Public Key**

The first time a client user connects to the server, he or she sees a prompt that includes the fingerprint of the server’s public host key. The server administrator can confirm the validity of the key by displaying the host key fingerprint on the server.

**To display the fingerprint that identifies the server’s public host key**

1. Log in to the server.
2. Use `ssh-keygen` to display the host key fingerprint:

   ```plaintext
   ssh-keygen -F /etc/ssh2/hostkey.pub
   ```

**Server Certificate Authentication Overview**

Certificate authentication is a form of public key authentication that solves some of the problems presented by public key authentication. With public key host authentication, the system administrator must either add the host public key for every server to each client’s list of known hosts, or count on client users to confirm the host identity correctly when they connect to an unknown host. Certificate authentication avoids this problem by using a trusted third party, called the certification authority (CA), to verify the validity of information coming from the host. With certificates, you can configure authentication using a single trust anchor instead of multiple unique server public keys.

**NOTE:** Reflection PKI Services Manager supports central management of PKI settings. You can install and configure a single instance of PKI Services Manager to provide certificate validation services for all supported Micro Focus and Attachmate products.

**Requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflection PKI Services Manager must be installed and correctly configured.</td>
<td>PKI Services Manager validates the certificate and uses a map file to determine which servers can authenticate with a valid certificate. You need to configure at least one trust anchor and one mapping rule for certificate validation to succeed. You may also need to configure access to intermediate certificates and to certificate revocation information.</td>
</tr>
<tr>
<td>A certificate signed by a CA and the associated private key must be installed on the server.</td>
<td>The server sends this certificate to the client to authenticate the server.</td>
</tr>
<tr>
<td>The Reflection for Secure IT UNIX client must have a copy of the PKI Services Manager public key and be configured to connect to PKI Services Manager.</td>
<td>The client communicates with PKI Services Manager to confirm the validity of the server certificate.</td>
</tr>
</tbody>
</table>
How it Works

1. The Reflection for Secure IT server presents a certificate to the client for server authentication.
2. The Reflection for Secure IT client connects to Reflection PKI Services Manager. (Set the server name and port for this connection using the Reflection for Secure IT client PkidAddress keyword.)
3. Reflection for Secure IT verifies the identity of PKI Services Manager using an installed public key. (Set the key name and location using the Reflection for Secure IT client PkidPublicKey keyword.)
4. Reflection for Secure IT sends the certificate and the server name to PKI Services Manager.
5. PKI Services Manager determines if the certificate is valid and whether the server is allowed to authenticate with this certificate based on the rules the PKI Services Manager administrator has configured in the PKI Services Manager map file. This information is returned to Reflection for Secure IT.
6. If the certificate is valid and the server presenting it is an allowed identity for this certificate, server authentication is successful.

Related Topics
- “Configure Server Certificate Authentication” on page 44
- “Configure Certificate Authentication for Users” on page 57
- “winpki and pkid Command Reference” on page 157
- “pkid_config Configuration File Reference” on page 159
- “pki_mapfile Map File Reference” on page 163

Obtain Authentication Certificates

Before you can configure authentication using certificates, you need a private key and an associated certificate signed by a trusted CA. For server authentication, these need to be installed and configured on the server. For user authentication, these need to be installed and configured on the client.

There are several ways to obtain the key and associated certificate. The approach you take depends on whether you want to obtain a certificate for an existing key, generate a new key and obtain a certificate for it, or obtain both the private key and the certificate from the CA.

To obtain a certificate for an existing private key

1. Use ssh-certtool to create a certificate request for your private key. For example:

   
   ssh-certtool -p privatekey pkcs10 "CN=acme,OU=demo,C=US"

   This creates a request file in PKCS#10 format. The default filename is output.pkcs10.

2. Submit the certificate request to the CA.
   The CA returns a digitally signed certificate.

3. If the returned certificate is packaged as a PKCS#12 (*.pfx or *.p12) or PKCS#7 file, you can use ssh-keygen to extract the certificate from the returned package.
   Use -k to extract the contents of a PKCS#12 file:

   
   ssh-keygen -k package.pfx
Use `-7` to extract the contents of a PKCS#7 file:

```
ssh-keygen -7 pkcs7file
```

**To generate a new private key and obtain a certificate**

1. Use `ssh-certtool` to create a private key and a certificate request for this private key. For example to generate an RSA key:

   ```
   ssh-certtool -n rsa pkcs10 "CN=acme,OU=demo,C=US"
   ```

   This creates a request file in PKCS#10 format. The default filename is `output.pkcs10`.

2. Submit the certificate request to the CA.

   The CA returns a digitally signed certificate.

3. If the returned certificate is packaged as a PKCS#12 (`*.pfx` or `*.p12`) or PKCS#7 file, you can use `ssh-keygen` to extract the certificate from the returned package.

   Use `-k` to extract the contents of a PKCS#12 file:

   ```
   ssh-keygen -k package.pfx
   ```

   Use `-7` to extract the contents of a PKCS#7 file:

   ```
   ssh-keygen -7 pkcs7file
   ```

**To obtain both the private key and certificate from a CA**

1. Submit your request to the CA.

   The CA returns a PKCS#12 (`*.pfx` or `*.p12`) that contains both the private key and a digitally signed certificate.

2. Use `ssh-keygen` with the `-k` option to extract the key and the certificate from the returned package. For example:

   ```
   ssh-keygen -k package.pfx
   ```

**Configure Server Certificate Authentication**

Before you begin, review the requirements described in the “Server Certificate Authentication Overview” on page 42 topic.

To configure server authentication using certificates, you need to install and configure Reflection PKI Services Manager and configure your server and client. Use the following procedures to get started. Many additional variations are possible. For more information, see the Reflection PKI Services Manager User Guide, which is available from http://support.attachmate.com/manuals/pki.html.

You can install and configure a single instance of PKI Services Manager to support certificate authentication requests from multiple Reflection for Secure IT clients and/or servers. However, because Reflection for Secure IT settings allow only one entry for the PKI Services Manager address and port, this configuration creates a potential single point of failure. If PKI Services Manager is unreachable or the server is not running, all authentication attempts using certificates will fail. To provide load balancing and failover, you can define a round-robin DNS entry for the PKI Services Manager host name or place the PKI Services Manager host behind a load balancing server. You can also configure PKI Services Manager to run in a Microsoft cluster environment.

**NOTE:** Paths shown here are based on the default installation options.
To install and configure PKI Services Manager

1 Log in as root on the Reflection PKI Services Manager server.
2 "Install Reflection PKI Services Manager" on page 20.
3 Put a copy of the certificate (or certificates) you want to designate as a trust anchor into your certificate store. The default PKI Services Manager store is in the following location in the installation folder:
   .../pkid/local-store
4 Open the PKI Services Manager configuration file in a text editor:
   .../pkid/config/pki_config
5 Use the TrustAnchor keyword to identify your trust anchor. For example:
   TrustAnchor = trustedca.crt
   -or-
   TrustAnchor = CN=SecureCA,O=Acme,C=US

   NOTE: To configure multiple trust anchors, add additional TrustAnchor lines.

6 Configure certificate revocation checking. For example:

   To                     Sample Configuration
   Use CRLs stored on an LDAP server.  RevocationCheckOrder = crls CRLServers=ldap://crlserver
   Use an OCSP responder. RevocationCheckOrder = ocsp OCSPResponders = http://ocspresponder

   NOTE: By default PKI Services Manager looks for CRLs in the local store. If you use this configuration, you need to copy the CRLs to your local store.

1 If intermediate certificates are required by the chain of trust in your certificates, configure access to these certificates. For example:

   To                     Sample Configuration
   Use intermediate certificates you have added to your local store.  CertSearchOrder=local
   Use certificates stored on an LDAP server. CertSearchOrder=certserver CertServers=ldap://ldapserver

2 Save your changes to the configuration file.
3 Open the PKI Services Manager map file (page 163) in a text editor:
   .../pkid/config/pki_mapfile
4 Create a host RuleType stanza and add one or more rules that define which hosts can authenticate with a valid certificate. For example:

   RuleType = host
   (myhost.com) Subject Contains "myhost"
For more sample rules, see Sample PKI Services Manager Mapping Rules (page 169).

NOTE: After a certificate is determined to be valid, rules are processed in order (based on rule type then sequence). If the certificate meets the requirements defined in the conditional expression (or if the rule has no condition), the allowed identities specified in that rule are allowed to authenticate. No additional rules are applied after the first match. This means that if you create a rule with no conditions, all allowed identities must be included in that rule.

5 Test for valid PKI Services Manager configuration:
   /usr/local/sbin/pkid -k
   No errors. Configuration is valid:

6 Restart Reflection PKI Services Manager.
   /usr/local/sbin/pkid restart

To configure the Reflection for Secure IT server

1 Install the server certificate and associated private key (page 43). For example:
   /etc/ssh2/server.key
   /etc/ssh2/server.crt

2 Set permissions on the server key for user-only read-only access:
   chmod 400 server.key

3 Open the server configuration file (/etc/ssh2/sshd2_config) in a text editor.

4 Configure the following keywords:
   HostCertificateFile=/etc/ssh2/server.crt
   HostKeyFile=/etc/ssh2/server.key

5 Restart the server (page 23).

To configure the Reflection for Secure IT client

1 If PKI Services Manager is not installed on the same host as the Reflection for Secure IT client, copy the PKI Services Manager public key to the Reflection for Secure IT client. The key location on PKI Services Manager is in the config directory in the PKI Services Manager installation directory:
   .../pkid/config/pki_key.pub
   Copy this to any location on the Reflection for Secure IT client. For example:
   /etc/ssh2/pki_key.pub

2 Open the client configuration file (/etc/ssh2/ssh2_config) in a text editor.

3 Edit PkidPublicKey to specify the location in which you placed the PKI Services Manager public key. For example:
   PkidPublicKey=/etc/ssh2/pki_key.pub

4 Edit PkidAddress to specify the PKI Services Manager host and port. For example:
   PkidAddress=pkiserver.acme.com:18081

NOTE: If you specify a host and omit the port, the default PKI Services Manager port (18081) is used.
Confirm that **HostKeyAlgorithms** is configured to prefer X.509 certificates over host keys. This is the default.

- `x509v3-rsa2048-sha256,x509v3-sign-rsa,x509v3-sign-dss,ssh-rsa-sha2-256@attachmate.com,ssh-rsa,ssh-dss`

**Related Topics**
- “Server Certificate Authentication Overview” on page 42
- “Obtain Authentication Certificates” on page 43
- “ssh-certtool Command Reference” on page 154
- “ssh-keygen Command Line Options” on page 138
- “pkid_config Configuration File Reference” on page 159
- “pki_mapfile Map File Reference” on page 163
- “Sample Mapping Rules” on page 169
- “Certificate Authentication for Users” on page 56

**Kerberos (GSSAPI) Authentication**

Kerberos is a security protocol that provides an alternate mechanism for both client and server authentication. Kerberos authentication relies on a trusted third party called the KDC (Key Distribution Center). The Secure Shell protocol supports Kerberos authentication via GSSAPI (Generic Security Services Application Programming Interface).

Advantages of using Kerberos authentication include:
- Using a trusted third party eliminates the key management tasks you encounter when you use public key authentication.
- When Kerberos is used for server authentication, no host key is required. This means that client users won't need to respond to an unknown host prompt.

**Server Authentication using GSSAPI**

By default, Secure Shell connections are established using this sequence of events:

1. Key exchange — the client and server negotiate a shared secret key, cipher, and hash for the session.
2. Server authentication — by default, the server presents a host key for this purpose.
3. Client authentication.

When GSSAPI is used for server authentication, the Kerberos KDC authenticates the server during the initial key exchange. No subsequent server authentication is needed, and the server never sends a host key to the client.

**Client Authentication using GSSAPI**

After a user has authenticated to the KDC, that user holds Kerberos credentials that can be used by other kerberized applications. When you configure Reflection for Secure IT to support GSSAPI, the server uses Kerberos credentials to authenticate client users. This means that users who have authenticated to the KDC need no additional authentication to connect to the server.
Kerberos System Requirements

Reflection for Secure IT supports the following Kerberos implementations:

- MIT Kerberos V5, release 1.5.4 or later
- Oracle Solaris native Kerberos libraries

Reflection for Secure IT uses the following Kerberos libraries. You may need to configure the keywords shown here to specify the fully-qualified path to these libraries on your system. (The default values of these settings depend on your operating system.)

<table>
<thead>
<tr>
<th>Library</th>
<th>Keyword</th>
<th>Used by</th>
</tr>
</thead>
<tbody>
<tr>
<td>libgssapi_krb5.so</td>
<td>LibGssKrb5</td>
<td>Client (sshd2_config) and server (sshd2_config)</td>
</tr>
<tr>
<td>libkrb5.so</td>
<td>LibKrb5</td>
<td>Server only (sshd2_config)</td>
</tr>
</tbody>
</table>

GSSAPI authentication on AIX requires additional steps to extract shared Kerberos libraries.

**To extract the Kerberos libraries on IBM AIX**

1. Change directories to the directory containing the static Kerberos libraries (usually /usr/lib).
   
   # cd /usr/lib

2. Run the following command to extract the shared Kerberos library:
   
   # ar -v -x libkrb5.a

3. Run the following command to extract the shared GSSAPI library:
   
   # ar -v -x libgssapi_krb5.a

Configure Kerberos Server and Client Authentication

Kerberos can be used for mutual authentication (both client and server), or for client authentication only.

- When the authentication method is `gssapi-keyex`, both server and client authentication occur during the key exchange portion of the connection negotiations. If this authentication fails, the connection fails; no subsequent authentication methods are attempted.
- When the authentication method is `gssapi-with-mic`, Kerberos is not used for server authentication. Client authentication using Kerberos is attempted after successful server authentication. If Kerberos authentication fails, other allowed authentication methods are tried.

Here's a quick summary of the important steps. The details are explained in the procedures that follow.

1. Configure connections to the KDC.
   - Add the host principal and install a keytab file on the Secure Shell server host.
   - Add client user principals.

2. Configure the **AllowedAuthentications** in the server configuration file (as needed).
3. Configure `AllowedAuthentications` and `GSSAPIDelegateCredentials` in the client configuration file (as needed).

4. Authenticate the client user to the KDC using `kinit` before you make a Secure Shell connection.

**To configure connections to the KDC**

1. Log in to your Secure Shell server.
2. Confirm that the server is configured to authenticate to your Kerberos realm. If not, install a correctly configured `krb5.conf` file.
3. Authenticate to your Kerberos realm using a principal with administrative rights:
   ```
   kinit root/admin
   ```
4. Launch the Kerberos administration utility:
   ```
   /usr/krb5/sbin/kadmin
   ```
5. Add a host principal for this server. For example, to add the host `myhost.sample.com`:
   ```
   addprinc -randkey host/myhost.sample.com
   ```
6. Extract a keytab file for this server:
   ```
   ktadd host/myhost.sample.com
   ```
7. Add a principal for each client user. For example, to add Joe:
   ```
   addprinc joe
   ```

**To configure Secure Shell settings on the server**

1. Open the server configuration file (`/etc/ssh2/sshd2_config`) in a text editor.
2. Edit the `AllowedAuthentications` keyword:
   ```
<table>
<thead>
<tr>
<th>To</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authenticate both the server and the client using Kerberos</td>
<td><code>AllowedAuthentications=gssapi-keyex</code></td>
</tr>
<tr>
<td>Authenticate only the client using Kerberos</td>
<td><code>AllowedAuthentications=gssapi-with-mic</code></td>
</tr>
</tbody>
</table>
   ```

**To configure the client**

1. Open the client configuration file (`/etc/ssh2/ssh2_config`) in a text editor.
2. Edit the `AllowedAuthentications` keyword:
   ```
<table>
<thead>
<tr>
<th>To</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authenticate both the server and the client using Kerberos</td>
<td><code>AllowedAuthentications=gssapi-keyex</code></td>
</tr>
<tr>
<td>Authenticate only the client using Kerberos</td>
<td><code>AllowedAuthentications=gssapi-with-mic</code></td>
</tr>
</tbody>
</table>
   ```
3 (Optional) Edit the **GSSAPIDelegateCredentials** keyword if you want to enable ticket forwarding:

```
GSSAPIDelegateCredentials=Yes
```

**To obtain Kerberos credentials**

Before you can connect to the Secure Shell server, you need to obtain your Kerberos credentials.

1 Use **kinit** to authenticate.

```
kinit -f
```

**NOTE:** The **-f** option is not required. This option requests a forwardable ticket. If ticket forwarding has been enabled (using **GSSAPIDelegateCredentials**) this ticket is forwarded to the server. This means that you can access other kerberized applications without having to obtain additional Kerberos credentials.

2 Enter your password for the Kerberos KDC.
User Authentication

Several methods of client authentication are available, and both the client and server can be configured to determine which method — or methods — are used. The server can be configured to allow, require, or deny client authentication methods. During Secure Shell connection negotiations, the server presents a list of allowed and required methods from which the client and server negotiate one or more authentication methods.

Authentication attempts follow the order of preference set by the client. The connection uses the first authentication technique highest in the client order of preference that is also allowed by the server. If the server is configured to require more than one method, multiple authentication methods are needed to establish a connection.

In this Chapter
- “Password and Keyboard Interactive Authentication” on page 51
- “Public Key Authentication” on page 53
- “Certificate Authentication for Users” on page 56
- “Pluggable Authentication Modules (PAM)” on page 59
- “RADIUS Authentication” on page 61
- “RSA SecurID Authentication” on page 62
- “Configure Account Management on HP-UX Trusted Systems” on page 64

Password and Keyboard Interactive Authentication

Reflection for Secure IT server supports both password and keyboard interactive authentication by default.

<table>
<thead>
<tr>
<th>Authentication method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Password</td>
<td>Prompts the client user for the login password for that user on the Secure Shell server host. The password is sent to the host through the encrypted channel.</td>
</tr>
<tr>
<td>Keyboard interactive</td>
<td>Supports any procedure in which authentication data is entered using the keyboard, including simple password authentication, thereby enabling the Secure Shell client to support a range of authentication mechanisms, such as RSA SecurID tokens or RADIUS servers. A client administrator could, for example, configure keyboard interactive authentication to handle situations in which multiple prompts are required, such as for password updates. Keyboard data is sent to the host through the encrypted channel.</td>
</tr>
</tbody>
</table>
Configure Password Authentication

Password authentication is supported by default; no configuration is required on either the server or the client to use this authentication method. Use these procedures if you want to modify the default server or client configuration.

**NOTE:** Password authentication can be also done using the keyboard-interactive method, which is the preferred method.

To configure password authentication on the client

1. Open the client configuration file (`/etc/ssh2/ssh2_config`) in a text editor.
2. Edit the `AllowedAuthentications` keyword.

To configure password authentication on the server

1. Open the server configuration file (`/etc/ssh2/sshd2_config`) in a text editor.
2. Edit `AllowedAuthentications` or `RequiredAuthentications`.
3. (Optional) Use `PasswordGuesses` to change the maximum number of attempts a user is allowed for password authentication. (The default is 3.) For example:

   `PasswordGuesses=5`

Configure Keyboard Interactive Authentication

Keyboard-interactive authentication is supported by default; no configuration is required on either the server or the client to use this authentication method.

Follow these procedures if you want to modify the default server or client configuration.

To configure keyboard interactive authentication on the client

1. Open the client configuration file (`/etc/ssh2/ssh2_config`) in a text editor.
2. Edit the `AllowedAuthentications` keyword. For example, to require keyboard interactive authentication:

   `AllowedAuthentications=keyboard-interactive`

To configure keyboard interactive authentication on the server

1. Open the server configuration file (`/etc/ssh2/sshd2_config`) in a text editor.
2. Edit `AllowedAuthentications` or `RequiredAuthentications`. For example:
To configure public key authentication on the client

1 (Optional) Modify the client's `AllowedAuthentications` setting.

**Public Key Authentication**

Public key authentication relies upon public/private key pairs. To configure public key authentication, each client user needs to create a key pair and upload the public key to the server. If the key is protected by a passphrase, the client user is prompted to enter that passphrase to complete the connection using public key authentication.

**In this Section**
- "Configure Public Key User Authentication" on page 53
- "Use the Key Agent" on page 55

**Configure Public Key User Authentication**

Public key authentication requires both client and server configuration. Here's a quick summary of the important steps. The details are explained in the procedures that follow.

1. Create a key pair on the client.
2. Add a line to the client identification file (`~/.ssh2/identification`) that identifies the private key.
3. Copy the public key to the user's directory on the server (`~/.ssh2`).
4. Add a line to the user's authorization file (`~/.ssh2/authorization`) on the server that identifies the public key.

**NOTE:** To help ensure secure authentication, and prevent tampering, information leakage and spoofing, files and directories used by the client and server must be configured with correct permissions and ownership. If these conditions aren't met, Secure Shell connections and public key authentication may fail. For details, see "File and Directory Permissions" on page 130.
Because public key authentication is allowed by default, this step is required only if you want to change this default. To modify the supported authentications, open the client configuration file (/etc/ssh2/ssh2_config). For example, to require public key authentication use:

```
AllowedAuthentications=publickey
```

2 Generate a public/private key pair using the `ssh-keygen` utility.

For example, the following command creates a default (2048-bit RSA) key pair (`mykey` and `mykey.pub`) in the current working directory. You are prompted to enter a passphrase during the key creation process. If you provide a passphrase, you will need to use it whenever you authenticate using this key.

```
ssh-keygen mykey
```

The next example uses `-P` to create a key that is not passphrase-protected. This option is less secure, but may be desirable for use with scripts and batch files. The `-t` specifies key type (DSA in this example). Because no key name is specified, the key is created using a default name and location, (`$HOME/.ssh2/id_dsa_1024_myhost_a` for this example, where myhost is the system's host name as returned by the `hostname` command).

```
ssh-keygen -P -t dsa
```

3 Create (or edit) the client identification file. The default name and location for this file is `~/.ssh2/identification`. Configure this file for user-only write access (600 is recommended).

4 In the identification file, add a line for the private key you just created. The format for key entries is `IdKey`, followed by the private key name. For example:

```
IdKey /home/joe/mykey
IdKey id_dsa_1024_myhost_a
```

**NOTE:** If no path information is provided, the client looks for listed keys in `~/.ssh2/`.

To configure public key authentication on the server

1 (Optional) Modify the server's `AllowedAuthentications` or `RequiredAuthentications` settings.

Because public key authentication is allowed by default, this step is required only if you want to change the default settings. To modify the supported authentications, open the server configuration file (`/etc/ssh2/sshd2_config`). For example, to require public key authentication, use:

```
RequiredAuthentications=publickey
```

2 Copy the client public key to the user-specific configuration directory on the server. The default location is `~/.ssh2`.

3 Create (or edit) the key authorization file for this user on this server. This file contains a list of the keys the server accepts for user authentication. The default name and location is `~/.ssh2/authorization`. Configure this file for user-only write access (600 is recommended).

4 In the authorization file, add a line for the public key you just copied. The format for key entries is `Key` followed by the public key name. For example:

```
Key /path/to/mykey.pub
Key id_dsa_1024_myhost_a.pub
```

Any listed key can be used by the server for user authentication. Keys are assumed to be in the user-specific configuration directory (by default, `~/.ssh2`) unless you specify an absolute path. If the key presented by the client doesn't match any of the keys listed in the authorization file, public key authentication fails.
Use the Key Agent

You can use the key agent, **ssh-agent**, to manage the private keys that you use for authentication. The agent enables you to store private keys and use these keys to authenticate **ssh**, **scp**, and **sftp** sessions. Because passphrases are required only when you add keys to the agent, using the agent can simplify scripting that relies on **ssh**. By default, the connection to the agent can be forwarded, which means you can use the stored identities securely anywhere in the network.

**NOTE:** Because agent forwarding creates an added security risk, you may want to disallow it. Use **ForwardAgent** on the client and **AllowAgentForwarding** on the server.

To launch the agent in your current shell

- Use the following command:

  ```
  eval `ssh-agent`
  ```

  When you launch using `eval`, you need to terminate the process manually. You can use the PID, or use `-k`, as shown here:

  ```
  ssh-agent -k
  ```

To launch the agent in a subshell

- Use the command argument to specify your shell; for example:

  ```
  ssh-agent $SHELL
  ```

  When you launch the agent in a subshell, it terminates automatically when you log out of the shell.

To add keys to the agent

- Use **ssh-add**; for example, to start the agent in your current shell and load it with the keys in your identification file, use the following command sequence:

  ```
  eval `ssh-agent`
  ssh-add
  ```

  You are prompted for passphrases when keys are added to the agent. After you have loaded the keys, you can connect to the servers that require any of the loaded keys without having to enter a passphrase.

**NOTE**

- When you run **ssh-agent** alone on the command line, a display appears showing how to configure required environment variables. However, these required variables aren’t yet configured. To configure the environment variables you can copy the displayed text, paste it to the command line, and execute the command. Until you do this, you won’t be able to use **ssh-add**. This additional step is not required when you use `eval` or `$SHELL` as shown in the preceding examples.

- If you use X11, call **ssh-add** with `’< /dev/null’` to activate the **ssh-askpass** prompting window. This window is used for passphrase prompts.

- If you are using private keys associated with X.509 certificates, use the **ssh-add -x** option to add these keys to the key agent:

  ```
  ssh-add -x
  ```
Certificate Authentication for Users

Using certificates for client authentication solves some of the problems presented by public key authentication. With public key authentication, each client must upload a copy of the public key to every server. Certificate authentication avoids this problem by using a trusted third party, the certification authority (CA), to verify the validity of information coming from the client. With certificates, you can configure authentication using a single trust anchor instead of multiple unique client public keys.

**NOTE:** Reflection PKI Services Manager supports central management of PKI settings. You can install and configure a single instance of PKI Services Manager to provide certificate validation services for all supported Micro Focus and Attachmate products.

**Requirements**

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflection PKI Services Manager must be installed and correctly configured.</td>
<td>PKI Services Manager validates the certificate and uses a map file to determine which users can authenticate with a valid certificate. You need to configure at least one trust anchor and one mapping rule for certificate validation to succeed. You may also need to configure access to intermediate certificates and to certificate revocation information.</td>
</tr>
<tr>
<td>A certificate signed by a CA and the associated private key must be installed on the client.</td>
<td>The client sends this certificate to the server to authenticate the user.</td>
</tr>
<tr>
<td>The Reflection for Secure IT server must have a copy of the PKI Services Manager public key and be configured to connect to PKI Services Manager.</td>
<td>The server communicates with PKI Services Manager to confirm the validity of the user certificate.</td>
</tr>
</tbody>
</table>

**How it Works**

1. The Reflection for Secure IT client presents a certificate to the server for user authentication.
2. The Reflection for Secure IT server connects to Reflection PKI Services Manager. (Set the server name and port for this connection using the Reflection for Secure IT server `PkidAddress` keyword.)
3. Reflection for Secure IT verifies the identity of PKI Services Manager using an installed public key. (Set the key name and location using the Reflection for Secure IT server `PkidPublicKey` keyword.)
4. Reflection for Secure IT sends the certificate and user name to PKI Services Manager.
5. PKI Services Manager determines if the certificate is valid and determines if the user is allowed to authenticate with this certificate based on the rules the PKI Services Manager administrator has configured in the PKI Services Manager map file (/opt/attachmate/pkid/config/pki_mapfile by default). This information is returned to Reflection for Secure IT.
6. If the certificate is valid and the user presenting it is an allowed identity for this certificate, the Reflection for Secure IT server validates the user’s digital signature to prove the client possesses the private key associated with the public key contained in the user’s certificate. If the digital signature is verified, the user authentication is successful.
Configure Certificate Authentication for Users

Before you begin, review the requirements described in the “Certificate Authentication for Users” on page 56 topic.

To configure user authentication using certificates, you need to install and configure Reflection PKI Services Manager and configure your server and client. Use the following procedures to get started. Many additional variations are possible. For more information, see the Reflection PKI Services Manager User Guide, which is available from http://support.attachmate.com/manuals/pki.html (http://support.attachmate.com/manuals/pki.html).

You can install and configure a single instance of PKI Services Manager to support certificate authentication requests from multiple Reflection for Secure IT clients and/or servers. However, because Reflection for Secure IT settings allow only one entry for the PKI Services Manager address and port, this configuration creates a potential single point of failure. If PKI Services Manager is unreachable or the server is not running, all authentication attempts using certificates will fail. To provide load balancing and failover, you can define a round-robin DNS entry for the PKI Services Manager host name or place the PKI Services Manager host behind a load balancing server. You can also configure PKI Services Manager to run in a Microsoft cluster environment.

**NOTE:** Paths shown here are based on the default installation options.

### To install and configure PKI Services Manager

1. Log in as root on the Reflection PKI Services Manager server.
2. “Install Reflection PKI Services Manager” on page 20.
3. Put a copy of the certificate (or certificates) you want to designate as a trust anchor into your certificate store. The default PKI Services Manager store is in the following location:

   /opt/attachmate/pkid/local-store

4. Open the PKI Services Manager configuration file in a text editor. The default name and location is:

   /opt/attachmate/pkid/config/pki_config

5. Use the **TrustAnchor** keyword to identify your trust anchor. For example:

   TrustAnchor = trustedca.crt

   -or-

   TrustAnchor = CN=SecureCA,O=Acme,C=US

   **NOTE:** To configure multiple trust anchors, add additional **TrustAnchor** lines.

6. Configure certificate revocation checking. For example:

   **Sample Configuration**

<table>
<thead>
<tr>
<th>To</th>
<th>Sample Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use CRLs stored on an LDAP server.</td>
<td>RevocationCheckOrder = crlserver CRLServers=ldap://crlserver</td>
</tr>
<tr>
<td>Use an OCSP responder.</td>
<td>RevocationCheckOrder = ocsp OCSPResponders = <a href="http://ocspresponder">http://ocspresponder</a></td>
</tr>
</tbody>
</table>

   **NOTE:** By default PKI Services Manager looks for CRLs in the local store. If you use this configuration, you need to copy the CRLs to your local store.
7 If intermediate certificates are required by the chain of trust in your certificates, configure access to these certificates. For example:

To Sample Configuration

Use intermediate certificates you have added to your local store. CertSearchOrder=local

Use certificates stored on an LDAP server. CertSearchOrder=certserver CertServers=ldap://ldapserver

8 Save your changes to the configuration file.

9 Open the PKI Services Manager map file (page 163) in a text editor. The default name and location is:

/opt/attachmate/pkid/config/pki_mapfile

10 Create a user RuleType stanza and add one or more rules that define which users can authenticate with a valid certificate. For example:

RuleType = user
   { %UPN.user% } UPN.host Equals "acme.com"
   { fred root } Subject.CN Contains "Fred"

For more sample rules, see Sample PKI Services Manager Mapping Rules (page 169).

**NOTE:** After a certificate is determined to be valid, rules are processed in order (based on rule type then sequence). If the certificate meets the requirements defined in the conditional expression (or if the rule has no condition), the allowed identities specified in that rule are allowed to authenticate. No additional rules are applied after the first match.

11 Test for valid PKI Services Manager configuration:

/usr/local/sbin/pkid -k

No errors. Configuration is valid:

12 Restart Reflection PKI Services Manager.

/usr/local/sbin/pkid restart

**To configure the Reflection for Secure IT server**

1 If PKI Services Manager is not installed on the same host as the Reflection for Secure IT server, copy the PKI Services Manager public key to the Reflection for Secure IT server.

The key location on PKI Services Manager is:

/opt/attachmate/pkid/config/pki_key.pub

Copy this to any location on the Reflection for Secure IT host. For example:

/etc/ssh2/pki_key.pub

**NOTE:** This key file should be owned by root and not be writable by any user but root.

2 Open the server configuration file (/etc/ssh2/sshd2_config) in a text editor.

3 Edit PkidPublicKey to specify the location in which you placed the PKI Services Manager public key. For example:

PkidPublicKey=/etc/ssh2/pki_key.pub
4 Edit **PkidAddress** to specify the PKI Services Manager host and port. For example:

```
PkidAddress=pkiserver.acme.com:18081
```

**NOTE:** If you specify a host and omit the port, the default PKI Services Manager port (18081) is used.

5 Configure **AllowedAuthentications** or **RequiredAuthentication** to allow or require public key authentication. The defaults shown below allow public key authentication, but don't require it:

```
AllowedAuthentications=gssapi-with-mic,publickey,keyboard-interactive,password
RequiredAuthentication=
```

To configure the Reflection for Secure IT client

1 Obtain a user certificate and associated private key (page 43).
2 Install the certificate and private key. For example:

```
~/.ssh2/userkey
~/.ssh2/userkey.crt
```

**NOTE:** The certificate must be in the same directory as the private key and use the same base name with a .crt file extension.

3 Set permissions on the user key for user-only read-only access:

```
chmod 400 userkey
```

4 Create (or edit) the client identification file. (The default is ~/.ssh2/identification.) Configure this file for user-only write access:

```
chmod 600 identification
```

5 Add a line to the client identification file that identifies the private key. Use the **CertKey** keyword. (Path information is optional if the key is in the ~/.ssh2/ directory.) For example:

```
CertKey userkey
```

6 Open the client configuration file (/etc/ssh2/ssh2_config) in a text editor.
7 Check your configuration of the following client settings. **AllowedAuthentications** must include publickey. **IdentificationFile** must specify the file you configured in step 3. The defaults are shown here:

```
AllowedAuthentications=gssapi-with-mic,publickey,keyboard-interactive,password
IdentificationFile=~/.ssh2/identification
```

**Pluggable Authentication Modules (PAM)**

You can configure the Reflection for Secure IT server to use Pluggable Authentication Modules (PAM) in combination with keyboard interactive authentication. PAM employs runtime pluggable modules that provide authentication-related services. These modules are divided into four categories: authentication, account management, session management, and password management.

When PAM is configured, Reflection for Secure IT transfers control of authentication to the PAM library. The PAM library loads the modules specified in the PAM configuration file, and the PAM library prompts Reflection for Secure IT to confirm successful authentication.

The following server keywords configure PAM authentication on the server.
Configure PAM Authentication

When PAM is configured, Reflection for Secure IT transfers control of authentication to the PAM library.

To configure PAM authentication on the server

1. Edit your PAM configuration settings to support the required modules: *auth*, *account*, *password*, and *session*. If required modules are not defined, the connection will be refused.
   
   On Linux systems, the following file is installed with the server:

   ```
   /etc/pam.d/ssh
   ```

   This file contains the default configuration information. For example, on SLES systems the *ssh* file includes the following:

   ```
   # PAM-1.0
   auth include common-auth
   auth required pam_nologin.so
   account include common-account
   password include common-password
   session include common-session
   ```

   On other systems, create (or configure) `/etc/pam.conf`. For example, on HP-UX:

   ```
   ssh auth required /usr/lib/security/libpam_unix.1
   ssh account required /usr/lib/security/libpam_unix.1
   ssh password required /usr/lib/security/libpam_unix.1
   ssh session required /usr/lib/security/libpam_unix.1
   ```

2. Open the server configuration file (`/etc/ssh2/sshd2_config`) in a text editor.

3. Confirm that **AllowedAuthentications** (or **RequiredAuthentications**) includes *keyboard-interactive* as an allowed authentication method (the default).
4 Configure **PamServiceName** to identify the name of your PAM service.
   - Use the default (ssh) if your PAM modules are defined in `/etc/pam.d/ssh`.
   - Or-
     - If your PAM modules are defined in `pam.conf`, the value of **PamServiceName** must match your service name (ssh in the example shown above). If ssh is not defined in `pam.conf`, you may be able to use the default service name `other`.

5 Configure the server to use PAM.

<table>
<thead>
<tr>
<th>To use PAM for</th>
<th>In the server configuration file, add</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authentication and password management</td>
<td>AuthKbdInt.Required=pam</td>
</tr>
<tr>
<td>Account management</td>
<td>AccountManagement=pam</td>
</tr>
<tr>
<td>Session management</td>
<td>UsePamSessions=yes</td>
</tr>
</tbody>
</table>

6 (Optional) To include the words "PAM authentication" in the prompt that client users see during authentication, include the following:

```
AuthKbdInt.Verbose=yes
```

**To configure PAM authentication on the client**

- Confirm that **AllowedAuthentications** includes keyboard-interactive as an allowed authentication method (the default).

**RADIUS Authentication**

RADIUS is an authentication, authorization, and accounting service that authenticates users by integrating with password databases, such as the UNIX password file, Active Directory, LDAP, and simple text files containing user/password pairs. Reflection for Secure IT supports RADIUS for authentication purposes only.

**Requirements**

One or more RADIUS authentication servers must be configured. To configure Reflection for Secure IT, you need the name of the RADIUS server, the port used for RADIUS communication (usually 1812 or 1645), and the shared secret used by the RADIUS server.

You'll use this information to create a RADIUS configuration file.

**How it Works**

The Reflection for Secure IT server acts as a RADIUS client in order to authenticate a user. Requests are sent to any RADIUS servers you have configured in the RADIUS file.

1. The Reflection for Secure IT server receives a keyboard-interactive authentication request from a client.
2. If RADIUS authentication is enabled, the Reflection for Secure IT server attempts to authenticate the user by sending an ACCESS-REQUEST message with the User-Name and Password attribute/value pair to the first RADIUS server you have configured.
3. The Reflection for Secure IT server waits for an ACCESS-ACCEPT or ACCESS-REJECT message from the RADIUS authentication server.
4. If the Reflection for Secure IT server receives an ACCESS-ACCEPT message, the client connection is allowed and the Reflection for Secure IT server provides user access based on the current server configuration. If the server receives an ACCESS-REJECT message, or it fails to receive a response, the server attempts to authenticate to any additional RADIUS servers you have configured. If no ACCESS-ACCEPT message is received from any RADIUS server, RADIUS authentication fails and the Reflection for Secure IT server attempts any other allowed authentications.

**NOTE:** Authentication fails if a user is able to authenticate to the RADIUS authentication server, but no account exists for that user on the Reflection for Secure IT server.

### Configure RADIUS Authentication

When RADIUS is configured, Reflection for Secure IT transfers control of authentication to the RADIUS authentication server.

**To configure the Reflection for Secure IT server**

1. Create the following file and set owner-only read and write access (permissions = 600).
   ```
   /etc/ssh2/radius_config
   ```

2. Open this file in a text editor. Add a line for each RADIUS server that identifies the server, the port used for RADIUS on that server, and the shared secret required for RADIUS clients to authenticate to that server. For example:
   ```
   server1:1812:secret1
   server2:1812:secret2
   ```

   **NOTE:** RADIUS servers are contacted in order from top to bottom until a response to the authentication request is received.

3. Open the server configuration file (`/etc/ssh2/sshd2_config`) in a text editor. Edit the following keywords:
   ```
   AllowedAuthentications=keyboard-interactive
   AuthKbdInt.Required=radius
   RadiusFile=/etc/ssh2/radius_config
   ```

**To configure the client**

- Enable keyboard-interactive authentication. (This is the default for all Reflection for Secure IT clients.)

### RSA SecurID Authentication

RSA SecurID is a two-factor authentication solution from RSA Security, Inc that is based on hardware or software tokens. We recommend that you review the Authentication Manager documentation before using SecurID.

Reflection for Secure IT supports RSA SecurID authentication using PAM.
Configure SecurID Authentication

Reflection for Secure IT supports the RSA Authentication Agent for PAM, which allows RSA SecurID tokens to be used when connecting to the server. The RSA Authentication Agent for PAM must be running on the same computer as the Reflection for Secure IT server.

To configure the client

- Enable keyboard-interactive authentication. (This is the default for all Reflection for Secure IT clients.)

To configure the server

1. Install the RSA Authentication Agent on the computer running the Reflection for Secure IT server.
2. Open the server configuration file (/etc/ssh2/sshd2_config) in a text editor.
3. Enable keyboard-interactive authentication and configure the server to use PAM for authentication and password management:

   ```
   AllowedAuthentications=keyboard-interactive
   AuthKbdInt.Required=pam
   ```

To start the server

**NOTE:** You need to set the environment variables VAR_ACE and LD_LIBRARY_PATH before you start the Secure Shell server. Set VAR_ACE to the directory of the RSA Agent for PAM installation that contains the sdconf.rec file. Set LD_LIBRARY_PATH to the directory where the RSA/Server or RSA/Agent is installed.

- To set the environment variables and start the server:

  ```
  $ VAR_ACE=/opt/ace/data LD_LIBRARY_PATH=/opt/ace/prog /usr/sbin/sshd2
  ```

  **NOTE:** To make the environment variable changes persist through a restart, you can modify the server startup script (page 23), or modify the root user’s default profile.
Configure Account Management on HP-UX Trusted Systems

To ensure that Reflection for Secure IT correctly respects the login restrictions imposed by HP-UX Trusted Systems, you must configure the server to use PAM account management.

**CAUTION:** Configuring PAM account management is required for use with HP-UX Trusted Systems to ensure that only allowed users can connect. If the server is not configured to use PAM account management, in some circumstances the server will allow users access to the system who should be denied access.

To configure PAM account management on the server

1. Open the server configuration file (`/etc/ssh2/sshd2_config`) in a text editor.
2. Configure the server to use PAM for account management:
   ```
   AccountManagement=pam
   ```

**NOTE:** To support PAM account management, PAM must be properly configured on the host system.

Related Topics

- “Configure PAM Authentication” on page 60
- “Pluggable Authentication Modules (PAM)” on page 59
Secure File Transfer

Reflection for Secure IT supports programs that you can use for secure file transfer: sftp and scp. Both commands can help you manage file transfers between computers efficiently and securely.

Use sftp to transfer files securely between the local computer and a remote host. You can also perform other file management commands, such as creating files and changing permissions. You can use sftp interactively or in combination with batch files to automate actions.

Use scp to copy files securely between the local computer and a remote host, or to transfer files securely between two remote hosts.

In this Chapter

- “Secure File Transfer (sftp)” on page 65
- “Use sftp Interactively” on page 66
- “Run sftp Batch Files” on page 66
- “Configuring the sftp Transfer Method (ASCII or Binary)” on page 67
- “Secure File Copy (scp)” on page 68
- “Smart Copy and Checkpoint Resume” on page 69
- “Configure Upload and Download Access” on page 70
- “Set File Permissions on Downloaded Files” on page 70
- “Set File Permissions on Uploaded Files” on page 72

Related Topics

- “File Transfer Auditing” on page 89
- “Troubleshooting Slow File Transfer Speed” on page 98
- “Access Control Settings” on page 85

Secure File Transfer (sftp)

Secure file transfer (sftp) provides a secure alternative to ftp. You can run sftp interactively, or use it in combination with a batch file for automated, secure file transfer.

Because sftp uses authentication and encryption provided by ssh, a Secure Shell server must be running on the remote computer. Settings for sftp connections are controlled by the ssh client configuration file. For details about these settings, see “Client Configuration Keywords” on page 105. You can also use the -o option to configure settings on the sftp command line. Command line options override configuration file settings.

For detailed information about command line options, see “sftp Command Line Options” on page 143. For an sftp command reference, see “Supported sftp Commands” on page 146.

Related Topics

- “Use sftp Interactively” on page 66
- “Run sftp Batch Files” on page 66
Use sftp Interactively

You can use an interactive sftp session to execute one or more file management commands securely on a remote computer.

To open an interactive sftp session

1. Connect to a remote host. For example:
   ```
sftp joe@myhost.com
   ```

   **NOTE:** You can omit the user name if your name on the Secure Shell server is the same as your current user name.

   After a successful connection is established, the following prompt appears:
   ```
sftp>
   ```

2. Do any of the following:

<table>
<thead>
<tr>
<th>To</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>View a list of supported commands</td>
<td><code>help</code>; for example:</td>
</tr>
<tr>
<td></td>
<td><code>sftp&gt; help</code></td>
</tr>
<tr>
<td>Learn more about supported commands</td>
<td><code>help command</code>; for example:</td>
</tr>
<tr>
<td></td>
<td><code>sftp&gt; help put</code></td>
</tr>
<tr>
<td>Transfer and manage files</td>
<td>Use any of the supported sftp commands (page 146). For example, to transfer the file <code>demo</code> from the local working directory to the remote working directory:</td>
</tr>
<tr>
<td></td>
<td><code>sftp&gt; put demo</code></td>
</tr>
<tr>
<td>End the session</td>
<td><code>quit</code>; for example:</td>
</tr>
<tr>
<td></td>
<td><code>sftp&gt; quit</code></td>
</tr>
</tbody>
</table>

**NOTE:** If you launch `sftp` without specifying a host name, you can use the interactive `open` and `close` commands to connect to one or more hosts during your interactive session.

Run sftp Batch Files

Using sftp batch files provides a secure way to automate file management.

To create and run an sftp batch file

1. Configure the client and server to support a non-interactive client authentication method, such as GSSAPI, or public key without passphrase protection.
NOTE: Authentication methods that require interaction are not supported when you use the `sftp` batch file option (-B).

2 On the client, create an `sftp` batch file. The batch file can use any of the interactive commands supported by `sftp` (page 146). For example, you might create a file called `demo` with commands such as:

   - `get path/file1`
   - `get webfiles/* .htm`

3 Use `sftp` to connect to the remote host and run the batch file. For example:

   `sftp -B demo myname@myhost.com`

   The client runs the commands in the batch file and then exits.

NOTE

- After a successful login, `sftp` executes each command in the batch file until a `bye`, `exit` or `quit` command is found, and then terminates the connection.
- If a command in the batch file fails, `sftp` continues executing the remaining commands, and returns the error code of the first failed command. However, commands prefixed with `-` (dash) always return 0, even if the command fails. To configure a batch file that returns a separate error for each transfer command, use `scp`.

Configuring the `sftp` Transfer Method (ASCII or Binary)

SFTP supports two transfer methods: ASCII and binary. In ASCII mode individual letters, numbers, and characters are transferred using their ASCII character code, and the receiving computer saves these in the correct text format for that system. During ASCII transfers between UNIX and Windows computers, newline characters are converted as appropriate for each system. (You can also manually configure newline character conversion if necessary.) In binary transfers, data is transferred to the server byte-by-byte with no data conversion.

Reflection for Secure IT also provides a smart transfer option called `auto`. In auto mode, the transfer method is determined by file extension. Files with specified file extensions use ASCII transfer; all other files use binary transfer. The default list of ASCII file types is `txt`, `htm*`, `pl`, `php*`. To modify this list for a given `sftp` session, use the `setext` command. To change the default file extension list, use the client keyword `FileCopyAsciiExtensions`. 
Secure File Copy (scp)

Use `scp` to copy files securely between the local computer and a remote host, or to transfer files securely between two remote hosts.

Both source and destination file names can include host and user specifications to indicate that files are to be copied to or from that host. Copies between two remote hosts are permitted. Wildcards are supported. When recursion is off (the default), name substitution occurs on file names only, not directories. When recursion is enabled (using `-r`), name substitution includes files and directories. By default, existing files are overwritten. To control overwrite behavior, use `--overwrite`. (If the files are identical no transfer occurs regardless of this setting value.)

Because `scp` uses authentication and encryption provided by `ssh`, a Secure Shell server must be running on the remote computer. Settings for `scp` connections are controlled by the `ssh` client configuration file. For details about these settings, see "Client Configuration Keywords" on page 105.

You can also use the `-o` option to configure settings on the `scp` command line. Command line options override configuration file settings.

Examples

The following samples show how you can use `scp` to transfer files securely — between a local computer and remote host, or between two remote hosts.
Identical Files (Smart File Copy)

If a client user initiates a transfer and an identically named file already exists on the server, the server computes a hash of the server copy of the file and sends this value to the client. The client computes a hash of the client copy of the file and compares that to the value from the server. If the two hashes are identical, this indicates that the files are identical, and no data transfer occurs. The timestamp of the destination file is updated unless you transfer using the `scp -p` option.

Smart file copy is enabled by default. To disable from the client, set `SmartFileCopy` to no. To disable it from the server, set `SmartFileTransfer` to no. When smart file copy is disabled, existing files are always overwritten.

Automatic Resume of Interrupted File Transfer (Checkpoint Resume)

Reflection for Secure IT client and servers can resume an interrupted file transfer at the point at which the transfer was interrupted. For example, if a connection is dropped during a file upload, the client user can restart the transfer. The Reflection for Secure IT client determines the size of the file on the server, and requests a hash of that file from the server. The client computes the hash of the local file up to the length that the server already has. If the hashes are the same, the transfer resumes at that point in the file.

NOTE: Computing a hash to compare files does not produce useful data for ASCII transfers between systems with different line endings, so the hash comparison is skipped in this case and the complete file is always transferred.

Checkpoint resume is enabled by default. To disable from the client, set `CheckpointResume` to no. To disable it from the server, set `SmartFileTransfer` to no. When checkpoint resume is disabled, file transfer always starts over after an interruption.

Related Topics

- “scp Command Line Options” on page 140
NOTE: If you transfer files in a high latency network, the time required to send the hash values across the network can cause delays that exceed the benefit of using these features. In this case, you may be able to improve performance by disabling the smart copy and checkpoint resume features.

Configure Upload and Download Access

By default, users have full access to all directories permitted by their login account. You can use AllowSftpCommands to limit what kinds of actions users can perform using sftp and scp. This keyword supports a comma-separated list of one or more of the following: all, none, browse, download, upload, delete, rename. The upload option enables users to modify files, create files, create directories, or modify file attributes on the server. The download option enables users to read file contents.

AllowSftpCommands controls access from commands that use the SFTP subsystem. This includes both scp and sftp commands from Reflection for Secure IT clients and sftp commands from OpenSSH clients. It does not affect scp commands from OpenSSH clients; the OpenSSH scp command does not use the SFTP subsystem; it executes an rcp command through the secure channel.

CAUTION: Client users may have a number of ways to access server files and directories. Factors to consider when configuring your server include session access, tunneling access, and file and directory permissions configured on the system.

To configure upload and download permissions

NOTE: This change affects both scp and sftp transfers.

1 Open the server configuration file (/etc/ssh2/sshd2_config) in a text editor. (You can also configure this keyword in subconfiguration files.)

2 Edit the AllowSftpCommands keyword. For example,

To allow users to view and download files, but disallow any changes to the server files:

AllowSftpCommands = browse, download

To allow users to browse and upload files, but not view the contents of files on the server:

AllowSftpCommands = browse, upload

3 To prevent file access via terminal sessions or remote command execution (including OpenSSH scp), you can use the SessionRestricted keyword:

SessionRestricted = subsystem

Set File Permissions on Downloaded Files

When you download a file to the client using either sftp or scp, the file permissions of the downloaded file can depend on both the client configuration and the source file permissions.

If the file already exists on the client:

- The client file permissions remain the same after a transfer; the transfer updates the contents of the file contents, but does not modify existing file permissions.
If the file does not exist on the client, the following factors affect the permissions set on the transferred file:

- The downloaded file is given the same permissions as the source file provided there are no settings in effect on the client that prevent the creation of files with these permissions.
- If there are local settings in effect that limit the permissions of newly created files, these are applied to the downloaded file. These settings can be globally configured, or can be modified for the current session using the `umask` command. Note: For uploads the relevant umask is the server umask, for downloads it's the local umask.
- When downloading files, if the local umask is 0xx, 1xx, 4xx, or 5xx, the user write bit of the resulting file will be set regardless of the remote file permissions.

**To set permissions on downloaded files using umask:**

1. Use `umask` to specify the limits you want for newly created files. For example, you can use either an octal number or a symbolic representation to limit new files to user-only read and write access.

   ```bash
   $ umask 066
   -or-
   $ umask u=rwx,g=x,o=x
   ```

2. Connect to the server and download using either `sftp` or `scp`.

   With the sample umask shown above, downloaded files are created on the client without group or world access.

**NOTE:** The file mode mask is specified differently for the octal and symbolic forms of the mask:

- If the mask is specified as an octal number, the mode mask contains the permission bits that should *not* be set on a newly created file.
- If the mask is specified as a symbolic representation, the mode mask specifies the bits that should be set.

The following session shows the use of `umask` to set permissions on files downloaded using `sftp`. The first file (`file1`) allows user, group, and world read/write access (666) on the server. The second file (`file2`) allows user read/write access, and group and world read-only access (644) on the server. After the download, both files allow user-only read/write access (600) on the client.

```bash
$ umask 066
$ sftp joe@myserver.com
Authentication successful.
sftp> ls -l file1
-rw-rw-rw-  0 joe  users  108 Sep 30 02:52 file1
sftp> get file1
/home/joe/file1 108 0.0KB/s 00:00 100%
sftp> llis -l file1
-rw-------  0 joe  users  8 Sep 30 11:47 file1
sftp> get file2
/home/joe/file2 225 0.0KB/s 00:00 100%
sftp> llis -l file2
-rw-------  0 joe  users  225 Sep 30 11:47 file2
sftp> exit
$```

Secure File Transfer
Set File Permissions on Uploaded Files

The options described here affect permissions on files uploaded using either sftp or scp. Two approaches are available:

- Using ForceSftpFilePermissions to set Permissions
- Using System Settings to Control Permissions

Using ForceSftpFilePermissions to set Permissions

ForceSftpFilePermissions is a server keyword that you can use to specify a file permission value for all files uploaded to the server using sftp or scp. This setting overrides all other permission setting actions. It takes a three-digit permission mode value. For example:

ForceSftpFilePermissions=600

With this setting, all uploaded files are set to 600 (-rw-------). In addition, if a user attempts to change the permissions on an existing file, that file is also set to 600, regardless of the permission value requested by the client user.

When ForceSftpFilePermissions is configured:

- All uploaded files are set to the specified value regardless of whether or not a file is newly created or overwrites an existing file.
- The system UMASK setting is ignored.
- Any chmod command executed by an sftp user ignores the user-specified value and changes the file's permissions to the value set by ForceSftpFilePermissions.
- The -p option is ignored if it is used on the sftp and scp command line.

In the following session, the user joe is connecting to demoserver.com, on which ForceSftpFilePermissions is set to 600. Joe's local file sample.txt has permissions=666. After the transfer, the file permissions for sample.txt on the server are set to 600. Joe lists permissions for his file test.txt on the server and sees that the permissions=666. Joe attempts a chmod to change the permissions to 644. Because the ForceSftpFilePermissions value overrides Joe's value, after this command, the file permissions are set to 600.

```
joe@abchost:~> ls -l sample.txt
-rw-rw-rw- 1 joe users 9668 2011-06-18 17:41 sample.txt
joe@abchost:~> sftp demoserver.com
Authentication successful.
sftp> put sample.txt
sample.txt                   668     9.4KB/s   00:00     100%
sftp> ls -l sample.txt
-rw-------    1 joe    joe   9668 Mar 18  2011 sample.txt
sftp> ls -l test.txt
-rw-rw-rw-    1 joe    joe    73 Jan 15 17:49 test.txt
sftp> chmod 644 test.txt
Changing mode on /home/joe/test.txt
sftp> ls -l test.txt
-rw-------    1 joe    joe    73 Jan 15 17:49 test.txt
sftp>
```

Using System Settings to Control Permissions

If ForceSftpFilePermissions is not configured, the system settings determine uploaded file permissions.
If the file already exists on the server:

- The server file permissions remain the same after a transfer; the transfer updates the contents of the file contents, but does not modify existing file permissions.

If the file does not exist on the server, the following factors affect the permissions set on the transferred file. Items lower on this list override items higher on the list.

1. The uploaded file is given the same permissions as the source file provided there are no settings in effect on the server that prevent the creation of files with these permissions.
2. If the client requests a UMASK value using the `SetRemoteEnv` keyword, those permission limits are applied.
3. System-wide settings for new file creation are applied. (For example, these may be configured in standard system files such as `/etc/default/login` and `/etc/environment`, or using PAM.)
4. If a UMASK value is configured in a global Reflection for Secure IT environment file (`/etc/ssh2/environment`), those permission limits are applied.
5. If a UMASK value is configured in a user-specific Reflection for Secure IT environment file (`~/.ssh2/environment`), those permission limits are applied.

**NOTE:** UMASK is included by default in the list of environment variables allowed by `SettableEnvironmentVars`. If UMASK is not included in this list, you cannot modify UMASK values using an `environment` file on the server or using the client `SetRemoteEnv` keyword.

### To set permissions on uploaded files on the server using the environment file

1. Create (or edit) the environment file.

   To configure | Use this path and file name
   --- | ---
   User-specific settings | `~/.ssh2/environment`
   Global settings | `/etc/ssh2/environment`

2. Add a line specifying the UMASK value that you want to apply to uploaded files. For example:

   ```
   UMASK=066
   ```

### To set permissions on uploaded files from the client using `SetRemoteEnv`

- Open the client configuration file (`/etc/ssh2/ssh2_config`) in a text editor. Add a line using `SetRemoteEnv` to specify the UMASK value you want to apply to uploaded files. For example:

  ```
  SetRemoteEnv=UMASK=066
  ```

  - or -

- Use `SetRemoteEnv` on the command line to specify a UMASK value. For example:

  ```
  sftp -oSetRemoteEnv=UMASK=066 joe@myserver.com
  ```

The following session shows the use of `SetRemoteEnv` to set permissions on a file uploaded using `scp`. The source file (`demo`) allows user, group, and world read/write access (644) on the client (abchost). After the upload, the file allows user-only read/write access (600) on the server (xyzhost).
joe@abchost:~> ls -l demo
-rw-r--r-- 1 joe users 30 2016-10-02 12:07 demo
joe@abchost:~> scp -oSetRemoteEnv=UMASK=066 demo joe@10.10.3.232:
Authentication successful.
    demo 30  0.0KB/s  00:00  100%
joe@abchost:~> ssh joe@10.10.3.232
Authentication successful.
Last login: Thu Oct  2 16:56:22 2016 from 150.215.83.121
[joe@xyzhost ~]$ ls -l demo
-rw------- 1 joe joe 30 Oct  2 16:57 demo
[joe@xyzhost ~]$
Port Forwarding

Port forwarding, also known as tunneling, provides a way to redirect communications through the Secure Shell channel of an active session. When port forwarding is configured, all data sent to a specified port is redirected through the secure channel. You can configure any of the following.

- Local port forwarding moves data securely between an application client running on the Secure Shell client host and a remote application server.
- Remote port forwarding moves data securely between an application client running on the Secure Shell server host and a local application server.
- FTP forwarding allows you to forward all FTP communications through the Secure Shell tunnel.
- X11 forwarding moves X protocol data securely between an X server running on the Secure Shell client host and an X client running on the Secure Shell server host. This is a special category of dynamic remote port forwarding, and is configured using different settings.

Terminology

Port forwarding involves two sets of client and server applications — the Secure Shell client and server, and the client/server pair whose data is being forwarded. In this guide, the following terms are used as defined below in reference to port forwarding:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure Shell server</td>
<td>The Reflection for Secure IT server daemon.</td>
</tr>
<tr>
<td>Secure Shell server host</td>
<td>The computer on which the Secure Shell server runs.</td>
</tr>
<tr>
<td>Secure Shell client</td>
<td>The Reflection for Secure IT client application.</td>
</tr>
<tr>
<td>Secure Shell client host</td>
<td>The computer on which the Secure Shell client runs.</td>
</tr>
<tr>
<td>Application client</td>
<td>The client program of the client/server pair whose data you want to forward. For example, this might be a mail client or Web browser.</td>
</tr>
<tr>
<td>Application client host</td>
<td>The computer on which the application client runs. This is often either the Secure Shell server host or the Secure Shell client host, but it can also be a third host.</td>
</tr>
<tr>
<td>Application server</td>
<td>The server program that communicates with your application client, such as a mail server or Web server.</td>
</tr>
<tr>
<td>Application server host</td>
<td>The computer on which the server application runs. This can be either the Secure Shell server host or the Secure Shell client host, or it can also be a third host.</td>
</tr>
</tbody>
</table>

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- “Local Port Forwarding” on page 76
- “Remote Port Forwarding” on page 78
- “Configure Port Forwarding” on page 79
- “FTP Forwarding” on page 80
- “X Protocol Forwarding” on page 81
- “Port Forwarding Settings” on page 82
Local Port Forwarding

Use local port forwarding to forward data securely from an application client running on the same computer as the Secure Shell client. When you configure local port forwarding, you designate an arbitrary local port to use for forwarding data, and a destination host and port to receive the data. Local port forwarding works as follows.

1. When the Secure Shell connection is established, the Secure Shell client opens a listening "socket" on page 176 on the local computer (the Secure Shell client host) using the designated local port. In most cases, this socket is available only to applications running on the Secure Shell client host.

The gateway ports setting controls whether locally forwarded ports are available to remote applications. By default this setting is not enabled, and the client uses the loopback address ("localhost" or 127.0.0.1) when it opens a socket for local port forwarding. This prevents applications running on other computers from connecting to the forwarded port. When you enable gateway ports, a remote application client can open a socket using the Secure Shell client's Ethernet address (such as an IP address, a URL, or a DNS name). For example, a Secure Shell client running on acme.com might be configured to forward port 8088. When gateway ports are not enabled, the forwarded socket is localhost:8088. When gateway ports are enabled, the forwarded socket is acme.com:8088.

CAUTION: Enabling gateway ports reduces the security of your client host, network, and connection because it allows remote applications to use the forwarded port on your system without authenticating.

2. An application client is configured to connect to the forwarded port (rather than directly to the application server host and port). When that client establishes a connection, all data is sent to the listening port, and then redirected to the Secure Shell client.

3. The Secure Shell client encrypts the data and sends it securely through the Secure Shell channel to the Secure Shell server.

4. The Secure Shell server receives the data, decrypts it, and redirects it to the destination host and port used by the application server.

NOTE: If the final destination host and port are not on the Secure Shell server host, data is sent in the clear between the Secure Shell host and the application server host.

5. The return data from the application server is directed to the Secure Shell server, which encrypts it and sends it securely to the Secure Shell client through the SSH tunnel. The Secure Shell client decrypts the data and redirects it to the original application client.

The general command-line syntax for local port forwarding is:

```
ssh -L listening_port:app_host:hostport user@sshserver
```

The diagrams that follow illustrate two ways to use this.
In the configuration shown above, the application client and the Secure Shell client both run on HostA. The Secure Shell server and application server both run on HostB. All data sent to port 2222 on HostA is forwarded to port 222 on HostB. In this arrangement, all data in transit is securely encrypted. The following command (in which localhost identifies the loopback address on HostB) configures this:

```
ssh -L 2222:localhost:222 user@HostB
```

The following diagram illustrates local port forwarding to a third host. In this configuration, the application server runs on a different host than the Secure Shell server. All data sent to port 2222 on HostA is forwarded to port 222 on HostC.
The following command configures this:

```
ssh -L 2222:HostC:222 user@HostB
```

**NOTE:** Data sent between HostB and HostC is not encrypted.

## Remote Port Forwarding

Use remote port forwarding to forward data securely from an application client running on the Secure Shell server host. When you configure remote port forwarding, you designate an arbitrary remote port to use for forwarding data and a destination host and port to receive the data. Remote port forwarding works as follows.

1. When the Secure Shell connection is established, the Secure Shell server opens a listening "socket" on page 176 on the Secure Shell server host using the specified listening port.

2. A client application running on the Secure Shell server host is configured to connect to the listening port (rather than directly to the application server host and port). When that client establishes a connection, all data is sent to the listening port, and then redirected to the Secure Shell server.

3. The Secure Shell server encrypts the data and sends it securely through the SSH tunnel to the Secure Shell client.
4. The Secure Shell client receives data, decrypts it, and redirects it to the destination host and port (on the Secure Shell client host) that is used by the server application.

5. The return data from the server application is directed to the Secure Shell client, which encrypts it and sends it securely to the Secure Shell server through the SSH tunnel. The Secure Shell server decrypts the data and redirects it to the original client application.

The general command-line syntax for remote port forwarding is:

```
ssh -R listening_port:app_host:hostport user@sshserver
```

The diagram that follows illustrates one possible remote port forwarding configuration.

![Diagram showing remote port forwarding](image)

The application server and the Secure Shell client run on HostA. The Secure Shell server and application client both run on HostB. All data sent to port 2222 on HostB is forwarded to port 222 on HostA. In this arrangement, all data in transit is securely encrypted. The following command configures this.

```
ssh -R 2222:localhost:222 user@HostB
```

## Configure Port Forwarding

You can establish a port forwarding tunnel using either the `ssh` command line or in the client configuration file (`/etc/ssh2/ssh2_config`).

**To configure and use local port forwarding**

1. Pick a local port to use for forwarding. (This procedure uses 2110 as an example.)

   **NOTE:** This can be any available port, but don't use port values less that 1024. These ports are, by convention, reserved for services, and may not be available.

2. Configure your application client (for example your e-mail client) to connect to the forwarded port on the local host rather than to the remote application server socket. For this example:
3 Connect the Secure Shell client.

Use local port forwarding to send data from the forwarded local port to the remote application server. The general command line syntax is:

```
ssh -L listening_port:app_host:hostport user@sshserver
```

For this example, the mailserver runs on the same host as the Secure Shell server. The application host in this case is "localhost" on mailserver.com. The command-line configuration is:

```
ssh -L 2110:localhost:110 joe@mailserver.com
```

4 Use the application client as you normally would.

The data is forwarded securely from the listening port on the client host (localhost:2110) through the secure channel to the remote application server’s listening socket on mailserver.com (localhost:110).

**Forwarding to a Third Host**

In the preceding example, the application server and Secure Shell server run on the same host. The forwarded data is encrypted for the entire transit. It’s also possible to use port forwarding when the application server runs on a different host. For example:

```
ssh -L 2110:mailserver.com:110 user@sshserver.com
```

In this case, data is forwarded through the secure tunnel to sshserver.com. Data is then forwarded in the clear to port 2110 on mailserver.com.

**FTP Forwarding**

You can configure Reflection for Secure IT to forward FTP communications through the Secure Shell tunnel. FTP forwarding supports both active and passive mode transfers.

Advantages of using FTP forwarding include:

- You can continue to use FTP applications. All communications (including the FTP command channel and all data channels) are securely encrypted between the Secure Shell client and the Secure Shell server.
- If the Secure Shell server and the FTP server run on the same computer, only the Secure Shell port (22) has to be opened in the firewall. Without tunneling, FTP communications require opening the FTP port (21) and a wide range of non-privileged ports for passive mode transfers.
- The FTP client computer doesn’t require any open ports in the firewall for active mode transfers.

Depending on your hardware resources, forwarding FTP connections using Secure Shell channels may lead to some variations in the transfer speeds when compared to plain FTP connections. If the network is faster than the CPU, tunneling FTP may result in slower transfer because of the encryption process. If the network is slower than the CPU, enabling Secure Shell compression may increase transfer rates.
**Local FTP Forwarding**

To forward FTP communications from a port used by a local FTP client to a remote FTP server, add the prefix "ftp/" before the local listening port.

In the following example, FTP communications sent from an FTP client (on the same computer as the Secure Shell client) are forwarded to an FTP server running on myhost.com. With this configuration, you would configure the FTP client to connect to localhost:2121.

```
ssh -L ftp/2121:myhost.com:21 user@myhost.com
```

-or-

```
LocalForward=ftp/2121:myhost.com:21
```

**NOTE:** The FTP client must be on the same server as the Reflection for Secure IT client. You can configure local FTP forwarding to an FTP server on a different host than the Reflection for Secure IT server, but in that case data is unencrypted in transit from the Reflection for Secure IT server to the FTP server.

**Remote FTP Forwarding**

To forward FTP communications from a port used by a remote FTP client to a local FTP server, add the prefix "ftp/" before the remote listening port.

In the following example, FTP communications sent from an FTP client (on the same computer as the Secure Shell server) are forwarded to an FTP server (on the same computer as the Secure Shell client). With this configuration, you would configure the FTP client to connect to port 3333.

```
ssh -R ftp/3333:localhost:21 user@myhost.com
```

-or-

```
RemoteForward=ftp/3333:localhost:21
```

**NOTE:** The FTP server must be on the same host as the Reflection for Secure IT client and the FTP client must be on the same host as the Reflection for Secure IT server.

**X Protocol Forwarding**

The X Window System provides support for graphical display on UNIX systems. X protocol forwarding provides a way to secure the communication between X clients and remote X servers. X forwarding is enabled by default. X forwarding works as follows:

1. If X forwarding is enabled, the Secure Shell client requests X forwarding when it connects to the server.
2. If X forwarding is supported by the server, the server sets itself up as a proxy X server on the server host, and sets the DISPLAY environment variable in the client shell to point to the proxy X display.
3. When you run an X client program on the server host, it connects to the proxy display.
4. The Secure Shell client acts as a proxy X client and connects to the X server on the client host.
5. All X protocol information is sent through the Secure Shell channel.
**Working with X11 Settings**

The client setting `ForwardX11` enables or disables X11 forwarding. (The default is yes.) The client setting `TrustX11Applications` specifies whether the X server treats forwarded X11 client applications as trusted. (The default is no.)

Under some conditions, the configuration of these settings may affect the launch speed of X client applications. This happens when more than two systems are involved. For example:

- **System 1**: runs an X server and the Secure Shell client.
- **System 2**: runs an X client application, the Secure Shell client, and the Secure Shell server.
- **System 3**: runs an X client application and the Secure Shell server.

When a user makes an `ssh` connection from System 1 to System 2 with `X11Forwarding=yes` (the default) and `TrustX11Applications=no` (the default), there is no delay in starting X applications.

If the user makes a subsequent `ssh` connection from the new shell to System 3 with `X11Forwarding=yes` (the default) and `TrustX11Applications=no` (the default), there will be a long delay (as much as 6 seconds) after the user authenticates during which X applications started from System 3 will not be displayed to the X server running on System 1. This delay is added by the xauth application as it tries to communicate with the X server and register a new cookie. In order to avoid this delay and run the X applications from System 3, set `TrustX11Applications=yes` for the second connection.

**NOTE:** Setting `TrustX11Applications=yes` for the second connection does not create any additional security risk to the X server running on System 1. This is because the xauth application registers into the existing cookie created on System 2 by the initial X11 forwarding (done from System 1), for which `TrustX11Applications=no`.

---

**Port Forwarding Settings**

Use the following keywords or command line options to configure port forwarding.

**Command Line Options**

You can use the following options on the `ssh` command line.

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>-L listening_port:host:hostport</code></td>
<td>Open the specified port on the Secure Shell client host (<code>listening_port</code>) and forward data to the destination <code>host</code> and <code>hostport</code>.</td>
</tr>
<tr>
<td><code>-R listening_port:host:hostport</code></td>
<td>Open the specified port on the Secure Shell server host (<code>listening_port</code>) and forward data to the destination <code>host</code> and <code>hostport</code>.</td>
</tr>
<tr>
<td><code>-X</code></td>
<td>Enables X11 connection forwarding and treats X11 clients as untrusted. Untrusted remote X11 clients are prevented from tampering with data belonging to trusted X11 clients.</td>
</tr>
<tr>
<td><code>-x</code></td>
<td>Disables X11 connection forwarding.</td>
</tr>
<tr>
<td><code>-Y</code></td>
<td>Enables X11 connection forwarding and treats X11 clients as trusted.</td>
</tr>
</tbody>
</table>

**Client Configuration Keywords**

You can configure the following settings in the client configuration file. (The global file is `/etc/ssh2/ssh2_config`; the user-specific file is `~/.ssh2/ssh2_config`.)
Port Forwarding

Server Configuration Keywords

You can configure the following settings in the server configuration file (/etc/ssh2/sshd2_config).

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ClearAllForwardings</td>
<td>Clears any local, remote, or dynamically forwarded ports that have already been processed from either a configuration file or the command line. scp and sftp clear all forwarded ports automatically, regardless of the value of this setting. The default is no.</td>
</tr>
<tr>
<td>ForwardX11</td>
<td>Equivalent to -X.</td>
</tr>
<tr>
<td>GatewayPorts</td>
<td>Controls whether forwarded ports on the Secure Shell client host are available to remote applications. The default is no, which prevents applications running on other computers from connecting to forwarded ports.</td>
</tr>
<tr>
<td>LocalForward</td>
<td>Equivalent to -L.</td>
</tr>
<tr>
<td>RemoteForward</td>
<td>Equivalent to -R.</td>
</tr>
<tr>
<td>TrustX11Applications</td>
<td>Specifies whether the X server treats forwarded X11 client applications as trusted. The default is no.</td>
</tr>
<tr>
<td>XauthPath</td>
<td>Specifies the full path of the xauth program. The default is /usr/bin/xauth.</td>
</tr>
</tbody>
</table>

Option Description

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AllowTCPForwarding</td>
<td>Enables or disables all port forwarding. The default is yes.</td>
</tr>
<tr>
<td>AllowX11Forwarding</td>
<td>Specifies whether X11 forwarding is allowed. The default is yes.</td>
</tr>
<tr>
<td>AllowTCPForwardingForGroups</td>
<td>Allows or denies port forwarding for specified groups. Regular expressions are supported.</td>
</tr>
<tr>
<td>DenyTCPForwardingForGroups</td>
<td>Allows or denies port forwarding only for specified users. Regular expressions are supported.</td>
</tr>
<tr>
<td>ForwardACL</td>
<td>Provides detailed control over port forwarding. For details, see &quot;Server Configuration Keywords&quot; on page 115.</td>
</tr>
<tr>
<td>GatewayPorts</td>
<td>Specifies whether remote hosts are allowed to connect to ports forwarded for the client. The default is no.</td>
</tr>
<tr>
<td>X11UseLocalHost</td>
<td>Specifies whether the server should bind X11 forwarding to the loopback address. The default is yes.</td>
</tr>
</tbody>
</table>
Controlling Access and Authorization

In this Chapter

- “Access Control Settings” on page 85
- “Using Allow and Deny Keywords” on page 86
- “Configuring User and Group Access” on page 87
- “Configuring Client Host Access” on page 88

Access Control Settings

The table below provides an overview of server settings you can use to control client access to the server.

By default, all client users with an account on the server host can connect to the server, open a terminal session, and access all local files and directories allowed for their user account from any client computer. You can edit the server configuration file (/etc/ssh2/sshd2_config) to customize access for client users, groups, and computers.

<table>
<thead>
<tr>
<th>To</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set the maximum number of connections</td>
<td>MaxConnections</td>
</tr>
<tr>
<td>Set the maximum number of multiplexed sessions supported over a single TCP connection. To disable connection reuse, set this keyword to 1.</td>
<td>MaxSessions</td>
</tr>
<tr>
<td>Allow access to specified session types only</td>
<td>SessionRestricted</td>
</tr>
<tr>
<td>Control access from client users</td>
<td>AllowUsers, DenyUsers, UserSpecificConfig</td>
</tr>
<tr>
<td>Control access from client groups</td>
<td>AllowGroups, DenyGroups, UserSpecificConfig</td>
</tr>
<tr>
<td>Control access from client hosts</td>
<td>AllowHosts, DenyHosts, HostSpecificConfig</td>
</tr>
<tr>
<td>Control access using TCP Wrappers</td>
<td>LibWrap</td>
</tr>
<tr>
<td>Restrict sftp and scp users or groups to a confined directory tree</td>
<td>ChrootSftpUsers, ChrootSftpGroups</td>
</tr>
<tr>
<td>Control upload and download access rights for sftp and scp users.</td>
<td>AllowSftpCommands</td>
</tr>
</tbody>
</table>
Using Allow and Deny Keywords

The following keywords are available for controlling access to users, groups, and/or client host computers:

**AllowUsers, DenyUsers, AllowGroups, DenyGroups, AllowHosts, DenyHosts, AllowTcpForwardingForUsers, DenyTcpForwardingForUsers, AllowTcpForwardingForGroups, DenyTcpForwardingForGroups, ForwardACL**

You can specify users, groups, or hosts for any of these keywords by using a single instance of the keyword with a comma-separated list of values, or by including multiple instances of the keyword, in which case the final assigned value is cumulative over all instances.

The server uses the following logic to determine whether to allow a connection.

1. Check to see if any "Deny" keywords are configured for a given access category (hosts, users, group, or TCP forwarding); and deny access if the client matches any denied expression.
2. Check to see if any "Allow" keywords are configured for the same category.
   - If no "Allow" keywords are configured, access is granted.
   - If any "Allow" keywords are configured, the server allows access only if the client matches an allowed expression.

**Examples**

The following samples show how you can allow access, deny access, or use a combination of allow and deny.

<table>
<thead>
<tr>
<th>To</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restrict port forwarding</td>
<td>AllowTcpForwardingForGroups</td>
</tr>
<tr>
<td></td>
<td>DenyTcpForwardingForGroups</td>
</tr>
<tr>
<td></td>
<td>AllowTcpForwardingForUsers</td>
</tr>
<tr>
<td></td>
<td>DenyTcpForwardingForUsers</td>
</tr>
<tr>
<td></td>
<td>ForwardACL</td>
</tr>
<tr>
<td></td>
<td>GatewayPorts</td>
</tr>
<tr>
<td></td>
<td>AllowX11Forwarding</td>
</tr>
<tr>
<td></td>
<td>X11UseLocalHost</td>
</tr>
<tr>
<td>Configure PAM authentication</td>
<td>AccountManagement</td>
</tr>
<tr>
<td></td>
<td>AuthKbdInt.Required</td>
</tr>
<tr>
<td></td>
<td>PamServiceName</td>
</tr>
<tr>
<td></td>
<td>UsePamSessions</td>
</tr>
</tbody>
</table>
NOTE: You can also configure user-specific and host-specific settings using subconfiguration files (page 32).

### Configuring User and Group Access

Edit the server configuration file (`/etc/ssh2/sshd2_config`) to control access to the server.

The following keywords configure user access: **AllowUsers**, **DenyUsers**, **AllowTcpForwardingForUsers**, **DenyTcpForwardingForUsers**, **ForwardACL**, **ChrootSftpUsers**, **UserSpecificConfig**. You can specify user names alone, or use the following syntax to include group and/or host information:

```
user[%group][@host]
```

Where `user` is a regular expression for a user (numerical UIDs are not supported), `group` is a regular expression for a group, (numerical GIDs are not supported), and `host` is a regular expression for host (which can be a domain name, IP address, or subnet mask). For example, the following denies access to all members of the interns group at myhost.com:

```
DenyUsers=.*%interns@myhost.com
```

The following keywords configure group access: **AllowGroups**, **DenyGroups**, **AllowTcpForwardingForGroups**, **DenyTcpForwardingForGroups**, **ChrootSftpGroups**. These keywords support any valid regular expression. Numerical GIDs are not supported. For example:

```
DenyGroups=interns
```

NOTE: Without the final line, no clients would be allowed access. This is because once any client is added to the allow list, clients are allowed access only if they match an allowed expression.
Configuring Client Host Access

Edit the server configuration file (/etc/ssh2/sshd2_config) to control access to the server. Note: The ResolveClientHostname setting controls whether the server attempts to resolve the client IP address to a domain name, and the default is 'yes'. The resolved domain name for a client is the fully qualified domain name. This means that when you add a host to the allow or deny list using a domain name, you must either use a fully qualified domain name, or a regular expression, to ensure that host domain names are handled correctly. For example, if you deny access to the client "mypc", the client mypc.myhost.com will be able to connect. You must explicitly deny access to "mypc\.myhost\.com" or use an expression such as "mypc\..*" to ensure that this client is denied access.

The following keywords configure settings for client host computers: AllowHosts, DenyHosts, HostSpecificConfig. You can specify hosts using either IP addresses or domain names. The server first tries to match using the IP address of the client. If that fails, it tries to match using a domain name.

You can also configure the server to force a match based on IP address.

To force matching to a specific IP address, start the host expression using a backslash followed by i (\i). For example:

DenyHosts = \i123.45.78.9

To match a range of IP addresses using a CIDR (Classless Inter-Domain Routing) subnet, start the host expression using a backslash followed by m (\m). For example:

DenyHosts = \m123.123.0.0/16

Note: If you use either \i or \m regular expressions are not supported within the IP address.

NOTE

- To configure localhost in any allow or deny list, include IP addresses for all external interfaces and also the local loopback address (127.0.0.1 and 0:0:0:0:0:0:0:1).
- To configure addresses in any allow or deny list, both IPv4 and IPv6 addresses must be specified. This is particularly important if you are configuring a deny list to ensure that access is blocked.
File Transfer Auditing

To maintain a detailed record of file transfer activity, you can configure the server to create file transfer logs. This logging is not enabled by default.

To enable file transfer auditing

1. Open the server configuration file (/etc/ssh2/sshd2_config) in a text editor.
2. Set `AuditLog` to 'sftp' as shown here:

   AuditLog = sftp

3. (Optional) Edit the values for `AuditLog.Directory` and/or `AuditLog.Sftp.WithHash`. The default values are:

   AuditLog.Directory=/etc/ssh2/logs
   AuditLog.Sftp.WithHash=yes

4. Save your changes to the configuration file.

When audit logging is enabled, Reflection for Secure IT creates a new log each day in the specified audit log directory. Audit logs use this name format: `sshd2-audit-YYYYMMDD.log`, where `YYYYMMDD` indicates the date.

Log files are created in comma-delimited format. The first line of the audit log file, shown here, identifies the logged content:


**NOTE**

- The server logs sftp transfers and scp transfers that use SCP2 (a file transfer implementation that uses the SFTP subsystem). Transfers using SCP1 (An early implementation of the SCP protocol used by OpenSSH) are not logged.
When SmartFileTransfer is enabled (the default), the server may not create an audit record when the client and server files are identical. To ensure that transfers of identical files create an audit record, set SmartFileTransfer to no.

If users have been limited to a home directory for sftp protocol connections (using ChrootSftpUsers or ChrootSftpGroups), the audit log directory must be located in the home directory. Because of this limitation, audit logging only works for chrooted users if they share the same home directory.

Auditing (Message Logging)

The following auditing services are always enabled.

- Login history
- Currently logged in users
- Failed logins

You can also configure additional auditing to maintain a record of file transfer activity. This auditing is not enabled by default. For more information, see Configure File Transfer Auditing (page 89).

The table below summarizes keywords used for configuring auditing.

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AuditLog</td>
<td>Specifies whether or not an audit log is created. Valid values are 'sftp' and 'none'. When 'sftp' is specified, a comma-delimited log file containing a detailed record of file transfer activity is created in the location specified by AuditLog.Directory. The first line of the audit log file, shown here, identifies the logged content: UserID,ClientIP,Action,ServerFilename,StartTime,EndTime,ServerFileModificationTime,ServerFileSize,BytesTransferred,Result,Reason,ServerFileHash. The default is 'none'.</td>
</tr>
<tr>
<td>AuditLog.Directory</td>
<td>The output location for audit logs. A new log is created each day using this name format: sshd2-audit-YYYYMMDD.log, where YYYYMMDD indicates the date. When AuditLog = sftp, this file is created the first time a client user transfers a file, or when you restart the server. The default is /etc/ssh2/logs.</td>
</tr>
<tr>
<td>AuditLog.Sftp.WithHash</td>
<td>Specifies whether or not sftp log entries include a file hash. The hash value can be used to identify multiple records identifying transfer of the same file. Each time an unchanged file is transferred, the hash value in the log is identical. If a file is changed, the hash value is different. The default is 'yes'.</td>
</tr>
<tr>
<td>SyslogFacility</td>
<td>A facility code for sshd messages. The value of SyslogFacility must correspond to a facility specified in syslog.conf. The default is 'AUTH'.</td>
</tr>
</tbody>
</table>
Log File Locations

File Transfer Audit Logs

If you have enabled file transfer auditing, logs are created by default in /etc/ssh2/logs. You can configure a non-default location using AuditLog.Directory.

Login Information

The output location for login information is platform-dependent. For details refer to the following table.

<table>
<thead>
<tr>
<th>Platform</th>
<th>Login history</th>
<th>Current login</th>
<th>Failed login</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPUX (11.11)</td>
<td>/var/adm/wtmp</td>
<td>/etc/utmp</td>
<td>/var/adm/btmp</td>
</tr>
<tr>
<td>HPUX (11.23, 11.31)</td>
<td>/var/adm/wtmps</td>
<td>/etc/utmpx</td>
<td>/var/adm/btmps</td>
</tr>
<tr>
<td>AIX</td>
<td>/var/adm/wtmp/etc/security/lastlog</td>
<td>/etc/utmp</td>
<td>/etc/security/failedlogin /etc/security/lastlog</td>
</tr>
<tr>
<td>Solaris</td>
<td>/var/adm/wtmpx</td>
<td>/var/adm/wtmpx</td>
<td>/var/adm/loginlog</td>
</tr>
<tr>
<td>RHEL</td>
<td>/var/log/lastlog</td>
<td>/var/run/utmp</td>
<td>/var/log/btmp</td>
</tr>
<tr>
<td>SLES</td>
<td>/var/log/wtmp</td>
<td>/var/run/utmp</td>
<td>/var/log/btmp</td>
</tr>
</tbody>
</table>

NOTE

- Some platforms write to more than one file.
- On some Linux systems, btmp is not present. The server writes to this database if it is present.
The output for **sshd** and **sftp-server** messages is affected by both Reflection for Secure IT configuration and **syslogd** configuration. For example, the following entry in `/etc/syslog.conf` configures a facility called local6 and sends output from that facility to `/var/adm/rsit_log`.

**NOTE:** This syntax shown requires a tab between the two entries.

```
local6.info /var/adm/rsit_log
```

To configure Reflection for Secure IT to send **sshd** messages to the **local6** facility, include the following line in the server configuration file (`/etc/ssh2/sshd2_config`).

```
SysLogFacility local6
```

**Solaris Audit Support**

The Solaris operating environment supports auditing of system events, such as file access, process operations and network activity. With auditing enabled, the system provides an audit trail of selected events in the form of a log file, which can be monitored to detect unauthorized use of the system. Auditing in the Solaris operating environment is provided by the Basic Security Module (BSM). Refer to the Solaris documentation for information about configuring BSM.

To generate audit records for Secure Shell connections

1. Verify that the Secure Shell (SSH) audit events are mapped to the correct audit class. The following line in the `/etc/security/audit_event` file defines that all Secure Shell events will belong to the login/logout class of events:

   ```
   6172:AUE_ssh:login - ssh:lo
   ```

   **NOTE:** If you are running Solaris 8, this entry does not exist, but must be added manually.

2. Edit the `/etc/security/audit_control` file, which lets you define a system-wide audit setting for all users. Add the login/logout event class to the `flags` section:

   ```
   flags:lo
   ```

3. (Optional) If some users need special audit settings, or you want to remove auditing for only some users, you can edit the `/etc/security/audit_user` file. The entries are of the following form:

   ```
   user:always_audit-flags:never_audit_flags
   ```

   For example, the following entry in the `/etc/security/audit_user` file disables auditing for a user 'joe':

   ```
   joe::lo
   ```

To view the audit log

1. Locate the audit log in:

   ```
   /var/audit
   ```

2. Use the `praudit` command to read the binary file format:

   ```
   praudit audit_file
   ```

   The audit entry for the Secure Shell login/logout events tells which user attempted to log in or out, from which host, and whether the connection succeeded or not.
Example 1
An entry for a user ‘joe’, logging on from host sphinx.company.com:

header,94,2,login - ssh,,Tue May 13 10:49:44 2010, + 863 msec
subject,joe,joe,other,joe,other,7763,7763,0 2805 sphinx.company.com
text,sshd login joe on /dev/pts/4
return,success,0

In this case, the user successfully logged on to the system, and was given a Secure Shell terminal session on /dev/pts/4.

Example 2
For Secure Shell logins not requiring a terminal session, such as remote commands or file transfers with scp or sftp, the terminal or tty number is replaced by the command the server executes on behalf of the user. For example:

header,116,2,login - ssh,,Tue May 13 10:49:58 2010, + 361 msec
subject,joe,joe,other,joe,other,7774,7774,0 2806 sphinx.company.com
text,sshd login joe on (no tty)
text,remote command: sftp
return,success,0

Example 3
An example of a failed login attempt:

header,81,2,AUE_ssh,,Tue May 13 11:22:51 2003, + 462 msec
subject,joe,joe,other,joe,other,8006,8006,0 0 sphinx.company.com
text,invalid password
return,failure: Interrupted system call,-1
11 Debug Logging

Reflection for Secure IT logs can provide you with detailed information to help in troubleshooting. The information included in the client log is different from that in the server log, and it is often useful to have both.

In this Chapter

• “Client Debugging” on page 95
• “Server Debugging” on page 96

Client Debugging

You can configure debugging on the ssh, sftp, and scp command line. You can also configure debugging that applies to all of these session types in the client configuration file (/etc/ssh2/ssh2_config).

Command Line Options

Use the following command-line options to configure client-side debugging.

<table>
<thead>
<tr>
<th>Option</th>
<th>Used by</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-d debug_level</td>
<td>ssh, ssh-agent</td>
<td>Sets the debug level. Increasing the value increases the amount of information displayed. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.)</td>
</tr>
<tr>
<td>-D debug_level</td>
<td>scp, sftp</td>
<td>Equivalent to ssh -d.</td>
</tr>
<tr>
<td>-v</td>
<td>ssh, scp, sftp</td>
<td>Sets the debug level to verbose mode, which is equivalent to setting the debug level to 2.</td>
</tr>
<tr>
<td>-q</td>
<td>ssh</td>
<td>Enables quiet mode, which causes all warning and diagnostic messages, including banners, to be suppressed.</td>
</tr>
</tbody>
</table>

Configuration File Keywords

You can configure the following settings in the client configuration file. (The global file is /etc/ssh2/ssh2_config; the user-specific file is ~/.ssh2/ssh2_config.)

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LogLevel</td>
<td>Sets the verbosity level for messages sent to the facility specified by SyslogFacility.</td>
</tr>
<tr>
<td>QuietMode</td>
<td>Causes all warning and diagnostic messages, including banners, to be suppressed.</td>
</tr>
<tr>
<td>VerboseMode</td>
<td>Sets the debug level to ‘verbose’ mode. Equivalent to -v and LogLevel = verbose.</td>
</tr>
<tr>
<td>SyslogFacility</td>
<td>Specifies the facility code used for logging ssh, sftp, and scp messages. The default value is USER. Set the value to ‘none’ to disable client auditing.</td>
</tr>
</tbody>
</table>
Server Debugging

Server event messages can arise from different sources and be controlled by different configuration options. The following table summarizes `sshd` command-line options and server configuration keywords that affect logging; and describes where to find the output.

<table>
<thead>
<tr>
<th>To</th>
<th>Use</th>
<th>Output Location</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debug a single client connection</td>
<td><code>-d debug_level</code></td>
<td>stderr</td>
<td>Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.) With this option, <code>sshd</code> terminates after the first client connection closes. This option is independent of the setting for <code>LogLevel</code>.</td>
</tr>
<tr>
<td>Enable persistent debugging</td>
<td><code>-D debug_level</code></td>
<td>/etc/ssh2/logs</td>
<td>A debug file is created using the following file name format: <code>debugYYMMDD_HHMMSS_uniqueID</code>. This option is independent of the setting for <code>LogLevel</code>.</td>
</tr>
<tr>
<td>Suppress debug messages</td>
<td><code>-q</code></td>
<td>N/A — affects syslog output only</td>
<td>This option overrides <code>LogLevel</code>.</td>
</tr>
<tr>
<td>View server startup messages</td>
<td><code>LogLevel</code></td>
<td>stderr</td>
<td>Output to <code>stderr</code> includes errors and warnings found while parsing <code>sshd2_config</code>.</td>
</tr>
</tbody>
</table>
12 Troubleshooting

In this Chapter

- “Troubleshooting Public Key Authentication” on page 97
- “Troubleshooting Slow File Transfer Speed” on page 98
- “Troubleshooting Systems Running SELinux” on page 99

Troubleshooting Public Key Authentication

The Problem: Public key authentication is configured, but client users are unable to connect using public key authentication.

Check the client configuration

1. Confirm that there is a private/public key pair on the client and note the name and location of the private key.
2. Open the client configuration file. (If the user has a user-specific file, check both the global and user file.)
   - Confirm that AllowedAuthentications includes 'publickey.'
   - Check the IdentificationFile setting. Note the name and location of the file. (The default is ~/.ssh2/identification).
3. Open the identification file
   - Confirm that this file includes a line that identifies the client's private key. For example:
     ```
     IdKey /home/joe/mykey
     ```
   - Confirm that the key name exactly matches the private key of the key pair. (For example, if your private key has a file extension, this extension needs to be included.)
   - If no path is specified, confirm that the keys are located in the Secure Shell user directory (~/.ssh2/)
4. Check file and directory permissions. (The second and third bullet items are required if StrictModes is enabled on the client, which is the default.)
   - Is the private key readable only by the owner (600)?
   - Is the identification file configured to allow write-access only to the user (600 or 644)?
   - Are the user directory and all parent directories configured to allow write access only to the user (755 or less)?

Check the server configuration

1. Confirm that there's a copy of the user's public key in the user-specific configuration directory on the server. The default location is ~/.ssh2.
2. Open the server configuration file.
   - Confirm that AllowedAuthentications includes 'publickey.'
   - Check the AuthorizationFile setting. Note the name and location of the file. (The default is ~/.ssh2/authorization.)
3 Open the authorization file.
   - Confirm that this file includes a line that identifies the server's copy of the client's public key. For example:
     
     ```
     Key /home/joe/mykey.pub
     ```
   - Confirm that the key name exactly matches the public key, including the file extension.
   - If no path is specified, confirm that the key is located in the Secure Shell user directory. (The default is `~/.ssh2/`. This is configurable on the server with the `UserConfigDirectory` keyword.)

4 Check file and directory permissions. (The second bullet item is required if `StrictModes` is enabled on the server, which is the default.)
   - Is the authorization file configured to allow write-access only to the user (600 or 644)?
   - Are the user directory and all parent directories configured to allow write access only to the user (755 or less)?

Related Topics

- “Configure Public Key User Authentication” on page 53
- “File and Directory Permissions” on page 130

Troubleshooting Slow File Transfer Speed

File transfer speed can be affected by number of factors, including the CPU power of your client and server systems, available “bandwidth” on page 175 for transfers, and “latency” on page 175 in your network. In most cases, you’ll see the best performance using the Reflection for Secure IT default settings. In some cases, the following settings may affect transfer speeds.

Check compression settings

You can configure compression on both the client and server using the `Compression` keyword. You can specify compression values 0-9. The default value for the server is 6. The default value for the client is 0. Increasing the value increases the amount of compression. Using higher values results in the use of less network bandwidth, but at the cost of more CPU cycles.

- Lowering the `Compression` value or setting it to zero may improve performance if your files are already compressed, if your network bandwidth is large, or if your computer has limited CPU power.
- Increasing the `Compression` value may improve performance if your files are uncompressed, network bandwidth is small, or your CPU is not a limiting factor.

Check smart copy and checkpoint resume settings

“Smart Copy and Checkpoint Resume” on page 69 help minimize the amount of time spent repeating unnecessary transfer of data. These features use a series of hashes sent between the client and server to determine if part or all of a file is identical. Identical content is not transferred. This functionality is enabled by default. If you transfer files in a high latency network, the time required to send the hash values across the network can cause delays that exceed the benefit of using these features.

- If you transfer large files across a high latency network, you may be able to improve performance by disabling the smart copy and checkpoint resume feature. To disable these features from the client, set `SmartFileCopy` and `CheckpointResume` to no. To disable these features from the server, set `SmartFileTransfer` to no.
Check High Performance Network (HPN) settings

Reflection for Secure IT supports HPN features that maximize file transfer performance. This functionality is enabled by default.

- To ensure best performance, confirm that HPNDisabled is set to ’no’ (the default) on both the client and server.

**NOTE:** Transfer speed improvements from enabling HPN on client and server are most noticeable in networks with high “latency” on page 175 and high “bandwidth” on page 175.

Troubleshooting Systems Running SELinux

The Problem: Error messages such as the following appear when you try to install or run Reflection for Secure IT on a Linux system that is running Security-Enhanced Linux (SELinux).

```plaintext
error while loading shared libraries: /usr/lib/libssccm.so.2.0.40: cannot restore segment prot after reloc: Permission denied
error while loading shared libraries: libssccm.so.2.0.40: cannot enable executable stack as shared object requires: Permission denied
```

These errors occur when SELinux is enabled and set to Enforcing as opposed to Targeted. The Reflection for Secure IT cryptographic module requires text relocation. The following procedure provides support for this requirement.

To install and run Reflection for Secure IT on a system with SELinux enabled

1. After you install Reflection for Secure IT and see error messages like the ones shown above, execute the following command. The library name you specify should match the library name in the error messages.

   ```bash
   chcon -t textrel_shlib_t /usr/lib/libssccm.so.2.0.40
   ```

2. Create a host key. (page 40)

3. Start the server. (page 23)

**NOTE:** You will need to repeat steps 1 and 3 each time you upgrade Reflection for Secure IT.
In this Chapter

- “Files Used by the Client” on page 101
- “Files Used by the Server” on page 103
- “Client Configuration Keywords” on page 105
- “Server Configuration Keywords” on page 115
- “File and Directory Permissions” on page 130
- “ssh Command Line Options” on page 132
- “ssh Escape Sequences” on page 136
- “ssh Exit Values” on page 137
- “ssh-keygen Command Line Options” on page 138
- “scp Command Line Options” on page 140
- “sftp Command Line Options” on page 143
- “Supported sftp Commands” on page 146
- “ssh-add Command Line Options” on page 149
- “ssh-agent Command Line Options” on page 150
- “sshd Command Line Options” on page 151
- “ssh-certview Command Reference” on page 152
- “ssh-certtool Command Reference” on page 154
- “winpki and pkid Command Reference” on page 157
- “pkid_config Configuration File Reference” on page 159
- “pki_mapfile Map File Reference” on page 163
- “Sample Mapping Rules” on page 169
- “Sample Map File with RuleType Stanzas” on page 170
- “PKI Settings Migration” on page 170
- “PKI Services Manager Return Codes” on page 172

Files Used by the Client

$HOME/.ssh2/ssh2_config

User-specific configuration file. The format is the same as the system-wide configuration file. Recommended permissions = 644.

/etc/ssh2/ssh2_config

System-wide configuration file. This file is installed when you install Reflection for Secure IT. The installed file shows default values as commented out lines. Edit this file to change system-wide settings. For information about keywords and supported values, see ssh2_config(5). Recommended permissions = 644.
$HOME/.ssh2/hostkeys/key_*.pub

This directory contains the public keys of hosts trusted by the current user. By default, keys are added automatically to this location when the user answers ‘yes’ in response to an unknown host prompt. (This behavior can be changed using the `StrictHostKeyChecking` keyword in the configuration file.) Starting with version 7.0, host keys use the following file name format:

`key_port_/IP.pub`

Where `port` is the port used for the ssh connection, `host` is the host name, and `IP` is the host IP address. (Earlier versions used `key_port_host.pub`, and this format is still supported.)

Note: By default the keys added to this directory have group and public read access (644). To improve security, set permissions on these files to make them readable only by the owner (600).

/etc/ssh2/hostkeys/key_*.pub

System-wide known hosts. Hosts with keys in this list are trusted for all users of the computer. No keys are installed to this location automatically. To add a system-wide trusted host, create this directory and put a copy of the host public key in it. Use the file name format described above for $HOME/.ssh2/hostkeys/key_*.pub.

$HOME/.ssh2/identification

An identification file is required if you use public keys or certificates for user authentication. (This is the default file name and location. You can redefine the name and/or location of the identification file on the `ssh` command line using `-i` or in the configuration file using the `IdentificationFile` keyword.) The identification file contains a list of one or more private keys held by a client user. Any listed key can be used by the client for user authentication. If more than one key is listed, the client tries the first key in the list, then continues trying the other keys in order. If no path information is provided, the client looks for listed keys in $HOME/.ssh2/. This file should have user-only write access (permissions = 600 or 644).

For standard keys use the following syntax to add keys to the list:

`IdKey keyname`

For example:

`IdKey id_dsa_2048_a`

For keys associated with n X.509 certificate use the following syntax.

`CertKey keyname`

The associated certificate must be in the same directory as the specified key and use the same base name with a .crt file extension.

NOTE:

- For public key authentication, you also need to configure the server. For certificate authentication, you need to install and configure Reflection PKI Services Manager and also configure the server.
- When `ChrootSftpUsers` or `ChrootSftpGroups` is enabled, connected users see additional subdirectories (`etc` on all platforms and `dev` on AIX) added to their home directory. These directories contain required files and cannot be moved or deleted. The `etc` directory contains the `rsit.conf` file, which identifies the installation location of files required by Reflection for Secure IT. A `localtime` file may also be present. It is needed so that processes such as logging can get the current time. The system `localtime` file is in a location that cannot be accessed by a
chrooted user. If the TZ environment variable set on the system, the localtime file is not created. Users running on AIX also require /dev/null, which is needed for correct logging to syslog.

Files Used by the Server

The server uses system-wide files (in /etc/ssh2) for all connections. Files in user-specific directories (~/.ssh2 by default) apply to connections from individual client users.

System-wide server files

/etc/ssh2/sshd2_config

The global server configuration file. This file must not be writable by group or other. For file format and supported settings see sshd2_config(5). Recommended permissions = 644.

/etc/ssh2/hostkey

The default private key of the public/private key pair used to identify the server to clients. This file should be readable and writable only by root. This file must be limited to user-only read and write access. If permissions are not sufficiently restricted, public key authentication will fail. Recommended permissions = 600.

/etc/ssh2/hostkey.pub

The default public key of the public/private key pair used to authenticate the server to clients. Recommended permissions = 644.

/etc/ssh2/subconfig

Directory for optional user-specific and host-specific subconfiguration files. Recommended permissions = 700.

/etc/ssh2/subconfig/subconfig_file

User-specific and host-specific subconfiguration files. For details see SUBCONFIGURATION FILES in sshd2_config(5).

/etc/ssh2/environment

If this file is present, it sets environment variable settings to use for all Secure Shell client connections to this server. (The keyword SettableEnvironmentVars controls which environment variables can be set.) Recommended permissions = 644. Note: Environment variable settings specified in this file override any values configured in standard system files such as /etc/default/login and /etc/environment. If the same environment variable is configured in this global file and also in a user-specific environment file (~/.ssh2/environment), the user-specific value overrides the global value. The pound sign (#) marks comment lines. The syntax is:

```
environment_variable=value
```

/etc/nologin

Limits login to root. If this file exists, only root is allowed to login. The text of nologin is displayed to anyone else who attempts to log in.

piddir/sshd2_22.pid

Contains the PID of the process listening for incoming connections. The PID directory is determined by your operating system. The port number (22 by default) encoded in this name is determined by the value of the Port keyword. You can specify a different name or location using the PidFile keyword.
/etc/motd

The message-of-the-day file. The text of this file is displayed when a user logs in. The **PrintMotd** keyword can be used to turn off this display.

/etc/ssh2/radius_config

A user-created file listing one or more RADIUS authentication servers. The file name suggested above is not required. After you create this file, use the **RadiusFile** keyword to specify your file name. For each RADIUS server, you need to enter the name, port, and shared secret. Recommended permissions = 600. The syntax is:

```
server1:port1:shared_secret1
server2:port2:shared_secret2
```

User-specific server files

~/.ssh2

The default directory for user-specific files on the server. (You can specify a different location with the **UserConfigDirectory** keyword.) Recommended permissions = 700.

~/.ssh2/authorization

The default client authorization file. (You can specify a different file with the **AuthorizationFile** keyword.) This file is required for Secure Shell public key authentication of client users. Each user must have an authorization file in that user's directory. This file must be limited to user-only write access. If permissions are not sufficiently restricted, public key authentication will fail. Recommended permissions = 600.

The file contains a list of key files that the server will use during public key authentication. If the key presented by the client doesn't match any of the keys listed in the authorization file, public key authentication fails. Keywords are not case sensitive and the pound sign (#) marks comment lines. The supported keywords are:

**key**

Specifies keys the server will accept for this user. The format for key entries is "key" followed by the name of a file that contains a public key. Keys are assumed to be in the user-specific configuration directory (~/.ssh2 by default) unless you specify an absolute path. For example, the following lines authorize the user to authenticate using either of the specified keys.

```
key mykey.pub
key id_rsa_2048_a.pub
```

**options**

Use this optional keyword to specify options that apply to the preceding key. All options for a given key must be configured on a single line. White space is allowed. Options must be configured on the line immediately following the line containing the key. The format is:

```
Options option_keyword="arg", [option_keyword="arg"],...
```

Three **Options** keywords are supported: **command**, **allow-from**, and **deny-from**

**command command**

The specified command is executed on the remote host, then the connection is closed. For example, with this configuration, the script "myscript" runs whenever mykey.pub is used for authentication.

```
key mykey.pub
options command="sh myscript"
```

**allow-from IP-address**
The key is allowed only for connections from the specified IP address. For example, the following configuration allows the specified key to be used only for connections from IP addresses starting with "150." and "10.10."

Key /home/joe/.ssh/mykey.pub

options allow-from="150\..*,10\..*"

deny-from IP-address

The key is not allowed for connections from the specified IP address.

Note: To configure addresses in any allow or deny list, both IPv4 and IPv6 addresses must be specified. This is particularly important if you are configuring a deny list to ensure that access is blocked. To configure localhost in any allow or deny list, include IP addresses for all external interfaces and also the local loopback address (127.0.0.1 and 0:0:0:0:0:0:0:1).

~/.hushlogin

If this file is present, it suppresses display of the user's last login, the message of the day, and the mail check.

~/.ssh2/environment

If this file is present, it sets environment variables to set for this user at login. (The keyword SettableEnvironmentVars controls which environment variables can be set.) Recommended permissions = 644. Note: Environment variable settings specified in this file override any values configured in standard system files such as /etc/default/login and /etc/environment, and also override settings configured in the global file (/etc/ssh2/environment). The pound sign (#) marks comment lines. The syntax is:

environment_variable=value

Client Configuration Keywords

You can configure the following settings in the client configuration file. (The global file is /etc/ssh2/ssh2_config; the user-specific file is ~/.ssh2/ssh2_config.) You can also configure these settings using the -o option on the ssh command line.

AddressFamily

Specifies which address formats are supported by the client. The allowed values are 'any' (allow the system to decide which address family to use), 'inet' (accept only IPv4), and 'inet6' (prefer IPv6 but accept IPv4). The default is 'inet'. You can also configure address family preference using the -4 and -6 command line options.

AllowedAuthentications

Specifies which authentication methods the client attempts, and the order in which they are tried. The supported methods are: 'gssapi-keyex', 'gssapi-with-mic', 'publickey', 'keyboard-interactive', and 'password'. Use a comma-separated list to specify supported methods. The client attempts authentication methods in order from first to last. The authentication technique used for the connection is the one highest in the client order of preference that is also allowed by the server. If the server is configured to require more than one method, multiple authentication methods may be needed to establish a connection. To support automated scripts, the least interactive methods should be placed first in the list. The default is 'gssapi-with-mic, publickey, keyboard-interactive, password'.
**AuthenticationSuccessMsg**

Specifies whether to display the following message when authentication has been completed successfully: "Authentication successful." The allowed values are 'yes' and 'no'. The default is 'yes'.

**BatchMode**

Specifies whether to disable all queries for user input, including password and passphrase prompts, which is useful for scripts and batch jobs. If `StrictHostKeyChecking` is set to 'ask' and `BatchMode` is set to 'yes', the client assumes a "no" response to all queries about unknown host keys. The allowed values are 'yes' and 'no'. The default is 'no'.

**CheckHostIP**

Specifies whether host IP address checking is performed using the host name and IP address encoded in the public key file name. When a user accepts a new host key, the key is added to the known hosts store using the format `key_port_host,IP.pub`. When `CheckHostIP` is enabled, host authentication fails if the actual IP of the specified host doesn't match the encoded IP address for that host. Enabling this setting helps detect DNS spoofing if the host key changes. The allowed values are 'yes' and 'no'. The default is 'no'.

Note: Host keys added to the host key store using versions earlier than v.7.0 do not include the host IP address. Disable `CheckHostIP` if you use keys with the older format.

**CheckpointResume**

When this setting is 'yes' (the default), interrupted file transfer resumes at the point of interruption. When this setting is 'no' transfers always start over. Note: Checkpoint resume can also be disabled on the server using the `SmartFileTransfer` keyword.

**Ciphers**

Specifies one or more (comma-separated) encryption algorithms supported by the client.

The cipher used for a given session is the cipher highest in the client's order of preference that is also supported by the server. Allowed values are 'aes128-ctr', 'aes128-cbc', 'aes192-ctr', 'aes192-cbc', 'aes256-ctr', 'aes256-cbc', 'blowfish-cbc', 'arcfour', 'arcfour128', 'arcfour256', 'cast128-cbc', and '3des-cbc'.

You can also set this value to 'none'. When 'none' is the agreed on cipher, data is not encrypted. Note that this method provides no confidentiality protection, and is not recommended.

The following values are provided for convenience: 'aes' (all supported aes ciphers), 'blowfish' (equivalent to 'blowfish-cbc'), 'cast' (equivalent to 'cast128-cbc'), '3des' (equivalent to '3des-cbc'), 'Any' or 'AnyStd' (all available ciphers plus 'none'), and 'AnyCipher' or 'AnyStdCipher' (all available ciphers).

You can also specify encryption algorithms on the `ssh` command line using the `-c` option. The default is 'AnyStdCipher'.

**ClearAllForwardings**

Clears any local, remote, or dynamically forwarded ports that have already been processed from either a configuration file or the command line. The allowed values are 'yes' and 'no'. The default is 'no'. Note: `scp` and `sftp` clear all forwarded ports automatically regardless of the value of this setting.

**Compression**

Specifies the level of compression. You can specify compression values 0-9. Increasing the value increases the amount of compression. Using higher values results in the use of less network bandwidth, but at the cost of more CPU cycles. Level 6 is equivalent to 'yes'. Level 0 is equivalent to 'no'. The default is 'no' (0).
ConnectionReuse

Note: Compression can be disabled on the ssh command line using the -C option, but can only be enabled using this keyword.

Specifies whether new ssh, scp, and sftp sessions can reuse an established connection. This feature allows you to start new sessions without having to reauthenticate. The allowed values are 'yes' and 'no'. The default is 'no'. When set to 'yes', a new session reuses an existing tunnel if the target host, port, and user are all identical to those used for the established connection. When set to 'no', the client establishes a new connection for each session, which means that each new connection repeats the authentication process and also applies any modified connection-specific settings (such as forwards and ciphers).

Note: Connection reuse may fail if the server administrator has configured restricted directory access using ChrootSftpGroups or ChrootSftpUsers.

ConnectionTimeout

Specifies the maximum time (in seconds) that the client waits when trying to connect to the server. The default is set to 0 (zero), which means that the client sets no limit and the actual limit is determined by the operating system.

DefaultDomain

Specifies a default domain name. You can add this setting to your configuration file if you want to be able to enter a short host name on the command line, but send a fully qualified domain name to make the connection. If you have configured a value for DefaultDomain and you enter a host name that doesn't contain any "." (dot) characters, the DefaultDomain value is concatenated to the host name using a "." character. (Note: You can include an optional dot at the beginning of the DefaultDomain string; the first "." in this string is ignored.) Any alpha-numeric character is accepted as a value. For example, if DefaultDomain is set to either "acme.com" or ".acme.com", the command "ssh joe@myhost" is sent as "ssh joe@myhost.acme.com".

DontReadStdin

Redirects stdin from /dev/null, which prevents reading from stdin. You can also configure this on the ssh command line using the -n option. The allowed values are 'yes' and 'no'. The default is 'no'.

EscapeChar

Sets the escape character for the terminal session. The default character is a tilde (~). Setting the escape character to 'none' means that no escape character is available and the tilde acts like any other character. For details, see ESCAPE SEQUENCES in the ssh man page. You can also set the escape character on the ssh command line using the -e option.

ExitOnForwardFailure

Specifies whether ssh terminates the connection if all requested dynamic, local, and remote port forwardings cannot be configured. The allowed values are 'yes' and 'no'. The default is 'no'.

FileCopyAsciiExtensions

Specifies which file types use ASCII transfer during sftp sessions when auto mode transfer is enabled. All other files use binary transfer. Specify a comma or space-separated list. Wildcard (zsh-glob) characters are supported. Don't precede file extensions with a period. To specify extensions containing spaces, use quotation marks around the extension or use a backslash as an escape character. The default is 'txt, htm*, pl, php*'. (You can use the setext during an sftp session to specify a different file list for that session. Use gettext to display the current list.)

Note: This setting is only relevant when auto transfer is enabled. The transfer method is set to binary by default. To enable auto transfer, use the sftp command "auto". To display the current transfer mode, use "ascii -s".
FipsMode
Specifies whether all connections will be made using security protocols and algorithms that meet FIPS 140-2 standards. The allowed values are 'yes' and 'no'. The default is 'no'.

ForcePTTYAllocation
Forces a tty allocation even if a command is specified. The allowed values are 'yes' and 'no'. The default is 'no'. You can also configure this on the ssh command line using the -t option.

ForwardAgent
Specifies whether a connection to the authentication agent (if established) is forwarded to the remote machine. The allowed values are 'yes' and 'no'. The default is 'yes'.

ForwardX11
Enables X11 connection forwarding and treats X11 clients as untrusted. Untrusted remote X11 clients are prevented from tampering with data belonging to trusted X11 clients. The allowed values are 'yes' and 'no'. When ForwardX11 is set to yes (the default), X11 forwarding is enabled only if the DISPLAY environment variable is set. If the DISPLAY variable is not set, the client will automatically disable X11 forwarding and will not set up the tunnel and authenticate. This helps minimize the risk of attacks using the X11 tunnel.

GatewayPorts
The gateway ports setting controls whether locally forwarded ports are available to remote applications. By default this setting is not enabled, and the client uses the loopback address (*localhost* or 127.0.0.1) when it opens a socket for local port forwarding. This prevents applications running on other computers from connecting to the forwarded port. When you enable gateway ports, a remote application client can open a socket using the Secure Shell client's Ethernet address (such as an IP address, a URL, or a DNS name). For example, a Secure Shell client running on acme.com might be configured to forward port 8088. When gateway ports are not enabled, the forwarded socket is localhost:8088. When gateway ports are enabled, the forwarded socket is acme.com:8088. The allowed values are 'yes' and 'no'. The default is 'no'. You can also configure this on the ssh command line using the -g option. Caution: This option should be used with extreme caution (and never with Internet-facing network adapters), because the client performs no authentication of remote host connections. If the application to which this connection is forwarded does not perform its own authentication, then all remote hosts connections are allowed unrestricted access to that application.

GoBackground
Use this keyword when you have configured port forwarding and you want the Secure Shell session to run in the background. The allowed values are 'yes', 'no', and 'oneshot'. The default is 'no'. If at least one port forwarding rule is configured, both 'yes' and 'oneshot' send the session to the background after authentication is complete. When you specify 'yes', the Secure Shell session remains in the background and continues to accept forward requests indefinitely until you manually kill the process. (This is equivalent to using -f on the ssh command line.) When you specify 'oneshot', the background session waits for only one forwarded connection to occur and exits as soon as the forwarded connection is closed. (This is equivalent to using -fo on the ssh command line.)

GSSAPIDelegateCredentials
Specifies whether to forward (delegate) GSSAPI credentials to the server. The allowed values are 'yes' and 'no'. The default is 'yes'.

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Host

Specifies the actual host name or IP address to use for a connection. The default is an empty string. This keyword can be used in combination with a host stanza expression to create an alternate name for connecting to a host. When this keyword appears outside any stanza, it can be used to specify a default host for the connection.

HostCA

This keyword is no longer supported. Use Reflection PKI Services Manager to configure trust anchors.

HostCANoCRLs

This keyword is no longer supported. Use Reflection PKI Services Manager to configure revocation checking.

HostCertNameCheck

Specifies whether server authentication using a certificate requires host name checking. When HostCertNameCheck is 'yes', authentication succeeds only if the host name or IP address specified for the connection is included in the allowed identity set for the certificate. (Use the PKI Services Manager map file to configure allowed identities.) When HostCertNameCheck is 'no', the client ignores the allowed identity set and accepts any valid certificate. When HostCertNameCheck is 'ask' (the default), the user receives a prompt when the server name is not an allowed identity, and is asked whether or not to continue.

HostKeyAlgorithms

Specifies, in order of preference, the host key algorithms proposed by the client. The default value is 'x509v3-rsa2048-sha256, x509v3-sign-rsa, x509v3-sign-dss, ssh-rsa-sha2-256@attachmate.com, ssh-rsa,ssh-dss'. This setting is useful when the server is configured for both certificate and standard host key authentication. The default value presents x509 algorithms before regular SSH key algorithms. Secure Shell protocol allows only one attempt to authenticate the host. If the host presents a certificate, and the client is not configured for host authentication using certificates, the connection fails. (This is different from user authentication in which multiple authentication methods and attempts are supported.) In this situation you can configure the client to prefer SSH keys over certificates by changing the order of preference to ',ssh-rsa-sha2-256@attachmate.com, ssh-rsa, ssh-dss, x509v3-rsa2048-sha256, x509v3-sign-rsa,x509v3-sign-dss'.

HostKeyAlias

Specifies an alias to use instead of the real host name when a host key is saved to the client's directory of known host keys. Host keys are stored using this naming format: key_port_host,IP.pub. The value you specify replaces the host portion of the stored host key name. This option is useful for tunneling Secure Shell connections, or when multiple servers are running on a single host.

HPNDisabled

Specifies whether Reflection for Secure IT uses HPN dynamic TCP window features to enhance performance. When HPNDisabled = 'no' (the default), Reflection for Secure IT adjusts the TCP window and TCP receive buffers to optimize performance. When HPNDisabled is 'yes', the receive buffer is set to 64 KB.

IdentificationFile

Specifies an alternate identification file to use for public key authentication. The file location is assumed to be in the current working directory unless you specify a fully-qualified or relative path. The default identity file is ~/.ssh2/identification. For details, see the FILES section below. You can also configure this on the ssh command line using the -i option.
IdentityFile

This keyword is deprecated. It is the equivalent of IdentificationFile.

KeepAlive

Specifies whether the client sends TCP keep-alive messages to the server. This keyword is deprecated. Use ServerAliveInterval instead. The allowed values are 'yes' and 'no'. The default is 'yes'.

KEXs

Specifies which key exchange algorithms the client supports. Supported values are 'diffie-hellman-group-exchange-sha256','diffie-hellman-group-exchange-sha1','diffie-hellman-group14-sha1'. Multiple algorithms can be specified as a comma-separated list. The default value is 'diffie-hellman-group-exchange-sha256,diffie-hellman-group-exchange-sha1,diffie-hellman-group14-sha1'.

LibGssKrb5

Use this setting if you use GSSAPI (Kerberos 5) authentication. It specifies the fully-qualified path to the Kerberos library called libgssapi_krb5.so.

LocalForward

Use this keyword to forward connections from an arbitrary port on the client through the secure tunnel. The syntax for configuring this setting is:

\[\text{protocol/}][\text{listening_host}:]\text{listening_port:}host:port\]

When a Secure Shell connection is established, the Secure Shell client opens a socket on the Secure Shell client host using the designated local port (\text{listening_port}). (On client hosts with multiple interfaces, use \text{listening_host} to specify which interface.) Configure your application client (the one whose data you want to forward) to send data to the forwarded socket (rather than directly to the destination host and port). When that client establishes a connection, all data sent to the forwarded port is redirected through the secure tunnel to the Secure Shell server, which decrypts it and then directs it to the destination socket (host,hostport). Unless the gateway ports option is enabled, the forwarded local port is available only to clients running on the same computer as the Secure Shell client. The optional protocol can be tcp or ftp.

Note: If the final destination host and port are not on the Secure Shell server host, data is sent in the clear between the Secure Shell host and the application server host.

The following example uses local forwarding to secure e-mail communications between a mail client running on the same computer as the Secure Shell client and a mail server running on the same computer as the Secure Shell server. The local mail client is configured to send communications to local port 14300. Data received on port 14300 is forwarded through the secure tunnel to the server, where it is redirected to port 143.

\text{LocalForward=14300:localhost:143}

In the following example, FTP communications sent from an FTP client (on the same computer as the Secure Shell client) are forwarded to an FTP server running on myhost.com. With this configuration, you would configure the FTP client to connect to localhost:2121.

\text{LocalForward=ftp/2121:myhost.com:21}

You can also configure local forwarding on the \text{ssh} command line using the -L option.
**LogLevel**

Sets the verbosity level used for ssh messages. Allowed values are 'fatal', 'error', 'quiet', 'info', 'verbose', 'debug1' ('debug' and 1 are equivalent), 'debug2' (2 is equivalent), 'debug3' (3 is equivalent), and 'trace' ('debug99' and 99 are equivalent). The syslog level associated with these values is CRIT for fatal, ERROR for error and quiet, INFO for info and verbose, and DEBUG for debug1, debug2, debug3, and trace. The default is 'info'.

Note: Setting logging to 'trace' can increase your security risk. At this level, information leakage is a concern, as unencrypted protocol information may be written out. Also, the volume of information written may fill up disk space rapidly, potentially causing the host or Reflection for Secure IT to stop responding.

**MACs**

Specifies, in order of preference, which MACs (message authentication codes) are supported by the client. Allowed values are 'hmac-sha256', 'hmac-sha1', 'hmac-sha1-96', 'hmac-md5', 'hmac-md5-96', 'hmac-sha512', and 'hmac-ripemd160'. Use 'AnyMac' to support all of these. Use 'AnyStdMac' to specify 'hmac-sha256, hmac-sha1,hmac-sha1-96,hmac-md5,hmac-md5-96, hmac-sha512'. Specifying hmac-sha256 also enables hmac-sha2-256. Specifying hmac-sha512 also enables hmac-sha2-512. Multiple MACs can also be specified as a comma-separated list. Additional options are 'none', 'any' (equivalent to AnyMac plus 'none'), and 'AnyStd' (equivalent to 'AnyStdMac' plus 'none'). When 'none' is the agreed on MAC, no message authentication code is used. Because this provides no data integrity protection, options that include 'none' are not recommended.

You can also configure MACs on the ssh command line using the -m option. The default is 'AnyStdMac'.

**NoHostAuthenticationForLocalHost**

This option disables host authentication when the client connects to localhost. It is useful when the home directory is shared across computers. In this situation localhost will refer to a different host on each of the computers, and the client user will get many warnings about changed host keys. Setting this to 'yes' disables authentication for localhost so the user won't see these warnings. The allowed values are 'yes' and 'no'. The default is 'no'.

**NumberOfPasswordPrompts**

Specifies the number of password prompts to respond to before giving up. Note: The server can also set a maximum number of allowed password attempts. If you set **NumberOfPasswordPrompts** to a larger value than is configured by the server, the connection will fail when the server limit is reached. The default is 3.

**PasswordPrompt**

Specifies the prompt to display for password authentication. Two variable options are supported: %r is replaced by the user name and %h is replaced by the host name. The default is "%r@%h's password:"

(This setting has no effect on keyboard-interactive authentication.)

**PkidAddress**

Specifies the port used to connect to PKI Services Manager. Use the format host:port. The default is localhost:18081. If you specify a host and omit the port, the default PKI Services Manager port (18081) is used.

**PkidPublicKey**

Specifies the name and location of the public key used by to confirm the identity of Reflection PKI Services Manager. The default is /install-directory/config/pki_key.pub.
Port

Specifies the port to connect to on the server. The default is 22, which is the standard port for Secure Shell connections. You can also configure this on the `ssh` command line using the `-p` option.

ProxyCommand

Specifies the command to use to connect to the server. The command string extends to the end of the line, and is executed with the user’s shell. Two variable options are supported in the command: ‘%h’ is replaced by the host name and ‘%p’ by the port. The command can be anything that reads from stdin and writes to stdout. The command should eventually connect to a Reflection for Secure IT server. You can use `ProxyCommand` in conjunction with a command such as `nc` (or `netcat`) that provides proxy support. For example, the following command uses `nc` to connect via an HTTP proxy at 198.168.2.1:

```
ProxyCommand /usr/bin/nc -X connect -x 198.168.2.1:8080 %h %p
```

The default is 'none', which disables this option. (This is equivalent to specifying an empty string).

Note: `CheckHostIP`, is not available for connections made with a proxy command.

QuietMode

Enables quiet mode, which causes all warning and diagnostic messages, including banners, to be suppressed. The allowed values are 'yes' and 'no'. The default is 'no'. You can also configure this on the `ssh` command line using the `-q` option.

RekeyIntervalSeconds

Specifies the number of seconds the client waits before initiating a negotiation for a new session key. The value must be an integer. The default is 3600. This key can be used in combination with `RekeyLimit`, in which case the client initiates a new key exchange whenever the first limit is reached.

RekeyLimit

Specifies the maximum amount of data that can be transmitted before the client initiates a negotiation for a new session key. The argument is the number of bytes, with an optional suffix of 'K', 'M', or 'G' to indicate kilobytes, megabytes, or gigabytes, respectively. Set this value to 0 (zero) to use the default value. The default is between '1G' and '4G', depending on the cipher. This key can be used in combination with `RekeyIntervalSeconds`, in which case the client initiates a new key exchange whenever the first limit is reached.

RelaySignals

Specifies which signals the client should relay to the server. `RelaySignals` accepts a comma-separated list of any of the following signals: ABRT, ALRM, FPE, HUP, ILL, INT, PIPE, QUIT, SEGV, TERM, USR1, USR2. The signals KILL and STOP cannot be caught, blocked, or ignored, so these signals are not supported. No signals are relayed by default.

RemoteForward

Use this keyword to forward connections from an arbitrary port on the server through the secure tunnel. The syntax for configuring this setting is:

```
[protocol/] [listening_host:]listening_port:host:hostport
```

When the Secure Shell connection is established, the Secure Shell server opens a socket on its host (the computer running the Secure Shell server) using the designated remote port (listening_port). (On server hosts with multiple interfaces, use `listening_host` to specify which interface.) Configure your client application (the one whose data you want to forward) to send data to the forwarded socket (rather than directly to the destination host and port). When that
client establishes a connection, all data sent to the forwarded port is redirected through the secure tunnel to the Secure Shell client, which decrypts it and then directs it to the destination socket (host, hostport). The optional protocol can be tcp or ftp.

In the following example, FTP communications sent from an FTP client (on the same computer as the Secure Shell server) are forwarded to an FTP server (on the same computer as the Secure Shell client). With this configuration, you would configure the FTP client to connect to port 3333.

RemoteForward=ftp/3333:localhost:21

You can also configure remote port forwarding on the ssh command line using the -R option.

SendNOPPPackets
Specifies whether the client sends NOOP messages through the Secure Shell channel to the server. Setting this to 'yes' is equivalent to setting ServerAliveCountMax to 3 and ServerAliveInterval to 600. The allowed values are 'yes' and 'no'. The default is 'no'.

ServerAliveCountMax
Use this setting to close sessions to servers that have become unresponsive. It is relevant only when ServerAliveInterval is set to a non-zero value. ServerAliveCountMax sets the maximum number of server alive messages the client will send without receiving a return message from the server. When this threshold is reached, the client terminates the session. The default is 3. For example, if ServerAliveInterval is set to 600, and ServerAliveCountMax is 3, the client sends a message to the server every 10 minutes until it has sent 3 messages to the server without response. This means that the client will close an unresponsive connection after about 30 minutes.

ServerAliveInterval
Sets a time interval, in seconds, for sending NOOP messages to the server through the Secure Shell channel. The client sends a message to the server when no data has been received from the server during the specified interval. Setting this to a non-zero value can be used to inform the Secure Shell server and the TCP stack that the client is still alive, inform all networking hardware (such as routers and NATs) that the Secure Shell connection is still active, and detect network problems and application problems. Use this setting in conjunction with ServerAliveCountMax to terminate a connection to a server that has become unresponsive. The default is 0; which configures the client to send no messages.

SetRemoteEnv
Specifies an environment variable to set on the server before executing a shell or a command. The value should be in the form: VAR=val, where val can be empty. The argument must be uppercase.

Note: Values set with this keyword are cumulative; you can set multiple values by configuring this keyword multiple times in one or more configuration files.

SftpVersion
Specifies the maximum SFTP protocol version supported by the client. Valid values are 3 and 4 (the default). If the server only supports an older version than what is specified in this setting, the version specified by the server is used.

SmartFileCopy
Specifies whether Reflection for Secure IT checks for identical files before doing a file transfer. When this setting is 'yes' (the default), existing files are checked for equality and no data transfer takes place if the files are identical. When this setting is 'no', no check for equality is made and existing files are always overwritten. Note: Smart file copy can also be disabled on the server using the SmartFileTransfer keyword.
StrictHostKeyChecking

This keyword determines how the client behaves when a host presents an unknown key for authentication. The possible values are:

'yes' - Connections succeed only when host keys have been manually copied to the user's host key directory (~/.ssh2/hostkeys), or the system-wide host key directory (/etc/ssh2/hostkeys). The client does not add host keys to the user's computer. This is the most secure option.

'ask' - This is the default. The client displays a prompt asking if the user wants to accept a key from an unknown host. This prompt shows the host key fingerprint, which can be used to verify the host's identity. If the user answers 'yes', the client adds the host key to the known host keys in the user's directory (~/.ssh2/hostkeys) and uses this key to verify the host's identity in subsequent connections.

'no' - Unknown host keys are added automatically to the user's host key directory (~/.ssh2/hostkeys) and used to verify the host's identity in subsequent connections. The user never knows when an unknown host key is presented.

StrictModes

Specifies file and directory permissions required for public key authentication. The allowed values are 'yes' and 'no'. The default is 'yes'. When set to 'yes', the user directory (~/.ssh2/) and all parent directories must be writable and executable only by the user (mode 755 is accepted). Recommended permissions for the user directory = 700. The user identification file (~/.ssh2/identification by default) must be configured for user-only read/write access (600 is recommended, 644 is accepted). When set to 'no' these file permissions are not enforced and sensitive files and information could be compromised.

Note: Additional file permission restrictions are enforced for all private keys. Keys must be configured for user-only read access regardless of the current StrictModes setting. If access to the private key is not sufficiently restricted, public key authentication will always fail. Recommended permissions for private keys = 600.

SysLogFacility

Specifies the facility code used to log messages for ssh, sftp, and scp connections. The default is 'USER'. When this value is 'none', Reflection for Secure IT disables logging to syslog. Other valid values are platform-dependent. See syslog(3) and syslog.conf(5).

TrustAnchor

This keyword is no longer supported. Use Reflection PKI Services Manager to configure trust anchors.

TrustX11Applications

Specifies whether the X server treats forwarded X11 client applications as trusted. The allowed values are 'yes' and 'no'. The default is 'no'. Set this to 'yes' to give remote X11 clients full access to the X11 display. When this is set to 'no', X11 applications are treated as untrusted. This avoids the risk created when a connection to a compromised host allows applications on that host to "sniff" input operations using the forwarded X11 connection.

User

Specifies the user name for the remote server. You can configure different user names for different hosts by defining this setting in host-specific stanzas. The default is the current value of the environment variable $USER.
VerboseMode

Sets the debug level to verbose mode, which is equivalent to setting the debug level to 2. You can also configure this on the ssh command line using the -v option. The allowed values are 'yes' and 'no'. The default is 'no'.

XauthPath

Specifies the location of the xauth(1) program. The default (for example /usr/X11R6/bin/xauth) is system-dependent.

Server Configuration Keywords

You can configure the following settings in the server configuration file. The default file is /etc/ssh2/sshd2_config.

AccountManagement

Configures the account management system that sshd uses to validate a user account. Account management services determine if an account is active, and whether or not a password is still valid. The allowed values are 'password', 'pam', 'aix', and 'none'. The default is 'pam,password', which requires the user account to pass validation by both systems.

- pam - Use PAM for account management. PAM account management applies to all sessions, regardless of the authentication method (or methods) used. If an account is locked, the connection is refused.
- password - Use the password database to validate the account.
- aix - For use on AIX systems. If a user authenticates successfully using public key authentication, the server ignores password accounting restrictions such as the requirement to update an expired password. If the account is locked using the AIX account_locked flag, the user will not be allowed to log in even if public key authentication is successful. Note: On non AIX systems, this value is equivalent to 'none'.
- none - Use no account validation. Use this only for troubleshooting.

AddressFamily

This setting is used by the server when it creates a listening, session, or forwarding TCP socket. The allowed values are 'any' (allow the system to decide which address family to use), 'inet' (accept only IPv4), and 'inet6' (accept only IPv6). The default is 'inet'. Note: The current value of ListenAddress may also affect whether or not the server accepts connections using IPv4 or IPv6 addresses.

AllowAgentForwarding

Specifies whether agent forwarding is allowed. The allowed values are 'yes' and 'no'. The default is 'yes'.

AllowedAuthentications

Specifies which authentication methods the server supports. The client and server agree on one or more authentication methods during the initial connection process, based on both client and server configuration. (Use RequiredAuthentications to require one or more authentication methods. RequiredAuthentications overrides AllowedAuthentications.)

The supported authentication methods are 'gssapi-keyex', 'gssapi-with-mic', 'publickey', 'keyboard-interactive', and 'password'. The default is 'gssapi-with-mic, publickey, keyboard-interactive, password'. 
AllowedPasswordAuthentications

This keyword is no longer supported. If you used it in previous versions, you need to manually migrate your setting. Refer to the following keywords: AllowedAuthentications, RequiredAuthentications, and AuthKbdInt.Required.

AllowGroups

Use this keyword to allow login only for users who are members of a specified group. Regular expressions are supported. For details, see “Configuring User and Group Access” on page 87. If this keyword is not configured, all groups are allowed to log in.

AllowHosts

Use this keyword to allow login only for specified client hosts. Regular expressions are supported. For details, see “Configuring Client Host Access” on page 88. If this keyword is not configured, all client hosts are allowed.

Notes:

If you configure a host expression using the domain name (rather than IP address), you must also set ResolveClientHostName to 'yes'. When ResolveClientHostName is 'yes', the resolved name is the fully qualified domain name. This means that when RequireReverseMapping is 'yes', you must specify a fully qualified domain name or use a regular expression for the host name to ensure that connections from an IP address are handled correctly.

To configure addresses in any allow or deny list, both IPv4 and IPv6 addresses must be specified. This is particularly important if you are configuring a deny list to ensure that access is blocked. To configure localhost in any allow or deny list, include IP addresses for all external interfaces and also the local loopback address (127.0.0.1 and 0:0:0:0:0:0:0:1).

AllowSftpCommands

Controls what kinds of operations users can perform using sftp and scp commands from Reflection for Secure IT clients. This keyword supports a comma-separated list of one or more of the following: 'all', 'none', 'browse', 'download', 'upload', 'delete', 'rename'. The upload option enables users to modify files, create files, create directories, or modify file attributes on the server. The download option enables users to read file contents. The default is 'all'.

Note: This setting affects both sftp and scp connections from Reflection for Secure IT clients. The SessionRestricted keyword also affects access to file transfers. The default value for SessionRestricted is 'shell, exec, subsystem'. For Reflection for Secure IT clients, the 'subsystem' session type is required for both sftp and scp transfers. For OpenSSH-style clients 'subsystem' is required for sftp transfers; 'exec' is required for scp transfers.

AllowTCPForwarding

Use this keyword to allow or deny port forwarding to all client users. The allowed values are 'yes' and 'no'. The default is 'yes'. This keyword controls both local (client to server) and remote (server to client forwarding). Use ForwardAcl for more fine-grained control.

AllowTCPForwardingForGroups

Use this keyword to allow port forwarding only for users who are members of a specified group. Regular expressions are supported.

AllowTCPForwardingForUsers

Use this keyword to allow port forwarding only for specified users. Regular expressions are supported.
AllowUsers

Use this keyword to allow login only for specified users. Regular expressions are supported. For
details, see “Configuring User and Group Access” on page 87.

AllowX11Forwarding

Specifies whether X11 forwarding is allowed. The allowed values are 'yes' and 'no'. The default is
'yes'.

AuditLog

Specifies whether or not an audit log is created. When 'sftp' is specified, a comma-delimited log
file containing a detailed record of file transfer activity is created in the location specified by
AuditLog.Directory. The first line of the audit log file, shown here, identifies the logged content:
UserID, ClientIP, Action, ServerFilename, StartTime, EndTime, ServerFileModificationTime,
ServerFileSize, BytesTransferred, Result, Reason, ServerFileHash. The default is 'none'.

AuditLog.Directory

The output location for audit logs. A new log is created each day using this name format: sshd2-
audit-YYYYMMDD.log, where YYYYMMDD indicates the date. When AuditLog = sftp, this file is
created the first time a client user transfers a file, or when you restart the server. The default is /etc/ssh2/logs.

Note: If users have been limited to a home directory for sftp protocol connections (using
ChrootSftpUsers or ChrootSftpGroups), the audit log directory must be located in the home
directory. Because of this limitation, audit logging only works for chrooted users if they share
the same home directory.

AuditLog.Sftp.WithHash

Specifies whether or not sftp log entries include a file hash. The hash value can be used to
identify multiple records identifying transfer of the same file. Each time an unchanged file is
transferred, the hash value in the log is identical. If a file is changed, the hash value is different.
The allowed values are 'yes' and 'no'. The default is 'yes'.

AuthFailureErrorMessages

The allowed values are 'yes' and 'no'. The default is 'no'. When set to 'no', no information about
authentication failures is sent to the client. This complies with SSH convention. To enable this
setting, you must also enable AuthImmediateDisconnect. When both
AuthFailureErrorMessages and AuthImmediateDisconnect are set to 'yes' the client user
receives information about the reason for the failure. Note: Messages sent to the client report
failures that occur regardless of which authentication method is used. For example, information
is sent to the client if the user account is disabled or unknown on the server host, or if a user is
on the denied user list. No information is provided about failures that are specific to the
authentication method used (such as an incorrect password, missing public key, or invalid
certificate).

Caution: Enabling this setting increases your security risk by providing clients with information
about valid account names.

AuthImmediateDisconnect

The allowed values are 'yes' and 'no'. The default is 'no'. When this setting is 'no', the server
responds identically to all failed authentication attempts. This complies with SSH convention.
When this setting is 'yes', users with blocked accounts are disconnected as soon as possible,
which means they might not see any authentication prompts. If a user is denied access because
of Reflection for Secure IT server settings (for example AllowUsers or DenyUsers), the
disconnection always happens immediately. If a user is denied access because of operating
system configuration, the timing of the disconnection is affected by the AccountManagement
setting. When AccountManagement=pam, denied users see PAM authentication prompts before
being disconnected. This is because PAM authentication happens before PAM account management. If you prefer to have users be disconnected without seeing PAM authentication prompts, set AccountManagement=pam,password (the default). In most cases, enabling password account management provides the server with enough information about the user account to reject the connection before PAM authentication starts.

Caution: Enabling this setting increases your security risk by providing clients with information about valid account names.

**AuthKbdInt.Required**

Specifies which authentication method to use for keyboard-interactive authentication. The specified authentication method must succeed for the user to be successfully authenticated. The allowed values are 'pam', 'password', and 'radius'. The default is 'pam', which specifies that PAM modules are used for authentication and password management. When 'password' is specified, the user response is handled as a standard login password. When 'radius' is specified, one or more RADIUS authentication servers are used for authentication.

**AuthKbdInt.Retries**

Sets the maximum number of attempts allowed for keyboard interactive authentication. The default is 3.

**AuthKbdInt.Verbose**

Specifies whether the server uses verbose keyboard interactive prompts. The allowed values are 'yes' and 'no'. The default is 'no'.

**AuthorizationFile**

Specifies the name of the file used for configuring user keys for public key authentication. For public key authentication to succeed, a key presented by a client user for authentication must be correctly identified in this file. For file syntax, see the FILES section.

The file is assumed to be relative to ~/.ssh2 (or whatever location is set for UserConfigDirectory) unless you specify an absolute path. The following macros are recognized: %U = user log-in name, %D = user's home directory, %IU = UID for user, %IG = GID for user. The default file is %D/.ssh2/authorization.

**AuthPublicKey.MaxSize**

Sets the largest public key size allowed for user authentication. The default is 32768, and values larger than this are not allowed. The range of accepted values is 512-32769. Using zero (0) is equivalent to using the default.

**AuthPublicKey.MinSize**

Sets the smallest public key size allowed for user authentication. The default is 512, and values smaller than this are not allowed. Using zero (0) is equivalent to using the default.

**AuthPublicKey.Retries**

Specifies the maximum number of attempts the server accepts for public key authentication. Once this number is reached, further attempts to authenticate using a public key are rejected, but the connection is not broken. This allows the client to attempt authentication using the next allowed method. The default is 100.

**BannerMessageFile**

Identifies a file that contains text for a banner message. The server sends this text to the client before the client authenticates. Note: Some clients do not support banner display. If you configure a banner, you should ensure that your Secure Shell client supports this feature. The default is /etc/ssh2/ssh_banner_message.
ChrootSftpGroups

Specifies groups whose users are restricted to their home directory for sftp protocol connections. Any sftp protocol request that operates on a file or directory is checked to ensure it is not outside of the confined directory or any of its child directories. Regular expressions are supported. Patterns match against group names, not GID's.

Note: This setting affects both sftp and scp connections from Reflection for Secure IT clients. The SessionRestricted keyword also affects access to file transfers. The default value for SessionRestricted is 'shell, exec, subsystem'. For Reflection for Secure IT clients, the 'subsystem' session type is required for both sftp and scp transfers. For OpenSSH-style clients 'subsystem' is required for sftp transfers; 'exec' is required for scp transfers.

When ChrootSftpUsers or ChrootSftpGroups is enabled, connected users see additional subdirectories (etc on all platforms and dev on AIX) added to their home directory. These directories contain required files and cannot be moved or deleted. The etc directory contains the rsit.conf file, which identifies the installation location of files required by Reflection for Secure IT. A localtime file may also be present. It is needed so that processes such as logging can get the current time. The system localtime file is in a location that cannot be accessed by a chrooted user. If the TZ environment variable set on the system, the localtime file is not created. Users running on AIX also require /dev/null, which is needed for correct logging to syslog.

ChrootSftpUsers

Specifies users who are restricted to their home directory for sftp protocol connections. Any sftp protocol request that operates on a file or directory is checked to ensure it is not outside of the confined directory or any of its child directories. Regular expressions are supported. Patterns match against user names, not UID's.

Note: This setting affects both sftp and scp connections from Reflection for Secure IT clients. The SessionRestricted keyword also affects access to file transfers. The default value for SessionRestricted is 'shell, exec, subsystem'. For Reflection for Secure IT clients, the 'subsystem' session type is required for both sftp and scp transfers. For OpenSSH-style clients 'subsystem' is required for sftp transfers; 'exec' is required for scp transfers.

When ChrootSftpUsers or ChrootSftpGroups is enabled, connected users see additional subdirectories (etc on all platforms and dev on AIX) added to their home directory. These directories contain required files and cannot be moved or deleted. The etc directory contains the rsit.conf file, which identifies the installation location of files required by Reflection for Secure IT. A localtime file may also be present. It is needed so that processes such as logging can get the current time. The system localtime file is in a location that cannot be accessed by a chrooted user. If the TZ environment variable set on the system, the localtime file is not created. Users running on AIX also require /dev/null, which is needed for correct logging to syslog.

Ciphers

Specifies one or more (comma separated) encryption algorithms the server supports. The default is AnyStdCipher.

The cipher used for a given session is the cipher highest in the client's order of preference that is also supported by the server. Allowed values are 'aes128-ctr', 'aes128-cbc', 'aes192-ctr', 'aes192-cbc', 'aes256-ctr', 'aes256-cbc', 'blowfish-cbc', 'arcfour', 'arcfour128', 'arcfour256', 'cast128-cbc', and '3des-cbc'.

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You can also set this value to 'none'. When 'none' is the agreed on cipher, data is not encrypted. Note that this method provides no confidentiality protection, and is not recommended.

The following values are provided for convenience: 'aes' (all supported aes ciphers), 'blowfish' (equivalent to 'blowfish-cbc'), 'cast' (equivalent to 'cast128-cbc'), '3des' (equivalent to '3des-cbc'), 'Any' or 'AnyStd' (all available ciphers plus 'none'), and 'AnyCipher' or 'AnyStdCipher' (all available ciphers).

**ClientAliveCountMax**

The client alive mechanism enables the server to determine when the client has become inactive. **ClientAliveCountMax** sets the maximum number of client alive messages the server sends through the encrypted channel to request a response from the client. If this number is reached with no response from the client, the server ends the session and disconnects the client. Specify the message interval using **ClientAliveInterval**. The default is 3.

Note: These settings affect the SSH connection and messages are sent through the SSH tunnel.

**ClientAliveInterval**

Sets the interval, in seconds, for sending client alive messages to the client. If the client is unresponsive for this interval, the server sends a message through the encrypted channel to request a response from the client. Use **ClientAliveCountMax** to specify how many messages the server sends without response before it ends the session and disconnects the client. The default is 0 (disabled).

**Compat.RSA.HashScheme**

This keyword is no longer used. Prior to version 7.2 SP1, you needed to set this keyword to 'yes' to enable verification of digital signatures using the MD5 hash. The server now always attempts verification using both SHA-1 and MD5, and allows authentication if either hash matches. This is equivalent to setting Compat.RSA.HashScheme to 'yes' in earlier versions. If **Compat.RSA.HashScheme** is present in a configuration file and set to 'no', the server now ignores this setting.

**Compression**

Specifies the level of compression. You can specify compression values 0-9. Increasing the value increases the amount of compression. Using higher values results in the use of less network bandwidth, but at the cost of more CPU cycles. Level 6 is equivalent to 'yes'. Level 0 is equivalent to 'no'. The default is 'yes' (6).

**DenyGroups**

Use this keyword to deny login for specified user groups. Regular expressions are supported. For details, see “Configuring User and Group Access” on page 87. If this keyword is not configured, all groups are allowed to log in.

**DenyHosts**

Use this keyword to deny login for specified client hosts. Regular expressions are supported. For details, see “Configuring Client Host Access” on page 88. If this keyword is not used, all client hosts are allowed.

Notes:

If you configure a host expression using the domain name (rather than IP address), you must also set **ResolveClientHostName** to 'yes'. You should also set **RequireReverseMapping** to 'yes' to prevent access from hosts whose domain name could not be resolved. When **ResolveClientHostName** is 'yes', the resolved name is the fully qualified domain name. This
means that when **RequireReverseMapping** is 'yes', you must specify a fully qualified domain name or use a regular expression for the host name to ensure that connections from an IP address are handled correctly.

To configure addresses in any allow or deny list, both IPv4 and IPv6 addresses must be specified. This is particularly important if you are configuring a deny list to ensure that access is blocked. To configure localhost in any allow or deny list, include IP addresses for all external interfaces and also the local loopback address (127.0.0.1 and 0:0:0:0:0:0:0:1).

**DenyTCPForwardingForGroups**

Use this keyword to deny port forwarding for specified user groups. Regular expressions are supported. For details, see “Configuring User and Group Access” on page 87.

**DenyTCPForwardingForUsers**

Use this keyword to deny port forwarding for specified users. Regular expressions are supported. For details, see “Configuring User and Group Access” on page 87.

**DenyUsers**

Use this keyword to deny login for specified users. Regular expressions are supported. For details, see “Configuring User and Group Access” on page 87. If this keyword is not configured, all users are allowed to log in.

**FipsMode**

Specifies whether all connections will be made using security protocols and algorithms that meet FIPS 140-2 standards. The allowed values are 'yes' and 'no'. The default is 'no'.

**ForceSftpFilePermissions**

Sets specified file permissions on all files uploaded to the server using **sftp** or **scp** and overrides all other permission setting actions. Use a three-digit permission mode value. For example, if you set **ForceSftpFilePermissions** to 600, all uploaded files are set to 600 (-rw------). In addition, if a user attempts to change the permissions on an existing file, that file is also set to 600, regardless of the permission value requested by the client user. This setting does not affect directory permissions.

When **ForceSftpFilePermissions** is configured:

All uploaded files are set to the specified value regardless of whether or not a file is newly created or overwrites an existing file.

The system UMASK setting is ignored.

Any **chmod** command executed by an **sftp** user ignores the user-specified value and changes the file's permissions to the value set by **ForceSftpFilePermissions**.

The -p option is ignored if it is used on the **sftp** or **scp** command line.

**ForwardACL**

Use this keyword for detailed control over client access to port forwarding. Regular expressions are supported. The syntax is:

```
ForwardACL allow|deny local|remote user_ex forward_ex [origin_ex]
```

**user_ex** is a regular expression that determines which users are allowed or denied access to port forwarding. For details, see “Configuring User and Group Access” on page 87.”
forward_ex is a regular expression in the form host%port. Its meaning depends on whether you are configuring restrictions on local or remote forwards. If you are configuring local forwarding control, it specifies the target host and port. If you are configuring remote forwarding control, the host is the server computer and the port is the port that server is forwarding to the client.

origin_ex is a regular expression that identifies an IP address. Its meaning depends on whether you are configuring restrictions on local or remote forwards. If you are configuring local forwarding control, it specifies the client machine making the forward request. If you are configuring remote forwarding control, it specifies the computer that is connecting to the forwarded port on the server.

**GatewayPorts**

Specifies whether remote hosts are allowed to connect to ports forwarded for the client. The allowed values are 'yes' and 'no'. The default is 'no'.

**HostCertificateFile**

Specifies an X.509 certificate to be used for server authentication. Specify the associated private key using HostKeyFile.

**HostKeyFile**

Specifies the filename and location of the private key used to authenticate the server. The default is /etc/ssh2/hostkey.

**HostSpecificConfig**

Specifies a host-specific subconfiguration file. The syntax is:

```
HostSpecificConfig host_expression subconfig_file
```

If the host expression matches the client host, the server uses the specified subconfiguration file.

If you configure a host expression using the domain name (rather than IP address), you must also set ResolveClientHost to 'yes'.

**HPNDisabled**

Specifies whether Reflection for Secure IT uses HPN dynamic TCP window features to enhance performance. When HPNDisabled = 'no' (the default), Reflection for Secure IT adjusts the TCP window and TCP receive buffers to optimize performance. When HPNDisabled is 'yes', the receive buffer is set to 64 KB.

**IdleTimeout**

Specifies how long a connection can remain inactive before the server terminates the connection. To set the time in seconds use an `s` or nothing after the number. You can also specify a time in minutes (m), hours (h), days (d), or weeks (w). Use zero (0) to set no limit. The default is 0.

**IgnoreRlogin**

This keyword applies only to AIX systems. It specifies whether the 'rlogin' attribute in /etc/security/user should be ignored or applied. The allowed values are 'yes' and 'no'. The default is 'no', which means that the server honors the current 'rlogin' value.

Notes:

The 'login' attribute in /etc/security/user has no effect on remote logins made using the Secure Shell client. This is true regardless of the value of IgnoreRlogin.

On AIX systems IgnoreRlogin is ignored if AccountManagement is set to 'none.'
KeepAlive
Specifies whether the system should send TCP keep alive messages to the other side. The server uses the system-wide value for how often the message is sent. The allowed values are 'yes' and 'no'. The default is 'yes'. Note: ClientAliveCountMax and ClientAliveInterval affect the SSH connection and messages are sent through the SSH tunnel. The KeepAlive setting affects the TCP connection, and is more vulnerable to spoofing because TCP messages are not sent in the secure tunnel.

KEXs
Specifies which key exchange algorithms the server supports. Supported values are 'diffie-hellman-group-exchange-sha256','diffie-hellman-group-exchange-sha1','diffie-hellman-group14-sha1'. Multiple algorithms can be specified as a comma-separated list. The default value is 'diffie-hellman-group-exchange-sha256,diffie-hellman-group-exchange-sha1,diffie-hellman-group14-sha1'.

LibGssKrb5
Use this setting if you use GSSAPI (Kerberos 5) authentication. It specifies the fully-qualified path to the Kerberos library called libgssapi_krb5.so.

LibKrb5
Use this setting if you use GSSAPI (Kerberos 5) authentication. It specifies the fully-qualified path to the Kerberos library called libkrb5.so.
Note: The server requires a library named libkrb5.so (or .sl on HP-UX PARISC). If a library of this name is not present, you need to create a symbolic link named libkrb5.so pointing to the actual library.

LibWrap
This keyword provides dynamic support for TCP Wrappers. To enable TCP Wrapper support, specify the fully qualified path to the libwrap shared library (for example, LibWrap=/usr/lib/libwrap.so). The libwrap file must be a shared library and not a static one. By default, this keyword is empty and the TCP Wrappers feature is disabled.
Note: Before using this keyword, you should confirm that the specified file is a valid libwrap library. This is important to ensure that only allowed users can connect. If the specified file doesn't exist, the sshd server won't start. However, if the file exists, sshd starts, but does not confirm that the file is a valid library. For each connection, the sshd process tries to load the specified file, and, if the file is not a valid library, the server logs an error message and allows the user to connect.

ListenAddress
Specifies the address of the interface to which the sshd server socket is bound. You can specify values using either IPv4 or IPv6 format, or use 'any' (the default). The value 'any' configures the server to listen to any available IPv4 or IPv6 address (equivalent to '::,0.0.0.0'). If you specify only IPv4 addresses, the client must connect using an IPv4 address. If you specify only IPv6 format, most operating systems will still allow IPv4 clients to connect; this is controlled by the operating system, not the Secure Shell server. You can optionally include a port in the address by adding a colon or space followed by the port number. This port value overrides the Port keyword setting. If you are specifying an IPv6 address, you need to surround the address with square brackets. For example:
IPv4 syntax: ListenAddress=209.85.171.99:6666
IPv6 syntax: ListenAddress=[::D155:AB63]:6666

ListenAddress interacts with the AddressFamily setting. When AddressFamily=inet, the ListenAddress value 'any' is equivalent to '0.0.0.0'. When AddressFamily=inet6, the ListenAddress value 'any' is equivalent to '[:]. If AddressFamily is set to either 'inet' or 'inet6'
and **ListenAddress** specifies an address of a different family, **sshd** will fail to start because of a configuration file error. If you specify a host name for **ListenAddress** rather than an IP address, the **AddressFamily** restrictions require that the host name be associated with an address of the appropriate family; and the server will bind to that address.

Note: Values set with this keyword are cumulative; you can set multiple values by configuring this keyword multiple times in one or more configuration files.

**LogCertificateSubject**

Specifies whether the Serial Number and Subject of certificates used for authentication are logged to the system log. Messages are logged for both successful and failed attempts. The allowed values are 'yes' and 'no'. The default is 'yes'.

**LoginGraceTime**

Sets the number of seconds allowed for client authentication. If the client fails to authenticate the user within the specified number of seconds, the server disconnects and exits. Use zero (0) to set no limit. The default is 120.

**LogLevel**

Sets the verbosity level used for **sshd** messages logged to syslog. Allowed values are 'fatal', 'error', 'quiet', 'info', 'verbose', 'debug1' ('debug' and 1 are equivalent), 'debug2' (2 is equivalent), 'debug3' (3 is equivalent), and 'trace' ('debug99' and 99 are equivalent). The syslog level associated with these values is CRIT for fatal, ERROR for error and quiet, INFO for info and verbose, and DEBUG for debug1, debug2, debug3, and trace. The default is 'error'.

Note: Setting logging to 'trace' can increase your security risk. At this level, information leakage is a concern, as unencrypted protocol information may be written out. Also, the volume of information written may fill up disk space rapidly, potentially causing the host or Reflection for Secure IT to stop responding.

**LogPublicKeyFingerPrint**

Specifies whether public key fingerprints used for authentication are logged to the system log. Messages are logged for both successful and failed attempts. The allowed values are 'yes' and 'no'. The default is 'yes'.

**MACs**

Specifies, in order of preference, which MACs (hashed message authentication codes) the server allows for verifying data integrity. Allowed values are 'hmac-sha256', 'hmac-sha1', 'hmac-sha1-96', 'hmac-md5', 'hmac-md5-96', 'hmac-sha512', and 'hmac-ripemd160'. Use 'AnyMac' to support all of these. Use 'AnyStdMac' to specify 'hmac-sha256, hmac-sha1,hmac-sha1-96,hmac-md5,hmac-md5-96, hmac-sha512'. Specifying hmac-sha256 also enables hmac-sha2-256. Specifying hmac-sha512 also enables hmac-sha2-512. Multiple MACs can also be specified as a comma-separated list. Additional options are 'none', 'any' (equivalent to AnyMac plus 'none'), and 'AnyStd' (equivalent to 'AnyStdMac' plus 'none'). When 'none' is the agreed on MAC, no message authentication code is used. Because this provides no data integrity protection, options that include 'none' are not recommended. The default is 'AnyStdMac'.

**MaxConnections**

Sets the maximum number of client connections allowed. Use zero (0) to set no limit. The default is 50.

**MaxSessions**

Specifies the maximum number of multiplexed sessions supported over a single TCP connection. (Multiplexing can be enabled on Reflection for Secure IT clients using the **ConnectionReuse** keyword.) The range of values is 0-10. The default is 10. Setting this value to 1 disables connection reuse. Setting this keyword to 0 disables all connections.
**MaxStartups**

Specifies the maximum number of concurrent unauthenticated connection attempts allowed. After this limit is reached additional connections are dropped until authentication succeeds or the **LoginGraceTime** limit is reached for a connection attempt. The default is 10.

**PamServiceName**

Specifies the name of the PAM (Pluggable Authentication Modules) service used for authentication and sessions. The default is 'ssh'.

**PamServiceNameForInternalProcesses**

Specifies the name of an optional PAM service to be used for internal processes. You can use the specified service to provide additional account and session management. For example:

```
PamServiceNameForInternalProcesses ssh-shell
```

In this case, all users still go through the service specified by **PamServiceName** ("ssh" by default). Shell and exec users will also go through the "ssh-shell" service.

*Note:* The specified PAM service will always support PAM account and session management and may support authentication management on particular platforms (Linux and AIX, but not Solaris). Because authentication management may or may not be used depending on the platform, it should always be set to pam_permit.so so that access to the system can be configured using account and session management.

**PamServiceNameForSubsystems**

Specifies the name of an optional PAM service to be used for subsystems. You can use the specified service to provide additional account and session management. The syntax is:

```
PamServiceNameForSubsystems subsystem PAMServicename
```

For example, You could use the following to provide additional account and session management for SFTP connections:

```
PAMServiceNameforSubsystems sftp ssh-sftp
```

In this case, all users still go through the service specified by PamServiceName ("ssh" by default). SFTP users will also go through the "ssh-sftp" service.

*Note:* The specified PAM service will always support PAM account and session management and may support authentication management on particular platforms (Linux and AIX, but not Solaris). Because authentication management may or may not be used depending on the platform, it should always be set to pam_permit.so so that access to the system can be configured using account and session management.

**PasswordGuesses**

Sets the maximum number of attempts the user is allowed for password authentication. The default is 3.

**PermitEmptyPasswords**

Specifies whether the server allows password authentication by users with empty (null) passwords. The allowed values are 'yes' and 'no'. The default is 'yes'.

**PermitRootLogin**

Specifies whether client users with root privileges can log in. The allowed values are 'yes', 'no', and 'without-password'. If you specify 'without-password', a user can log in with root privileges only if 'public key' or 'GSSAPI' authentication methods are used to authenticate the user. The default is 'yes', which allows root login for all authentication methods.
**PidFile**

Specifies the file that contains the process ID of the sshd daemon. Use a fully qualified path. If the file name contains the string %s, the string will be replaced by the server port number.

**PkidAddress**

Specifies the port used to connect to PKI Services Manager. Use the format host:port. The default is localhost:18081. If you specify a host and omit the port, the default PKI Services Manager port (18081) is used.

**PkidPublicKey**

Specifies the name and location of the public key used by to confirm the identity of Reflection PKI Services Manager. The default is /install-directory/pkid/config/pki_key.pub.

**Port**

Specifies the port on which the server listens. The default is 22, which is the standard port for Secure Shell connections.

**PrintLastLog**

Specifies whether the Reflection for Secure IT server displays the date and time of the last user login when a user logs in interactively. The allowed values are 'yes' and 'no'. The default is 'yes'.

**PrintMotd**

Specifies whether the server prints the message-of-the-day text from the file /etc/motd when a user logs into a terminal session. (This setting does not override the display of /etc/issue.) The allowed values are 'yes' and 'no'. The default is 'yes'.

**ProtocolVersionString**

Specifies the software version portion of the string that the server sends to clients during the initial connection protocol. (The first part of the string is always "SSH-2.0-", which indicates the SSH version supported by the server. This is required by the protocol RFC and cannot be edited.) Use double quotation marks if the string includes spaces. When ProtocolVersionString is an empty string (the default), the software version portion of the string is generated automatically, and includes the server's version and build number. This number will be updated automatically when you upgrade your server software.

Note: Many clients use the protocol string to identify the server type and enable compatible features. Changing the default value may cause public key authentication to fail, and may also affect the functionality of other features that vary between servers.

**QuietMode**

This keyword is deprecated. Use LogLevel.

**RadiusFile**

Specifies the name of the file used for configuring RADIUS authentication. The file is assumed to be relative to /etc/ssh2 unless you specify an absolute path. For file syntax, see /etc/ssh2/radius_config in the FILES section. There is no default; this keyword can have no value.

**RekeyIntervalSeconds**

Specify the interval (in seconds) after which the server initiates a new key exchange. Setting this value too low can make communication between the client and server impossible. To avoid this problem, it is recommended that you avoid specifying an interval of less than 200 seconds. Use 0 (zero) to turn off rekey requests initiated by the server. Using 0 does not prevent the client from requesting a rekey. The default is 3600.
RequiredAuthentications
Use this keyword to require one or more client authentication methods. All specified authentication methods must succeed before a user is considered authenticated. The supported authentication methods are 'gssapi-keyex', 'gssapi-with-mic', 'publickey', 'keyboard-interactive', and 'password'.

Note: RequiredAuthentications overrides AllowedAuthentications.

RequireReverseMapping
Specifies whether DNS lookup must succeed when checking whether connections from client hosts are allowed. To enable this feature you also need to set ResolveClientHostName to 'yes'. The allowed values are 'yes' and 'no'. The default is 'no'.

ResolveClientHostname
Specifies whether the server attempts to resolve the client IP address to a domain name. Setting this to 'yes' may slow down the connection time, but is required if you configure any keywords to match host names based on domain name, rather than IP address. (See AllowHosts, DenyHosts, UserSpecificConfig, and HostSpecificConfig.) Setting this keyword to 'yes' also means that DNS names appear in the log rather than IP addresses. The allowed values are 'yes' and 'no'. The default is 'yes'.

Note: When ResolveClientHostname is 'yes', the resolved name is always the fully qualified domain name. This means that you must use a fully qualified domain name with any keywords in which you specify a host name, or use a regular expression to ensure that host names are handled correctly.

SessionRestricted
Specifies what session types the server allows. The possible values are 'shell' (which allows terminal shell sessions), 'exec' (which allows the client to execute commands on the server), and 'subsystem' (which is required to support sftp and scp transfers from Reflection for Secure IT clients). The default is 'shell, exec, subsystem'.

Note: For OpenSSH-style clients 'subsystem' is required for sftp transfers; 'exec' is required for scp transfers.

SettableEnvironmentVars
Specifies which environment variables can be configured by the client. This value limits the scope of the client SetRemoteEnv keyword on the client and the user-specific environment file (~/.ssh2/environment). (Note: This setting does not affect variables configured in /etc/environment, /etc/ssh2/environment or other server files which can be controlled only by root.) The arguments must be uppercase. This keyword is enabled in the default configuration file and set to the following value: 'LANG, LC_ALL, LC_COLLATE, LC_CTYPE, LC_MONETARY, LC_NUMERIC, LC_TIME, PATH, TERM, TZ, UMASK'

SftpLogCategory
Determines which categories of sftp server messages are sent to the facility specified by SftpSysLogFacility. Use a comma-separated list. The default is 'loginlogout,directorylistings,downloads,modifications/uploads', which configures logging of all categories. You can specify any of those options, plus 'all', or 'none'.

SftpSysLogFacility
Specifies the facility code used for logging messages from the sftp-server subsystem. This value is empty by default. When this value is empty and LogLevel is not empty, logging goes to the AUTH facility. When SftpSysLogFacility and LogLevel are both empty, the server does no logging to syslog. When this value is 'none', Reflection for Secure IT disables logging to syslog.
Reflection for Secure IT for UNIX

(regardless of the **LogLevel** setting). Other valid values are platform-dependent. See syslog(3). Valid values are platform-dependent. See syslog(3). Setting this to "auth" puts the log messages in the same facility as the default for **sshd**.

**SftpVersion**

Specifies the maximum SFTP protocol version supported by the server. Valid values are 3 and 4 (the default). If the client only supports an older version than what is specified in this setting, the version specified by the client is used.

Note: This keyword only affects connections when **Subsystem-sftp** is configured to use the default internal sftp-server (Subsystem-sftp internal://sftp-server). If you have configured an external sftp-server, use `-v 3` or `-v 4` to specify an SFTP version. For example, `subsystem-sftp /usr/libexec/sftp-server -v 3`.

**SmartFileTransfer**

Specifies whether the server performs checks for file equality before transferring data. When this keyword is 'yes' (the default), the server supports smart file copy (which enables skipping transfer of identical files) and checkpoint resume (which enables interrupted file transfers to resume at the point of interruption). When this keyword is 'no', Reflection for Secure IT always transfers the entire content of every file. Note: Smart file copy can be disabled on the client using **SmartFileCopy**. Checkpoint resume can be disabled on the client using **CheckpointResume**.

**StrictModes**

Specifies the directory permissions required for public key authentication. The allowed values are 'yes' and 'no'. The default is 'yes'. When set to 'yes', the user's directory (`~/.ssh2`) and all parent directories must be writable and executable only by the user (mode 744 is accepted). Recommended permissions for the user directory = 700. If these conditions aren't met, public key authentication fails. When set to 'no' these file permissions are not enforced and sensitive files and information could be compromised.

Note: Additional file permission requirements are enforced for each user's authorization file (`~/.ssh2/authorization`) regardless of the current **StrictModes** setting. This file must be configured to prevent group and public write access (600 is recommended, 644 is accepted). If the authorization file is not sufficiently restricted, public key authentication will always fail.

**Subsystem**

Specifies a subsystem to export to the client. The argument specifies the command to execute when the client requests the subsystem. The separator character following the keyword can be a dash, an equals sign, or a space.

To support **sftp** and **scp** transfers, the sftp-server subsystem must be specified. The default configuration shown below executes the sftp service internally in the child process.

```
Subsystem-sftp internal://sftp-server
```

**SyslogFacility**

Specifies the facility code used for logging messages from the server. The default is 'AUTH'. When this value is 'none', Reflection for Secure IT disables logging to syslog. Other valid values are platform-dependent. See syslog(3).

Note: Setting this value to 'none' is not recommended because it means you have no audit log of connection attempts or user logins. In the event of a denial-of-service attack, an audit log can help identify a set of IP addresses connecting excessively. An audit log can also provide important evidence if a user falsely claims to not have accessed your system (non-repudiation).

Note: The debugging level you specify for writing to this log can have security ramifications. For more information see **LogLevel**.
TrustAnchor

This keyword is no longer supported. Use Reflection PKI Services Manager to configure trust anchors.

UseLogin

Specifies whether login(1) is used for interactive login sessions. The allowed values are 'yes' and 'no'. The default is 'no'.

Notes:
login(1) is never used for remote command execution.
Enabling this setting disables X11Forwarding because login(1) does not know how to handle xauth(1) cookies.
Using login(1) disables privilege separation. By default, sshd creates a new process that has the privilege of the authenticated user after a successful authentication. This is done to prevent privilege escalation by containing any corruption within the unprivileged processes. Enabling UseLogin disables this functionality.

UsePAM

This setting provides an alternate way to configure the server to use PAM. The allowed values are 'yes' and 'no'. If UsePam is not configured, the server uses the current values of AuthKbdInt.Required, AccountManagement, and UsePamSessions. Setting this keyword to 'yes' is equivalent to setting AuthKbdInt.Required=pam, AccountManagement=pam, and UsePamSessions=yes. Setting this keyword to 'no' is equivalent to setting AuthKbdInt.Required=password, AccountManagement=password, and UsePamSessions=no.

Note: If you modify UsePAM, be sure that none of the related keywords are set after UsePAM in the configuration file. If AuthKbdInt.Required, AccountManagement, or UsePamSessions is set to a conflicting value after UsePAM, that value overrides the value configured by UsePAM because the last value read by the server is the one it uses.

UsePAMAcctMgmt

This keyword is deprecated. Setting it to 'yes' is equivalent to setting AccountManagement=pam.

UsePamSessions

Specifies whether or not PAM is used for session management. The allowed values are 'yes' and 'no'. The default is 'yes'.

UserConfigDirectory

Specifies the directory used for user-specific information. This directory contains the authentication file (required for key authentication) and other user-specific files listed in the FILES section. The following macros are recognized: %U = user log-in name, %D = user's home directory, %IU = UID for user, %IG = GID for user. The default is '%D/.ssh2'.

UserSpecificConfig

Specifies a user-specific configuration file. The syntax is:

UserSpecificConfig user_expression sub config_file

If the user expression matches the user attempting a connection, the server uses the specified subconfiguration file.

Note: If you configure the host portion of this expression to match based on host domain name (rather than IP address), you must also set ResolveClientHostName to 'yes'.

VerboseMode

This keyword is deprecated. Use LogLevel.
X11DisplayOffset
Sets the first display number available for X11 forwarding by the server. The default is 10.

X11UseLocalHost
Specifies whether the server should bind X11 forwarding to the loopback address or to the wildcard address. The allowed values are 'yes' and 'no'. The default is 'yes'.

XAuthPath
Specifies the location of the xauth(1) program. The default (for example /usr/X11R6/bin/xauth) is system-dependent.

File and Directory Permissions
To help ensure secure authentication, and prevent tampering, information leakage and spoofing, files and directories used by the client and server must be configured with correct permissions and ownership. If these conditions aren't met, Secure Shell connections and public key authentication may fail.

NOTE
- The StrictModes setting helps ensure enforcement of a satisfactory level of security and is enabled by default on both the server and the client.
- Files must be owned by root or by the owner of the home directory in which the files reside.
- Where permission requirements are enforced, the permissions must be at the level indicated in the table below, or more restrictive (less than or equal to the octal value shown in brackets).
- Files and directories shown in parentheses are the defaults.

Client-side files and directories

<table>
<thead>
<tr>
<th>File or Directory</th>
<th>Maximum Security</th>
<th>Required when StrictModes = no</th>
<th>Required when StrictModes = yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure Shell directory (~/.ssh2/)</td>
<td>700</td>
<td>No requirements</td>
<td>User-only write access [755]</td>
</tr>
<tr>
<td>User home directory and All parent directories</td>
<td>744 755</td>
<td>No requirements</td>
<td>User-only write access [755]</td>
</tr>
<tr>
<td>User’s private keys</td>
<td>600</td>
<td>User-only read/write access [600]</td>
<td>User-only read/write access [600]</td>
</tr>
<tr>
<td>User's public keys</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>User’s identification file (~/.ssh2/identification)</td>
<td>600</td>
<td>No requirements</td>
<td>User-only write access [644]</td>
</tr>
<tr>
<td>User’s host keys directory (~/.ssh2/hostkeys)</td>
<td>700</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Host public key files</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>User's configuration file (~/.ssh2/ssh2_config)</td>
<td>600</td>
<td>No requirements</td>
<td>User-only write access [644]</td>
</tr>
<tr>
<td>File or Directory</td>
<td>Maximum Security</td>
<td>Required when StrictModes = no</td>
<td>Required when StrictModes = yes</td>
</tr>
<tr>
<td>------------------</td>
<td>------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>Client PKI Services Manager public key (specified using <code>PkidPublicKey</code>)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Global configuration directory (<code>/etc/ssh2/</code>)</td>
<td>755</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Global host keys directory (<code>/etc/ssh2/hostkeys</code>)</td>
<td>755</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Global host public key files</td>
<td>644</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Global user configuration file (<code>/etc/ssh2/ssh2_config</code>)</td>
<td>644</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
</tbody>
</table>

**Server-side files and directories (user-specific)**

<table>
<thead>
<tr>
<th>File or Directory</th>
<th>Maximum Security</th>
<th>Required when StrictModes = no</th>
<th>Required when StrictModes = yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secure Shell directory (<code>~/.ssh2/</code>)</td>
<td>700</td>
<td>No requirements</td>
<td>User-only write access [755]</td>
</tr>
<tr>
<td>User home directory and all parent directories</td>
<td>744 755</td>
<td>No requirements</td>
<td>User-only write access [755]</td>
</tr>
<tr>
<td>User's authorization file on the server (<code>~/.ssh2/authorization</code>)</td>
<td>600</td>
<td>User-only write access [644]</td>
<td>User-only write access [644]</td>
</tr>
<tr>
<td>User's secure shell environment file on the server (<code>~/.ssh2/environment</code>)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>User's login behavior file (<code>~/.hushlogin</code>)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
</tbody>
</table>

**Server-side files and directories (global)**

<table>
<thead>
<tr>
<th>File or Directory</th>
<th>Maximum Security</th>
<th>Required when StrictModes = no</th>
<th>Required when StrictModes = yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Server configuration directory (<code>/etc/ssh2</code>)</td>
<td>644</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Server private key file (<code>/etc/ssh2/hostkey</code>)</td>
<td>600</td>
<td>Root-only read/write access [600]</td>
<td>Root-only read/write access [600]</td>
</tr>
<tr>
<td>Server public key file (<code>/etc/ssh2/hostkey.pub</code>)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Server RADIUS authentication configuration file (<code>/etc/ssh2/radius_config</code>)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Subconfiguration file directory (<code>/etc/ssh2/subconfig</code>)</td>
<td>700</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Subconfiguration files</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
</tbody>
</table>
The syntax for `ssh` is:

```
```

Options are available in both a single-character form (such as `-o`) and a descriptive equivalent (`-- option`). Single characters are shown here. To view the descriptive equivalents, use the `-h` command line option.

Caution: All options specified on the command line (including user names, host names, and other sensitive information) will show up in a process status (`ps`) listing. Exercise care when specifying sensitive options and switches so that other users cannot easily see that information. A more secure alternative is to set these options in a configuration file and to protect the configuration file using recommended file permissions (configuration file = 600, directory containing the file = 700).

- **-4**
  Forces connections using IPv4 addresses only. You can also configure IP address requirements using the `AddressFamily` keyword.

- **-6**
  Forces connections using IPv6 addresses only. You can also configure IP address requirements using the `AddressFamily` keyword.

- **-a**
  Disables authentication agent forwarding. Authentication agent forwarding is enabled using the `ForwardAgent` keyword, which is set to 'yes' by default. You can use `-a` to override the configuration file setting.

- **-c cipher**
  Specifies one or more (comma-separated) encryption algorithms supported by the client. The cipher used for a given session is the cipher highest in the client's order of preference that is also supported by the server. Allowed values are 'aes128-ctr', 'aes128-cbc', 'aes192-ctr', 'aes192-cbc', 'aes256-ctr', 'aes256-cbc', 'blowfish-cbc', 'arcfour', 'arcfour128', 'arcfour256', 'cast128-cbc', and '3des-cbc'.

---

<table>
<thead>
<tr>
<th>File or Directory</th>
<th>Maximum Security</th>
<th>Required when StrictModes = no</th>
<th>Required when StrictModes = yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global Secure Shell environment file (/etc/ssh2/environment)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Client PKI Services Manager public key (specified using <code>PkidPublicKey</code>)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Server logs directory (/etc/ssh2/logs)</td>
<td>711</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
<tr>
<td>Server audit log files (/etc/ssh2/logs/sshd2-audit-*)</td>
<td>600</td>
<td>No requirements</td>
<td>No requirements</td>
</tr>
</tbody>
</table>
You can also set this value to 'none'. When 'none' is the agreed on cipher, data is not encrypted. Note that this method provides no confidentiality protection, and is not recommended.

The following values are provided for convenience: 'aes' (all supported aes ciphers), 'blowfish' (equivalent to 'blowfish-cbc'), 'cast' (equivalent to 'cast128-cbc'), '3des' (equivalent to '3des-cbc'), 'Any' or 'AnyStd' (all available ciphers plus 'none'), and 'AnyCipher' or 'AnyStdCipher' (all available ciphers).

You can also configure encryption algorithms in the configuration file using the **Ciphers** keyword; the default is 'AnyStdCipher'.

**-C**
Disables compression. Compression is desirable on modem lines and other slow connections, but will slow down response rates on fast networks. Compression also adds extra randomness to the packet, making it harder for a malicious person to decrypt the packet. Compression can be enabled using the **Compression** keyword in the configuration file. Using **-C** overrides the configuration file setting.

**-d debug_level**
Sets the debug level. Increasing the value increases the amount of information displayed. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.)

Note: Setting logging to 99 can increase your security risk. At this level, information leakage is a concern, as unencrypted protocol information may be written out. Also, the volume of information written may fill up disk space rapidly, potentially causing the host or Reflection for Secure IT to stop responding.

**-e character**
Sets the escape character for the terminal session. The default character is a tilde (~). Setting the escape character to 'none' means that no escape character is available and the tilde acts like any other character. For details, see ESCAPE SEQUENCES below. You can also set the escape character in the configuration file using the **EscapeChar** keyword.

**-f**
Use this option when you have configured port forwarding and you want the Secure Shell session to run in the background. If at least one port forwarding rule is configured, this option sends the Secure Shell session to the background after authentication is complete. The session remains in the background and continues to accept forward requests indefinitely until you manually kill the process. (This is equivalent to setting **GoBackground=yes** in the configuration file.)

**-fo**
The options works like **-f**, but in this case the background session waits for only one forwarded connection to occur and exits as soon as the forwarded connection is closed. (This is equivalent to setting **GoBackground=oneshot** in the configuration file.)

**-F file**
Specifies an additional configuration file. Settings are read from this file in addition to the default user-specific file (`~/.ssh2/ssh2_config`) and/or the system-wide file (`/etc/ssh2/ssh2_config`). Settings in this file override settings in both the user-specific file and the system-wide file.
-g
Enables gateway ports. Remote hosts are allowed to connect to local forwarded ports. You can also configure this in the configuration file using the **GatewayPorts** keyword.

Caution: This option should be used with extreme caution (and never with Internet-facing network adapters), because the client performs no authentication of remote host connections. If the application to which this connection is forwarded does not perform its own authentication, then all remote hosts connections are allowed unrestricted access to that application.

-h
Displays a brief summary of command options.

-i file
Specifies an alternate identification file to use for public key authentication. The file location is assumed to be in the current working directory unless you specify a fully-qualified or relative path. The default identity file is `~/.ssh2/identification`. You can also specify an identity file in the configuration file using the **IdentificationFile** keyword.

-l username
Specifies a name to use for login on the remote computer. You can also specify a user name in the configuration file using the **Username** keyword. (Note: If you include the optional [user@] as part of your host specification, -l overrides the specified user name.)

-L [protocol/] [listening_host:] listening_port:host:port
Redirects data from the specified local port, through the secure tunnel to the specified destination host and port. When a Secure Shell connection is established, the Secure Shell client opens a socket on the Secure Shell client host using the designated local port (listening_port). (On client hosts with multiple interfaces, use listening_host to specify which interface.) Configure your application client (the one whose data you want to forward) to send data to the forwarded socket (rather than directly to the destination host and port). When that client establishes a connection, all data sent to the forwarded port is redirected through the secure tunnel to the Secure Shell server, which decrypts it and then directs it to the destination socket (host:hostport). Unless the gateway ports option is enabled, the forwarded local port is available only to clients running on the same computer as the Secure Shell client. The optional protocol can be tcp or ftp. Multiple client applications can use the forwarded port, but the forward is active only while ssh is running.

Note: If the final destination host and port are not on the Secure Shell server host, data is sent in the clear between the Secure Shell host and the application server host.

You can also configure local forwarding in the configuration file using the **LocalForward** keyword.

-m mac_algorithm
Specifies, in order of preference, which MACs (message authentication codes) are supported by the client. Allowed values are 'hmac-sha256', 'hmac-sha1', 'hmac-sha1-96', 'hmac-md5', 'hmac-md5-96', 'hmac-sha512', and 'hmac-ripemd160'. Use 'AnyMac' to support all of these. Use 'AnyStdMac' to specify 'hmac-sha256', hmac-sha1,hmac-sha1-96,hmac-md5,hmac-md5-96, hmac-sha512'. Specifying hmac-sha256 also enables hmac-sha2-256. Specifying hmac-sha512 also enables hmac-sha2-512. Multiple MACs can also be specified as a comma-separated list. Additional options are 'none', 'any' (equivalent to AnyMac plus 'none'), and 'AnyStd' (equivalent to 'AnyStdMac' plus 'none'). When 'none' is the agreed on MAC, no message authentication code is used. Because this provides no data integrity protection, options that include 'none' are not recommended.

You can also configure MACs in the configuration file using the **MACs** keyword; the default is 'AnyStdMac'.
-n
Redirects stdin from /dev/null, which prevents reading from stdin. You can also configure this in the configuration file using the **DontReadStdin** keyword.

-o **option**
Sets any option that can be configured using a configuration file keyword. For a list of keywords and their meanings, see ssh2_config(5). Syntax alternatives are shown below. Use quotation marks to contain expressions that include spaces.

- o key1=value
- o key1="sample value"
- o "key1 value"
- o key=value1,value2
- o key="value1, value2"

To configure multiple options, use multiple -o switches.

- o key1=value -o key2=value

-p **port**
Specifies the port to connect to on the server. The default is 22, which is the standard port for Secure Shell connections. You can also configure the port in the configuration file using the **Port** keyword.

-q
Enables quiet mode, which causes all warning and diagnostic messages, including banners, to be suppressed. You can also configure this in the configuration file using the **QuietMode** keyword.

-R [protocol] [listening_host:] listening_port:host:hostport
Redirects data from the specified remote port (on the computer running the Secure Shell server), through the secure tunnel to the specified destination host and port. When the Secure Shell connection is established, the Secure Shell server opens a socket on its host (the computer running the Secure Shell server) using the designated remote port (**listening_port**). (On server hosts with multiple interfaces, use **listening_host** to specify which interface.) Configure your client application (the one whose data you want to forward) to send data to the forwarded socket (rather than directly to the destination host and port). When that client establishes a connection, all data sent to the forwarded port is redirected through the secure tunnel to the Secure Shell client, which decrypts it and then directs it to the destination socket (**host**, **hostport**). The optional **protocol** can be tcp or ftp.

You can also configure remote forwarding in the configuration file using the **RemoteForward** keyword.

-s **subsystem**
Invokes the specified subsystem on the remote system. Subsystems are a feature of the Secure Shell protocol which facilitates the use of Secure Shell as a secure transport for other applications (such as sftp). Subsystems must be defined by the Secure Shell server.

-S
Connects without requesting a session channel on the server. This can be used with port-forwarding requests if a session channel (and tty) is not needed, or the server does not give one.

-t
Forces a tty allocation even if a command is specified. You can also configure this in the configuration file using the **ForcePTTYAllocation** keyword.
-v
Sets the debug level to verbose mode, which is equivalent to using `-d 2`. You can also configure this in the configuration file using the VerboseMode keyword.

-V
Displays product name and version information and exits. If other options are specified on the command line, they are ignored.

-W password_file
Specifies a file containing the password to use for the connection. Set permissions on the password file to 600; the file is not accepted if it has read or write permissions for group or other. Also, for a non-root user, the file is not accepted if there has been a change in identity (user id). This option applies only to password authentication. If AllowedAuthentications is configured to attempt keyboard-interactive before password authentication (the default), users will receive a password prompt even if a valid password file is present. To prevent this, modify the allowed authentications list to support only password authentication or to attempt password authentication before keyboard-interactive.

Note: Passphraseless public keys provide a more secure way to configure authentication without requiring user interaction, because private keys are not transmitted over the encrypted connection like passwords are.

-X
Enables X11 connection forwarding and treats X11 clients as untrusted. Untrusted remote X11 clients are prevented from tampering with data belonging to trusted X11 clients. You can also configure this in the configuration file using the ForwardX11 keyword.

-x
Disables X11 connection forwarding. You can also configure this in the configuration file using the ForwardX11 keyword.

-Y
Enables X11 connection forwarding and treats X11 clients as trusted.

**ssh Escape Sequences**

Use escape sequences to manage your client terminal session. Escape sequences are recognized only after a newline character. If you have just logged in, press Enter before you enter your first escape sequence. You can configure an alternate escape character using `-e` on the command line or EscapeChar in the configuration file.

The following escape sequences are available. These are shown with the default escape character, a tilde (`~`).

~. Terminates the connection.

~^Z Suspend ssh.

~# Lists active forwarded connections. Note: Forwarded connections are listed only when the ports are actually transmitting data.

~- Disables use of the escape character for the duration of the session.

~? Displays a list of available escape sequences.
Sends the escape character to the host. (Type the escape character twice to send one escape character.)

~C Execute command mode, which you can use to request port forwarding. The options are:

- L[bind_address]:port:host:hostport Request local forward
- R[bind_address]:port:host:hostport Request remote forward
- KL[bind_address]:port Cancel local forward
- KR[bind_address]:port Cancel remote forward

~V Sends version information to stderr.

~s Sends connection information to stderr.

~r Initiates an immediate key exchange to establish new encryption and integrity keys.

~l Enters line mode. Keystrokes are stored to a buffer and output when you press Enter.

~B Sends a BREAK to the remote system.

### ssh Exit Values

Exit values are provided to assist in troubleshooting. In scripts we recommend that you use only zero or non-zero for error handling. Looking for specific non-zero values is not reliable because of variability caused by operating systems and servers.

Error codes are limited to values 0-255. Errors 65-79 are disconnect conditions, calculated as 64 + error value returned from host, as defined in RFC4253. Errors values 128-254 are system Signals, calculated as 128 + Signal value. Error value 255 is returned when `ssh` fails after being executed by another process, such as `scp`.

- 0 Success.
- 1 Generic error.
- 2 Remote host connection failure.
- 65 Access denied by host for this client address.
- 66 Protocol error.
- 67 Key exchange failed.
- 68 Authentication failed.
- 69 MAC error.
- 70 Compression error.
- 71 Service not available.
- 72 Protocol version not supported.
- 73 Host key not verifiable.
- 74 Connection lost.
- 75 Disconnected by application.
Too many connections.
Cancelled by user.
No more authentication methods available.
Unknown user name.

**ssh-keygen Command Line Options**

The `ssh-keygen` syntax is:

```
```

Use `ssh-keygen` to create RSA and DSA keys for public key authentication, to edit the properties of existing keys, and to convert key file formats for compatibility with other Secure Shell implementations.

When no options are specified, `ssh-keygen` generates a 2048-bit RSA key pair and queries you for a passphrase to protect the private key. If you don't specify a file name on the command line, keys are created in `~/.ssh2/` and given a default name that identifies the key type, size, and host name (for example, `home/joe/.ssh2/id_rsa_2048_myhost_a`). If you specify a file name, keys are saved to the current working directory unless you include a fully qualified path name. For each private key you create, `ssh-keygen` also generates a public key. Public keys are given the same base name as the private key, with an added `.pub` extension (for example, `id_rsa_2048_myhost_a.pub`).

**Command Line Options**

Options are available in both a single-character form (such as `-b`) and a descriptive equivalent (`--bits`). Single characters are shown here. To view the descriptive equivalents, use the `-h` command line option.

**-7 file**

Extracts certificate(s) and CRL(s) from the specified PKCS#7 file.

**-b bits**

Specifies the key size. Up to a point, a larger key size improves security. Increasing key size slows down the initial connection, but has no effect on the speed of encryption or decryption of the data stream after a successful connection has been made. The length of key you should use depends on many factors, including: the key type, the lifetime of the key, the value of the data being protected, the resources available to a potential attacker, and the size of the symmetric key you use in conjunction with this asymmetric key. To ensure the best choice for your needs, we recommend that you contact your security officer. The default for RSA keys is 2048 bits and 1024 bits for DSA keys. The minimum allowed value is 512. The maximum allowed value is 32768.

**-c comment**

Specifies information for the comment field within the key file. Use quotation marks if the string includes spaces. If you do not specify a comment, a default comment is created that includes the key type, creator, date, and time. Note: The comment is displayed when a passphrase-protected key is used for client authentication. Don't store passphrases or other sensitive information in the comment.
-D private_key
  Uses the specified private key to derive a new copy of the public key.

-e private_key
  Changes the passphrase of the specified private key. When you use this option alone you will be queried for the old and new passphrase for the specified private key. To edit the passphrase without opening an interactive session, you can use this option in combination with -p and -N. To change to a null passphrase, you can use this option in combination with -P.

-f
  Enables FIPS mode. This mode enforces key creation using FIPS-approved key strength.

-F key
  Displays the fingerprint of the specified key in Bubble Babble format.

-h
  Displays a brief summary of command options.

-H key
  Uses the specified Reflection public key to generate a public key in OpenSSH format. The converted key is created using the same base file name with an added .ssh extension. You can use the key that is created to configure public key client authentication on an OpenSSH server.

-i key
  Displays information about the specified key.

-k file
  Extracts certificate(s) and private key(s) from the specified PKCS #12 file.

-N new_passphrase
  Changes the passphrase to the specified new passphrase. Use this option in combination with -e.

-o key_name
  Specifies the filename for the generated private key. (A public key is also created and is always given the same name as the private key plus a .pub file extension.) Note: An alternate way of naming key files is to specify one or more key filenames at the end of the ssh-keygen command.

-O key
  Uses the specified OpenSSH public or private key to create a public or private key in Reflection format. The converted key is created using the same base file name with an added .ssh2 extension.

-p passphrase
  Specifies a passphrase. Use quotation marks if the phrase includes spaces. This option creates the initial passphrase when you generate a new key. If you are managing an existing key, use this option to specify the passphrase that protects that key. If a passphrase is required and you don't use -p, you'll be prompted for the passphrase. Ensure that you follow your company's security policy for password length and complexity.
-P

Creates a key with no passphrase. You can use this option to create keys for server authentication. Passphrases are strongly recommended for client keys. Passphraseless keys should be used only for accounts that require unattended authentication (such as file transfer scripts). Passphraseless private key files should be protected using operating system file access controls (key file = 400, directory containing the key = 700).

-q

Hides the key generation progress indicator.

-t key_type

Specifies the algorithm used for key generation. Possible values are "rsa" and "dsa". The default is "rsa".

-V

Displays ssh-keygen version information.

-X cert

Extracts the public key from the specified X.509 certificate file.

[key_name1 key_name2...]

Specifies the file name (or names) to be used for the generated private key (or keys). The public key is created using the same name with a ".pub" file extension.

scp Command Line Options

The scp syntax is:

```
```

Options are available in both a single-character form (such as -o) and a descriptive equivalent (--option). Single characters are shown here. To view the descriptive equivalents, use the -h command line option.

Caution: All options specified on the command line (including user names, host names, and other sensitive information) will show up in a process status (ps) listing. Exercise care when specifying sensitive options and switches so that other users cannot easily see that information. A more secure alternative is to set these options in a configuration file and to protect the configuration file using recommended file permissions (configuration file = 600, directory containing the file = 700).

-4

Forces connections using IPv4 addresses only. You can also configure IP address requirements using the AddressFamily keyword.

-6

Forces connections using IPv6 addresses only. You can also configure IP address requirements using the AddressFamily keyword.
-a [newline_type]
Transfers files in ASCII mode. Use the optional argument to handle newline conversion. You can specify either 'unix' or 'dos'. By default, the value you specify for newline_type sets the destination newline convention, but you can specify either source or destination conventions by prefixing the argument with 'src:' or 'dest:'. For example:
scp -a src:unix --a dest:dos unixhost:src_file winhost:dest_file
Defaults are: 'dest:unix', 'src:unix'. If destination and source types are the same, no conversion occurs. Otherwise a conversion occurs based on values you specify for the 'src' and 'dest' newline types.
When -a is used without specified source or destination conventions, the client attempts to retrieve the end-of-line convention for source and/or destination from the server(s) to which connections have been established. If the server does not support this functionality, the DOS end-of-line convention is assumed.

-b buffer_size
Specifies the buffer size used for data transfer. The default is 32768 bytes. The minimum allowed value is 1024. The maximum allowed value is 4194304 bytes. In most cases the default value provides close to optimal transfer speeds. On some systems, moderate increases to the buffer size can improve performance. Caution: Using very large buffer sizes rarely improves performance and can create problems including: slower transfers, transfer failures with servers that don't support very large buffers, and fatal errors when client or server memory limits are exceeded.

-B
Runs scp in batch mode, which disables all queries for user input. This is useful for scripts and batch jobs. Authentication methods that require user interaction are not supported when you use this option. In batch mode scp always overwrites existing destination files unless --overwrite is set to 'no'.

-c cipher
Specifies one or more (comma-separated) encryption algorithms supported by the client. The cipher used for a given session is the cipher highest in the client's order of preference that is also supported by the server. Allowed values are 'aes128-ctr', 'aes128-cbc', 'aes192-ctr', 'aes192-cbc', 'aes256-ctr', 'aes256-cbc', 'blowfish-cbc', 'arcfour', 'arcfour128', 'arcfour256', 'cast128-cbc', and '3des-cbc'.
You can also set this value to 'none'. When 'none' is the agreed on cipher, data is not encrypted. Note that this method provides no confidentiality protection, and is not recommended.
The following values are provided for convenience: 'aes' (all supported aes ciphers), 'blowfish' (equivalent to 'blowfish-cbc'), 'cast' (equivalent to 'cast128-cbc'), '3des' (equivalent to '3des-cbc'), 'Any' or 'AnyStd' (all available ciphers plus 'none'), and 'AnyCipher' or 'AnyStdCipher' (all available ciphers).
If no cipher is specified, the cipher is determined by the Ciphers keyword in the Secure Shell configuration file ssh2_config(5); the default is 'AnyStdCipher'.

-d
Forces the destination to be a directory that already exists. For example, the following command copies source_file to the directory called destination if this directory exists. If the directory doesn't exist, source_file is copied to the demo directory and given the file name destination.
scp source_file joe@myhost:~/demo/destination
With the `-d` flag added, the following command copies `source_file` to the `destination` directory, but fails if this directory doesn't exist.

```
scp -d source_file joe@myhost:~/demo/destination
```

### `-D debug_level`

Sets the debug level. Increasing the value increases the amount of information displayed. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.)

### `-F file`

Specifies an additional configuration file. Settings are read from this file in addition to the default user-specific file (`~/.ssh2/ssh2_config`) and/or the system-wide file (`/etc/ssh2/ssh2_config`). Settings in this file override settings in both the user-specific file and the system-wide file.

### `-h`

Displays a brief summary of command options.

### `-i file`

Specifies an alternate identification file to use for public key authentication. The file location is assumed to be in the current working directory unless you specify a fully-qualified or relative path. The default identity file is `~/.ssh2/identification`.

### `-N max_requests`

Specifies the maximum number of concurrent requests. Increasing this may slightly improve file transfer speed, but also increases memory use. The default is 256.

### `-o option`

Sets any option that can be configured using a configuration file keyword. For a list of keywords and their meanings, see `ssh2_config(5)`. Syntax alternatives are shown below. Use quotation marks to contain expressions that include spaces.

- `-o key1=value`
- `-o key1="sample value"`
- `-o "key1 value"`
- `-o key=value1,value2`
- `-o key="value1, value2"`

To configure multiple options, use multiple `-o` switches.

- `-o key1=value` `-o key2=value`

### `--overwrite [yes|no|ask]`

Specifies whether or not to overwrite existing destination files. The allowed values are 'yes', 'no', and 'ask'. The default is 'yes'. Note: When the source and destination files are identical, no transfer occurs regardless of the value of this setting.

### `-P`

Preserves the modification times and file attributes of the original file.

### `-P port`

Specifies the port to connect to on the server. The default is 22, which is the standard port for Secure Shell connections. You can also configure the port in the configuration file using the `Port` keyword.
-q
  Runs in quiet mode. Only fatal errors are displayed.

-Q
  Disables display of all file transfer statistics.

-r
  Copies recursively, including all subdirectories.

--statistics yes|no|simple
  Specifies how much information about the transfer is provided. When set to 'yes', the statistics
  include the filename, size, transfer rate, and a progress indicator that updates during the
  transfer. This is the default when a tty is present. When set to 'simple', the statistics include
  the filename, size, and transfer rate, but no progress indicator. This is the default when there is no tty
  (for example in cron jobs). When set to 'no', no transfer statistics are given (this is equivalent to
  the -Q option).

  Note: Setting statistics output to 'simple' can resolve problems caused when piping output to a
  file causes long filenames to be truncated.

-u
  Deletes the source file after the copy to the destination location is completed.

-v
  Sets the debug level to verbose mode, which is equivalent to setting the debug level to 2. You
  can also configure this in the configuration file using the VerboseMode keyword.

-V
  Displays product name and version information and exits. If other options are specified on the
  command line, they are ignored.

-W password_file
  Specifies a file containing the password to use for the connection. Set permissions on the
  password file to 600; the file is not accepted if it has read or write permissions for group or other.
  Also, for a non-root user, the file is not accepted if there has been a change in identity (userid).
  This option applies only to password authentication. If AllowedAuthentications is configured to
  attempt keyboard-interactive before password authentication (the default), users will receive a
  password prompt even if a valid password file is present. To prevent this, modify the allowed
  authentications list to support only password authentication or to attempt password
  authentication before keyboard-interactive.

  Note: Passphraseless public keys provide a more secure way to configure authentication without
  requiring user interaction, because private keys are not transmitted over the encrypted
  connection like passwords are.

sftp Command Line Options

The sftp syntax is:


Options are available in both a single-character form (such as -o) and a descriptive equivalent (--
 option). Single characters are shown here. To view the descriptive equivalents, use the -h command
 line option.
Caution: All options specified on the command line (including user names, host names, and other sensitive information) will show up in a process status (ps) listing. Exercise care when specifying sensitive options and switches so that other users cannot easily see that information. A more secure alternative is to set these options in a configuration file and to protect the configuration file using recommended file permissions (configuration file = 600, directory containing the file = 700).

-4

Forces connections using IPv4 addresses only. You can also configure IP address requirements using the AddressFamily keyword.

-6

Forces connections using IPv6 addresses only. You can also configure IP address requirements using the AddressFamily keyword.

-b buffer_size

Specifies the buffer size used for data transfer. The default is 32768 bytes. The minimum allowed value is 1024. The maximum allowed value is 4194304 bytes. In most cases the default value provides close to optimal transfer speeds. On some systems, moderate increases to the buffer size can improve performance. Caution: Using very large buffer sizes rarely improves performance and can create problems including: slower transfers, transfer failures with servers that don't support very large buffers, and fatal errors when client or server memory limits are exceeded.

-B batch_file

Specifies a file to use for batch processing sftp commands. After a successful login, sftp executes each command in the specified file until a bye, exit or quit command is found, and then terminates the connection. Authentication methods that require user interaction are not supported in this mode. The batch file can use any of the interactive commands documented below. If a command in the batch file fails, sftp continues executing the remaining commands, and returns the error code of the first failed command. However, commands prefixed with "-" (dash) always return 0, even if the command fails.

-c cipher

Specifies one or more (comma-separated) encryption algorithms supported by the client. If no cipher is specified, the cipher is determined by the Ciphers keyword in the Secure Shell configuration file ssh2_config(5); the default is 'AnyStdCipher'. The cipher used for a given session is the cipher highest in the client's order of preference that is also supported by the server. Allowed values are 'aes128-ctr', 'aes128-cbc', 'aes192-ctr', 'aes192-cbc', 'aes256-ctr', 'aes256-cbc', 'blowfish-cbc', 'arcfour', 'arcfour128', 'arcfour256', 'cast128-cbc', and '3des-cbc'. You can also set this value to 'none'. When 'none' is the agreed on cipher, data is not encrypted. Note that this method provides no confidentiality protection, and is not recommended. The following values are provided for convenience: 'aes' (all supported aes ciphers), 'blowfish' (equivalent to 'blowfish-cbc'), 'cast' (equivalent to 'cast128-cbc'), '3des' (equivalent to '3des-cbc'), 'Any' or 'AnyStd' (all available ciphers plus 'none'), and 'AnyCipher' or 'AnyStdCipher' (all available ciphers).

-D debug_level

Sets the debug level. Increasing the value increases the amount of information displayed. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.)

-h

Displays a brief summary of command options.
-m mac_algorithm
Specifies which MACs (message authentication codes) are supported for this connection. Allowed values are 'hmac-sha256', 'hmac-sha1', 'hmac-sha1-96', 'hmac-md5', 'hmac-md5-96', 'hmac-sha512', and 'hmac-ripemd160'. Use 'AnyMac' to support all of these. Use 'AnyStdMac' to specify 'hmac-sha256, hmac-sha1,hmac-sha1-96,hmac-md5,hmac-md5-96, hmac-sha512'. Specifying hmac-sha256 also enables hmac-sha2-256. Specifying hmac-sha512 also enables hmac-sha2-512. Multiple MACs can also be specified as a comma-separated list. Additional options are 'none', 'any' (equivalent to AnyMac plus 'none'), and 'AnyStd' (equivalent to 'AnyStdMac' plus 'none'). When 'none' is the agreed on MAC, no message authentication code is used. Because this provides no data integrity protection, options that include 'none' are not recommended.

-N max_requests
Specifies the maximum number of concurrent requests. Increasing this may slightly improve file transfer speed, but also increases memory use. The default is 256.

-o option
Sets any option that can be configured using a configuration file keyword. For a list of keywords and their meanings, see ssh2_config(5). Syntax alternatives are shown below. Use quotation marks to contain expressions that include spaces.

- o key1=value
- o key1="sample value"
- o "key1value"
- o key=value1,value2
- o key="value1, value2"

To configure multiple options, use multiple -o switches.

- o key1=value -o key2=value

--overwrite [yes|no|ask]
Specifies whether or not to overwrite existing destination files. The allowed values are 'yes', 'no', and 'ask'. The default is 'yes'. Note: When the source and destination files are identical, no transfer occurs regardless of the value of this setting.

-P port
Specifies the port to connect to on the server. The default is 22, which is the standard port for Secure Shell connections. You can also configure the port in the configuration file using the Port keyword.

-v
Sets the debug level to verbose mode, which is equivalent to setting the debug level to 2. You can also configure this in the configuration file using the VerboseMode keyword.

-V
Displays product name and version information and exits. If other options are specified on the command line, they are ignored.

-W password_file
Specifies a file containing the password to use for the connection. Set permissions on the password file to 600; the file is not accepted if it has read or write permissions for group or other. Also, for a non-root user, the file is not accepted if there has been a change in identity (userid). This option applies only to password authentication. If AllowedAuthentications is configured to attempt keyboard-interactive before password authentication (the default), users will receive a
password prompt even if a valid password file is present. To prevent this, modify the allowed authentications list to support only password authentication or to attempt password authentication before keyboard-interactive.

Note: Passphraseless public keys provide a more secure way to configure authentication without requiring user interaction, because private keys are not transmitted over the encrypted connection like passwords are.

Supported sftp Commands

You can use the following commands in interactive sftp sessions and in sftp batch files.

**ascii [-s] [remote_newline] [local_newline]**

Sets the current file transfer mode to ASCII. ASCII mode is useful for translating end-of-line characters. Use remote_newline and local_newline if you need to override the default handling of new lines. Supported values for remote_newline are ‘DOS’ (\r\n) and ‘Unix’ (\n). If no explicit value for the remote end-of-line convention is given, the remote host is queried to provide the convention. If the remote host does not support this functionality, the DOS end-of-line convention is assumed. The only supported value for local_newline is 'Unix' (\n). Use -s to display the current transfer mode.

**auto**

Sets the transfer mode to 'auto'. In auto mode, the transfer method is determined by file extension. Files with specified file extensions use ASCII transfer; all other files use binary transfer. The default list of ASCII file types is "txt, htm*, pl, php*. To modify this list for a given sftp session, use the setext command. To change the default file extension list, use the client keyword FileCopyAsciiExtensions.

**binary**

Sets the transfer mode to binary. In this mode, files transfer without any modification. Binary is the default transfer mode. This command is useful for turning off ASCII mode within a batch script.

**bye**

This is a synonym for quit.

**cd directory**

Changes the remote directory to directory.

**chgrp group file**

Sets group ownership of files or directories specified by file to group. The group must be specified as a numeric group id (GID).

**chmod[-R] mode file**

Sets file permissions for the files or directories specified by file. The mode must be specified in numeric format (for example, 664). Use -R to change files and directories recursively.

**chown owner file**

Sets the owner of the files or directories specified by file to owner. The owner must be specified as a numeric user id (UID).

**close**

Closes the connection to the remote server without exiting sftp.
**debug** *debug_level | disable | no*

Sets the debug level. Increasing the value increases the amount of information displayed. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.) Use either ‘disable’ or ‘no’ to disable debugging.

**dir**

This is a synonym for **ls**.

**exit**

This is a synonym for **quit**.

**get [-preserve] | [-p] remote-file [remote-file . . .]**

Copies the specified file or files to the current local working directory. (To copy to a different location, use **lcd** to change the local working directory.) If a file with the same name already exists, the existing file is overwritten. Wildcards are supported, but name substitution occurs on file names only, not directories. Use either **--preserve** or **-p** to preserve file attributes and time stamps.

**gettext**

Displays the current list of file extensions that use ASCII file transfer when auto mode is enabled. Use **auto** to enable auto mode. Use **setext** to change this list for the current session. Use the client keyword **FileCopyAsciiExtensions** to change the default list.

**help | ? [command]**

Displays **sftp** help. Use **command** to display help on the specified command.

**lcd** directory

Sets the local directory to **directory**.

**lls [-1 | -a | -f | -l | -n | -r | -S | -t | --] [file]**

Displays the local directory listing. The options are:
- **-1** (one column)
- **-a** (show hidden files)
- **-f** (do not sort)
- **-l** (long list format)
- **-n** (long list format with numeric user and group ids)
- **-r** (reverse order)
- **-S** (sort by size)
- **-t** (sort by file access time)
- **--** (treat hyphens that follow as ordinary characters.)

**lmkdir** directory

Creates the specified local directory.

**ln**

This is a synonym for **symlink**.

**lpwd**

Displays the local working directory.
ls [-1 | -a | -f | -l | -n | -r | -S | -t | --] [file]
Displays the remote directory listing. The options are the same as for lls, and are described above.

mget
This is a synonym for get.

mkdir directory
Creates the specified remote directory.

mput
This is a synonym for put.

open [-l] [user@host]
Opens a connection to the specified host. Use -l to connect to the local host; in which case both local and remote commands act on files on the local file system.

Copies the specified file or files to the current remote working directory. (To copy to a different location, use cd to change the remote working directory.) If a file with the same name already exists, the existing file is overwritten. Wildcards are supported, but name substitution occurs on file names only, not directories. Use either --preserve or -p to preserve file attributes and time stamps.

pwd
Displays the remote working directory.

quit
Exits sftp and closes the connection.

rename source destination
Renames a file from source to destination. No rename occurs if the destination file already exists.

rm file
Deletes the specified remote file or files. Wildcards are supported.

rmdir directory
Deletes the specified remote directory.

setext
Specifies the current list of file extensions that use ASCII file transfer when auto mode is enabled. To specify multiple extensions, use a comma or space-separated list; this command is not cumulative. Wildcard (zsh-glob) characters are supported. Don't precede file extensions with a period. To specify extensions containing spaces, use quotation marks around the extension or use a backslash as an escape character. Use auto to enable auto mode. Use getext to display the current list. Use the client keyword FileCopyAsciiExtensions to change the default list.

symlink linked_path target_path
Creates a symbolic link (soft) from linked_path to target_path on the remote host.

verbose
Sets the debug level to verbose mode, which is equivalent to setting the debug level to 2. To disable verbose mode, use 'debug disable'.
version
Displays the supported SFTP protocol version.

**ssh-add Command Line Options**

The syntax for `ssh-add` is:

```
```

Use `file1, file2...` to specify keys to add to the agent. Specifying a key file is optional. If don't specify any key files, `ssh-add` adds all the keys specified in your identification file (which is `~/.ssh2/identification` by default).

Options are available in both a single-character form (such as `-o`) and a descriptive equivalent (`--option`). Single characters are shown here. To view the descriptive equivalents, use the `-h` command line option.

- `-c`
  
  Specifies that agent should ask for confirmation before using a key.

- `-d`
  
  Removes one or more specified keys from the agent. Use the `file` argument to specify the key file(s).

- `-D`
  
  Removes all identities from the agent.

- `-h`
  
  Displays a brief summary of command options.

- `-l`
  
  Lists all the identities currently loaded in the key agent.

- `-L`
  
  Locks the key agent. You are prompted for a password, which you will need to use to unlock the agent. Use `-U` to unlock.

- `-p`
  
  Reads the passphrase from stdin. This may be done over a pipe.

- `-t <timeout>`
  
  Sets a timeout for the key. Use zero (0) to set no limit. Keys are deleted after the specified timeout.

  By default, the timeout value is set in minutes. You can specify other units using this syntax:

  `n<unit>[n<unit>...]`

  Where unit can be: s (seconds), m (minutes), h (hours), d (days), or w (weeks). (Upper or lower case units are both accepted with the same meaning.) For example:

  `3600s = 3600 seconds (1 hour)`
  
  `2w = 2 weeks`
  
  `2d4h = 2 days and 4 hours`
-U
Unlocks an agent that has been locked using -L. You are prompted for the required password.

-V
Displays product name and version information and exits. If other options are specified on the command line, they are ignored.

-x
Specifies that the key files to be added are associated with X.509 certificates. If you use -x without specifying a file or files, Reflection for Secure IT reads your identification file (~/.ssh2/identification by default) and adds all the keys identified using the CertKey keyword. Certificates must be in the same directory as the associated private key and use the same base name with a .crt file extension.

**ssh-agent Command Line Options**

The syntax for **ssh-agent** is:

```
ssh-agent [-c] [-d debug_level] [-h] [-k] [-s] [-t timeout] [-V] [command]
```

Options are available in both a single-character form (such as -o) and a descriptive equivalent (--option). Single characters are shown here. To view the descriptive equivalents, use the -h command line option.

-c
Forces the shell to be csh. By default **ssh-agent** uses the SHELL environment variable to determine which shell to invoke. This option overrides the default behavior.

-d debug_level
Sets the debug level. Increasing the value increases the amount of information displayed. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.)

-h
Displays a brief summary of command options.

-k
Kills the current agent (given by the SSH_AGENT_PID environment variable).

-s
Forces the shell to be sh. By default **ssh-agent** uses the SHELL environment variable to determine which shell to invoke. This option overrides the default behavior.

-t timeout
Sets a default timeout for any key added to the agent. Keys are deleted after the specified timeout. By default keys have no timeout limit, which is equivalent to setting a timeout value of zero(0). (You can also specify timeouts when you add keys by using the **ssh-add** -t option, which overrides this setting.)

By default, the timeout value is set in minutes. You can specify other units using this syntax:

```
n<unit>[n<unit>...]
```

Where unit can be: s (seconds), m (minutes), h (hours), d (days), or w (weeks). (Upper or lower case units are both accepted with the same meaning.) For example:

```
3600s = 3600 seconds (1 hour)
```
2w = 2 weeks
2d4h = 2 days and 4 hours

-V
Displays product name and version information and exits. If other options are specified on the command line, they are ignored.

sshd Command Line Options

-4
Forces connections using IPv4 addresses only. You can also configure IP address requirements using the AddressFamily keyword.

-6
Forces connections using IPv6 addresses only. You can also configure IP address requirements using the AddressFamily keyword.

-b
When this option is specified sshd doesn't detach and doesn't become a daemon. This can be used for monitoring.

-d level
Sets the debug level and sends debug output to stderr. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.) With this option sshd logs information for only one client connection, and terminates after the client connection closes.

Note: Setting logging to 99 can increase your security risk. At this level, information leakage is a concern, as unencrypted protocol information may be written out. Also, the volume of information written may fill up disk space rapidly, potentially causing the host or Reflection for Secure IT to stop responding.

-D level
Sets the debug level and sends debug output to a file. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.) With this option, sshd does not terminate after a client connection closes. This setting can only be used by root.

Note: Setting logging to 99 can increase your security risk. At this level, information leakage is a concern, as unencrypted protocol information may be written out. Also, the volume of information written may fill up disk space rapidly, potentially causing the host or Reflection for Secure IT to stop responding.

The output file is located in /etc/ssh2/logs and uses a file name in the form:
debugYYMMDD_HHMMSS_uniqueID, where YY=year, MM=month, DD=day, HH=hour, MM=minutes, SS=seconds, and uniqueID is a unique value that ensures that servers started at the same time use different logs.

-f config_file
Specifies an alternate name and location for the server configuration file. The server reads the specified file instead of the default file. (The default configuration file is /etc/ssh2/sshd2_config.)

-g login_timeout
Sets the number of seconds allowed for client authentication. If the client fails to authenticate the user within the specified number of seconds, the server disconnects and exits. Use zero (0) to set no limit.
-m file

Use this option to migrate settings from a F-Secure configuration file or a prior version of Reflection for Secure IT. The specified should be the name of the server configuration file to be migrated.

-h host_key_file

Specifies the filename and location of the private key used to authenticate the server. If the path is not fully qualified, the path is assumed to be relative to /etc/ssh2. The default is /etc/ssh2/hostkey.

-o option

Sets any option that can be configured using a configuration file keyword. For a list of keywords and their meanings, see sshd2_config(5). Options configured on the command line override options configured in the configuration file. Syntax alternatives are shown below. Use quotation marks to contain expressions that include spaces.

-o key1=value
-o key1="sample value"
-o "key1 value"
-o key=value1,value2
-o key="value1, value2"

To configure multiple options, use multiple -o switches.

-o key1=value -o key2=value

-p port

Specifies the port on which the server listens. The default is 22, which is the standard port for Secure Shell connections. The command line value overrides any value set in the configuration file. Only one port is allowed; if you configure multiple ports, the last configured port is used.

-q

Enables quiet mode. In this mode only errors are logged to the system log. (Both -d and -D are ignored if -q is used on the same command line.)

-v

Sets the debug level to verbose mode, which is equivalent to using '-d 2'.

-V

Displays product name and version information and exits. If other options are specified on the command line, they are ignored.

ssh-certview Command Reference

SYNOPSIS


DESCRIPTION

Use ssh-certview to view the contents of X.509 certificates (in either PEM or DER format), CRL lists, or PKCS#10 requests. You can also output sample syntax for use in pki_mapfile(5), which is used by Reflection PKI Services Manager to map certificates to allowed identities.
The **ssh-certview** output for certificate fields is compliant with RFC2253. To be compliant with this standard, Subject and Issuer fields start with the Common Name (for example, "CN = Secure CA, O = Secure Corporation, C = US"). This format is also used by Reflection PKI Services Manager.

**NOTE:** Other utilities (including earlier versions of Reflection for Secure IT) reverse the order of the field content in the Subject field output. The reversed format is not equivalent and will not result in a match if used in a PKI Services Manager map file.

**OPTIONS**

Options are available in both a single-character form (such as `-o`) and a descriptive equivalent (`-- option`). Single characters are shown here. To view the descriptive equivalents, use the `-h` command line option.

- **-C**
  Specifies that output should include a comment mark (#) at the beginning of each line of output.

- **-c**
  Extracts content from a certificate and outputs correct syntax for inclusion in pki_mapfile(5). Unless you also specify `-q`, standard output is also included, and is preceded by comment marks.

- **-d debug_level**
  Sets the debug level. Increasing the value increases the amount of information displayed. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.)

- **-h**
  Displays a brief summary of command options.

- **-q**
  Turns off display of all output except map file syntax. Use this option with `-c` to output just map file syntax without commented certificate information.

- **-V**
  Displays product name and version information and exits. If other options are specified on the command line, they are ignored.

- **-v**
  Increases the verbosity of the output data.
  If you are viewing a certificate with `-v`, the output includes Issuer, Serial Number (hex), Subject, Subject Alternative Name, Validity period, Extensions if set (including Key usage, Constraints, CDP, AIA, Policy OIDs), Public key type, and Public key fingerprint. Without this option, the output shows Issuer, Serial Number (hex), and Subject.
  If you are viewing CRL with `-v`, the output includes the entire list of revoked certificates. Without this option, the output shows issuer and update information.

**EXAMPLES**

To view the contents of the specified certificate, including full information about certificate extensions:

```
ssh-certview -v sample.crt
```

To view the contents of the certificate cacert.pem, the certificate request cacert.pem.p10, and the certification revocation file example.revoke.crl:

```
ssh-certview cacert.pem cacert.pem.p10 example.revoke.crl
```
To extract sample output from the specified certificate for inclusion in a PKI Services Manager map file:

```
ssh-certview -q -c cacert.pem
```

## ssh-certtool Command Reference

### SYNOPSIS

```
ssh-certtool [options] action [arguments]
```

The value for `action` can be either **pkcs10** (to create a PKCS#10 certificate request) or **pkcs12** (to create a PKCS#12 package). The applicable arguments depend on which action you specify as shown here:

```
ssh-certtool [options] pkcs10 subject [keyUsage] [extendedKeyUsage]
ssh-certtool [options] pkcs12 [file1] ... [fileN]
```

To see help about each of these two options, you can use the following:

```
ssh-certtool --help pkcs10
ssh-certtool --help pkcs12
```

### DESCRIPTION

You can use `ssh-certtool` to create a PKCS#10 certificate request or to create a PKCS#12 package containing a private key and one or more certificates.

#### Creating a PKCS#10 certificate request

The general syntax for creating a PKCS#10 file is:

```
ssh-certtool [options] pkcs10 subject [keyUsage] [extendedKeyUsage]
```

Note: `req` is supported as a synonym for **pkcs10**.

The value you specify as `subject` defines the certificate's Subject field. The subject name is required. Use the distinguished name syntax specified by RFC2253. Use commas to separate Subject elements (RDNs). RDNs can be specified using standard abbreviations (CN) or OIDs (2.5.4.3). Quotation marks are required if the subject name contains embedded white space.

Note: SubjectName elements in the `subject` argument must be specified in uppercase (CN, DC, OU, O, C). For example, "CN=Steve Kille, O=Isode Limited, C=GB".

The filename of the generated certificate request is based on the prefix specified by the `-o` option, with `.pkcs10` appended. The default filename of a generated private key, when `-o` is not specified, is `output.pkcs10`.

To create a request using an existing private key use `-p` to specify the key. To generate a new private key for the request, omit the `-p` option. By default, `ssh-certtool` creates a 2048-bit RSA key. To specify a key type, use type `-n`. To specify key size, use `-b`. The filename of the generated private key is based on the prefix specified by the `-o` option, with `.ssh2` appended. The default filename of a generated private key, when `-o` is not specified, is `output.ssh2`. If a key with the same name already exists, you are prompted to overwrite it. If you elect not to overwrite it, `ssh-certtool` exits with a return code of zero.

You can use optional flags to set `keyUsage` and `extendedKeyUsage` fields. Use commas, spaces or tabs to separate items. All Key Usage and Extended Key Usage flags are marked as critical in the PKCS#10 request. Valid `keyUsage` flags are `digitalSignature`, `nonRepudiation`, `keyEncipherment`, `dataEncipherment`, `keyAgreement`, `keyCertSign`, `cRLSign`, `encipherOnly` and `decipherOnly`. If you
omit this argument, the digitalSignature and keyEncipherment flags are set by default. Valid
extendedKeyUsage flags are anyExtendedKeyUsage, serverAuth, clientAuth, codeSigning and
emailProtection. No extended key usage flags are set by default.

Creating a PKCS#12 package

The general syntax for creating a PKCS#12 package is:

```
ssh-certtool [options] pkcs12 [file1] ... [fileN]
```

This constructs a PKCS#12 package file containing one private key and multiple certificates read
from the file arguments. The PKCS#12 package file contains one safe, which contains the private key
and all the certificates. The filename of the generated package file is based on the prefix specified by
the -o option, with .p12 appended. The default filename of the generated PKCS#12 package, when -o
is not specified, is output.p12. The PKCS#12 package is protected by an HMAC, and ssh-certtool
prompts you for a passphrase before creating the package.

File arguments containing private keys can be read in naked PKCS#8 format, in ssh2 PEM format, or
in OpenSSH PEM format. If the key is protected by a passphrase, ssh-certtool prompts for the
passphrase. File arguments containing certificates are recognized in both DER-encoded and PEM-
encoded format.

By default, the individual private key and certificates are saved into the PKCS#12 output file using
default PBE protection schemes. The default scheme for key encryption is pbeWithSHA1And3-
KeyTripleDES-CBC. The default for safe encryption is pbeWithSHA1And40BitRC2-CBC format. You
can use the -z option to configure different PBE protection schemes.

OPTIONS

Options are available in both a single-character form (such as -o) and a descriptive equivalent (--
option). Single characters are shown here. To view the descriptive equivalents, use the -h command
line option.

-`b bits`

  Specifies the key size used for generated keys. The default for RSA keys is 2048 bits and for
  DSA keys is 1024 bits. The value for a DSA key must be an integral multiple of 64. This option is
  valid for PKCS#10 file creation only.

-`c comment`

  Specifies a comment to include in the private key file. This option is valid for PKCS#10 file
  creation only.

-`d debug_level`

  Enables debug output. Use 1, 2, 3, or 99. (Values 4-98 are accepted, but are equivalent to 3.)

-`f`

  Enables FIPS mode. This mode forces all keys generated using ssh-certtool to meet FIPS
  standards, and ensures that any PKCS#10 certificate requests you create include keys that meet
  FIPS standards. Note: Using this option does not place any limits on keys included in PKCS#12
  packages.

-`h [action]`

  Displays a brief summary of command options. Specify an action (either pkcs10 or pkcs12) to
  see additional information about that action.

-`n algorithm`

  Specifies the algorithm used for key generation. Possible values are "rsa" and "dsa". The
  default is "rsa". This option is valid for PKCS#10 file creation only.
-o output_file_prefix
   Specifies the first portion of the filename for output files. You can include an absolute path to
generate the file in a different location. The default is "output". (The filename suffix is generated
based on the file type: the suffix for PKCS#10 files is .pkcs10, for PKCS#12 is .p12, and for
private keys is .ssh2.)

-p private_key
   Specifies a private key to use in a certificate request. This option is valid for PKCS#10 file
creation only.

-P
   Saves the private key with an empty passphrase. This option is valid for PKCS#10 file creation
only.

--passphrase passphrase
   Specifies a passphrase for the private key. This option is valid for PKCS#10 file creation only.

-V
   Displays product name and version information and exits. If other options are specified on the
command line, they are ignored.

-z Key=Value
   Specifies certificate options for PKCS#10 requests, and encryption options for PKCS#12
packages.

   For PKCS#10 requests, Key can be DNS, Email, UPN, or IP. Use these to set values for the
   corresponding extensions in the SubjectAltName field of the certificate. These extensions are
   not marked as critical. There should be no white space in this option, including before or after the
equal sign, unless the value literally contains white space characters in its name. For IP, specify
   any valid IPv4 or IPv6 address. You can configure multiple extensions, but you can only set one
   value for each extension type. To specify more than one extension, repeat the -z option. For
   example:
   
   -z Email=joe@microfocus.com -z IP=10.10.10.10

   For PKCS#12 packages, Key must be either KeyPBE or SafePBE (case-insensitive). There
   should be no whitespace in this option, including before or after the equal sign. KeyPBE sets the
   key encryption and hmac scheme. SafePBE sets the safe encryption and hmac scheme. Values
   are listed below. The default for KeyPBE is PBE-SHA1-3DES. The default for SafePBE is PBE-
   SHA1-RC2-40. The long names in parentheses are synonyms.

   None
   PBE-SHA1-RC4-128 (pbeWithSHA1And128BitRC4)
   PBE-SHA1-RC4-40 (pbeWithSHA1And40BitRC4)
   PBE-SHA1-3DES (pbeWithSHA1And3-KeyTripleDES-CBC)
   PBE-SHA1-2DES (pbeWithSHA1And2-KeyTripleDES-CBC)
   PBE-SHA1-RC2-128 (pbeWithSHA1And128BitRC2-CBC)
   PBE-SHA1-DES (pbeWithSHA1AndDES-CBC)
   PBE-SHA1-RC2-40 (pbeWithSHA1And40BitRC2-CBC)
   PBE-MD2-RC2-64 (pbeWithMD2AndRC2-CBC)
   PBE-MD5-RC2-64 (pbeWithMD5AndRC2-CBC)
EXAMPLES

To create a PKCS#10 request using a newly generated key:

```
ssh-certtool -n RSA -z DNS=steves.dns.server.com -z Email=steved@myorg.org pkcs10
  CN=steved,C=myorg.org,OU=rsit,C=US DigitalSignature,nonRepudiation
  ServerAuth,ClientAuth
```

To create a PKCS#12 package file and specify encryption for the key and safe:

```
ssh-certtool -z keyPBE=default -z safePBE=PBE-SHA1-RC4-40 -o file pkcs12 id_rsa.crt
id_rsa
```

winpki and pkid Command Reference

Use **winpki** (on Windows) or **pkid** (on UNIX systems) to configure, start, and stop the PKI Services Manager service, and to check certificate validity and allowed identities.

**Synopsis**

Windows: `winpki [command [command args]] [options...]`

UNIX: `pkid [command [command args]] [options...]`

command = start | stop | restart | reload | ping | validate <cert>


**Commands**

**start**

Starts the service.

**stop**

Stops the service.

**restart**

Stops and restarts the service.

**reload**

Reloads the configuration without stopping the service. Reloading the configuration also clears the internal in-memory caches used for downloading certificates and CRLs. Although certificate and CRL lifetimes are honored by the cache, it might be necessary to clear these manually if a certificate or CRL has been updated at its source before it has expired. Note: Most settings become available when you reload; however some settings require a restart.

**ping**

Displays service status and the port used by the service.

**validate certificate**

Validates a certificate and optionally provides information about allowed identities. The service must be running. For example, to determine if sample.crt is valid (UNIX syntax):

```
pkid validate sample.crt
```
Use -u, -t, or -w after the certificate name to get information about allowed identities for the specified certificate. For example, to determine if the user joe can authenticate using sample.cer (Windows syntax):

```
winpki validate sample.cer -u joe
```

**Options**

Both short (-b path) and long (--baseDir path) options are shown.

- **-b path** --**baseDir path**
  
  Specifies the data directory used for PKI Services Manager configuration.

- **-c cert** --**cert cert**
  
  Validates the specified certificate. This option is available when the service is not running. Use the `validate` command to validate certificates when the service is running.

- **-d level** --**debug level**
  
  Specifies the amount of information sent to the log. Allowed values are: 'error', 'warn', 'info', 'debug', and 'trace'. The default is 'error'.

- **-f file** --**config_file file**
  
  Launches using a non-default configuration file.

- **-h** --**help**
  
  Displays a brief summary of command options.

- **-i** --**init**
  
  This option is rarely needed. It initializes PKI Services Manager, which creates a key pair for the server, and creates user data directories and files. Initialization happens automatically during installation on UNIX systems and on first run on Windows systems. Using this option has no effect if your system is already initialized. Note: You can create new keys by deleting the existing keys (`pki_key` and `pki_key.pub`), and then using this option. Existing configuration files are not affected.

- **-k** --**check-config**
  
  Checks for errors in your configuration and map files and then quits.

- **-m path** --**migrate path**
  
  Migrates certificate authentication settings from Reflection and F-Secure configuration files. If `path` specifies a directory, PKI Services Manager looks for server (`sshd2_config`) and client (`ssh2_config`) configuration files in that directory and migrates settings from those files. If `path` specifies a file, PKI Services Manager migrates the settings in the specified file. Full path information is required for both files and directories. Note: If the `pki_config` file in the destination folder already has a trust anchor configured, no migration occurs. This helps ensure that the migration won't overwrite modifications you have already configured.

  Settings are migrated to the `pki_config` and `pki_map` files used by PKI Services Manager. If you use the -b switch, files with your migrated settings are created in the specified directory. If you omit this switch, the files are created in the default PKI Services Manager configuration directory.

  A migration log is created in the `logs` directory located in the PKI Services Manager data directory. By default, this log records at a level of 'info' which shows if errors or warnings occurred. The level can be elevated using -d.
-o key=value--option key=value

Sets any option that can be configured using a configuration file keyword. Options configured this way override configuration file settings. For a list of keywords and their meanings, see pki_config (page 159). Syntax alternatives are shown below. Use quotation marks to contain expressions that include spaces.

- o  key1=value
- o  key1="sample value"
- o  "key1 value"
- o  key=value1,value2
- o  key="value1, value2"

To configure multiple options, use multiple -o switches.

- o  key1=value - o  key2=value

-p --showkey

Displays the public fingerprint and shows the full path and key name.

Use this option after the certificate name following a validate command. PKI Services Manager reads the map file(s) and reports whether the specified host is an allowed identity for the host certificate being validated.

-t host--hostName host

Use this option after the certificate name following a validate command. PKI Services Manager reads the map file(s) and reports whether the specified host is an allowed identity for the host certificate being validated.

-u user--userID user

Use this option after the certificate name following a validate command. PKI Services Manager reads the map file(s) and reports whether the specified user is an allowed identity for the user certificate being validated. If you include a server name (in the form user@server), PKI Services Manager reports on whether the user is allowed to authenticate to the specified server. If you specify only a user name, PKI Services Manager tests whether the user is allowed to authenticate with this certificate without checking for host-specific conditions.

-V --version

Displays the product name and version.

-w [host] --whoAmI [host]

Use this option after the certificate name following a validate command. PKI Services Manager reads the identity map file(s) and returns a list of all allowed identities for the certificate being authenticated. If you specify a server name after this option, the list is limited to allowed users for connections to that server. If no server name is specified, PKI Services Manager doesn't check for server-specific conditions.

pkid_config Configuration File Reference

The Reflection PKI Services Manager console saves settings to the configuration file. You can also view and edit this file manually. The default file location is:

- UNIX

/opt/attachmate/pkid/config/pki_config
• Windows:
  \\ProgramData\Attachmate\ReflectionPKI\config\pki_config

File Format

The configuration file consists of keywords followed by values. The value can be separated from the
keyword by tabs, spaces, or spaces and one '='. Any line starting with a pound sign (#) is a comment.
Any empty line is ignored. Some keywords can appear multiple times, and these settings are applied
cumulatively. Changes to settings do not take effect until you reload the settings or restart the service.
(If a restart is required, that information is given in the keyword description.)

The file includes a global section that contains settings that apply to all validation queries. You can
also create stanzas that configure certificate-specific settings. The TrustAnchor keyword marks the
beginning of each trust anchor stanza. Settings beneath the TrustAnchor keyword apply only to that
trust anchor. The stanza ends at the next TrustAnchor keyword.

Some settings must be configured outside any trust anchor stanzas. These settings apply to all
validation queries. Where a setting is supported both globally and within a stanza, the value within the
trust anchor stanza overrides the global value.

Keywords

AllowClientStats
  Specifies whether PKI Services Manager allows clients to request PKI Services Manager
  runtime statistics. Configure this keyword once, outside any stanza. The allowed values are 'yes'
  and 'no'. The default is 'yes'.

AllowVers1
  Specifies whether PKI Services Manager allows version 1 certificates for a trust anchor. Note:
  Intermediate certificates must be version 3 regardless of the value of this setting. Configure this
  keyword once, outside any stanza. The allowed values are 'yes' and 'no'. The default is 'no'.

AllowWhoAmI
  Specifies whether PKI Services Manager allows a client to query for the mapped identity (using -w
  or --whoAmI) when using PKI Services Manager to validate certificates. Configure this
  keyword once, outside any stanza. The allowed values are 'yes' and 'no'. The default is 'yes'.

CertSearchOrder
  A comma-separated list that specifies where PKI Services Manager searches for intermediate
certificates required to validate a certificate. Listed locations are searched in order. The options
  are 'local', 'certserver', 'aia', and 'windows'. The default is 'local, certserver,' (Note: If you select
  'windows', PKI Services Manager uses only those certificates that are installed for use by the
  local computer, not certificates installed for the current user. To view and manage the local
  computer certificates, use the Microsoft Management Console. Add the Certificates Snap-in and
  configure it to manage certificates for the computer account.) Configure this keyword once,
  outside any stanza.

CertServers
  Specifies a server from which PKI Services Manager can retrieve intermediate certificates when
  'certserver' is included in the CertSearchOrder list. You can specify either an HTTP or an LDAP
  server. (For example: ldap://certserver:10389 or http://certserver:1080) This keyword
can be configured multiple times outside any stanza. The values are cumulative.
CRLServers
Specifies a server from which PKI Services Manager can retrieve Certificate Revocation Lists (CRLs) when 'crlserver' is included in the RevocationCheckOrder list. You can specify either an HTTP or an LDAP server. (For example: ldap://crlserver:10389 or http://crlserver:1080.) This keyword can be configured multiple times outside of any stanza and multiple times per stanza. The values are cumulative.

ClientDebugging
Specifies whether the application that is requesting certificate validation can request and receive debug messages from PKI Services Manager. Configure this keyword once, outside any stanza. The allowed values are 'yes' and 'no'. The default is 'no'. Note: To view these messages you also need to set a sufficiently detailed debug level in the calling application. For the Reflection for Secure IT Server for Windows, specify "Protocol details" or higher. For the Reflection for Secure IT Client and Server for UNIX, specify debug level 3 or higher.

EnforceDODPKI
Determines whether PKI Services Manager enforces settings that meet US Department of Defense PKI requirements. The allowed values are 'yes' and 'no'. The default is 'no'. When this setting is 'yes', the service will not start unless the following conditions are met: FipsMode = yes; AllowVers1 = no; CertSearchOrder does not include 'windows'; and RevocationCheckOrder has at least one option specified and does not include 'none'.

ExplicitPolicy
Determines whether PKI Services Manager enforces application policies. This keyword can be configured once outside of any stanza and once per stanza. The allowed values are 'yes' and 'no'. The default is 'no'. If the value is 'yes' you must specify one or more application policies to be enforced using the PolicyOID keyword. Each application policy is specified with a Policy Identifier (OID). (Note: Policies may also be required by the certificate being presented or by a certificate within the chain of trust.)

FipsMode
Enforces security protocols and algorithms that meet FIPS 140-2 standards. The allowed values are 'yes' and 'no'. The default is 'yes'. Configure this keyword once, outside any stanza. You need to restart the service if you modify this setting.

KeyFilePath
Specifies the path to the private key used to identify Reflection PKI Services Manager. When no path is specified, the path or file name is relative to the PKI Services Manager configuration directory. Configure this keyword once, outside any stanza. This setting is required. If KeyFilePath is not specified, or no key is present, the PKI Services Manager service will not start. The default is 'pki_key'. You need to restart the service if you modify this setting. PKI Services Manager creates a key pair when it initializes the settings, but you can also use a key pair created by ssh-keygen (or another tool). Only RSA keys are allowed.

ListenAddress
Specifies the port on which PKI Services Manager listens for validation requests. The syntax is host:port. You can specify the host name using either an IP address or a host name. IP addresses can be in either IPv4 or IPv6 format. IPv6 addresses must be enclosed in square brackets, for example [:D155:AB63]:18081. The default is 0.0.0.0:18081, which configures the server to listen on port 18081 using all available network adapters. This setting is required. You need to restart the service if you modify this setting.
LocalStore
The local store is used to hold items that are required for certificate validation. Depending on your configuration, this may include trusted root certificates, intermediate certificates, and/or Certificate Revocation Lists (CRLs). You can specify directories or files. When a directory is specified, all files in the specified directory and any subdirectories are included in the store. Files must be binary or base 64 encoded X.509 certificates or CRLs. This keyword can be configured multiple times outside any stanza. The values are cumulative. This setting is required.

LogFacility
Specifies the output location for log messages. Allowed values are 'file' and 'none'. The default is 'file'. Log files are created daily and saved to a directory called logs located in the PKI Services Manager data directory. Configure this keyword once, outside any stanza. You need to restart the service if you modify this setting.

LogLevel
Specifies the amount of information sent to the log. Allowed values are: 'error', 'warn', 'info', 'debug', and 'trace'. The log can contain both auditing messages (labeled "[audit]"), and debug messages (labeled "[debug]"). Auditing messages provide information about both successful and unsuccessful validation attempts. Debug messages are designed to help in troubleshooting. The default log level is 'error'. At this level, auditing messages are sent to the log, but debug messages are sent only if a PKI Services Manager error occurs, generally because PKI Services Manager is not correctly configured. The other options include audit messages plus increasing levels of detail in the debug messages. Configure this keyword once, outside any stanza.

MapFile
Specifies the location of the PKI Services Manager map file. Use the map file to configure which users or computers are allowed to authenticate with a valid certificate. When no path is specified, the path or file name is relative to the PKI Services Manager configuration directory. This setting is required. This keyword can be configured once outside of any stanza and once per stanza.

MaxLogFiles
Specifies the maximum number of log files to create. A new log file is automatically created daily. When the maximum is reached, the oldest log is removed. The default is 10. Configure this keyword once, outside any stanza. You need to restart the service if you modify this setting.

NetworkTimeout
Specifies the timeout for any network download: LDAP, HTTP, or OCSP. Units are milliseconds. The default is 20000. Configure this keyword once, outside any stanza.

OCSPCertificate
Specifies a certificate that can be used to verify the signature of the OCSP response. This is needed only if the OCSP response does not include the signer's certificate. The value can be either a certificate file or the Subject value of the certificate (for example OcspCertificate = "CN = Secure CA, O = Secure Corporation, C = US"). If you use the Subject value, the certificate must be in the local store. This keyword can be configured multiple times outside of any stanza and multiple times per stanza. The values are cumulative.

OCSPResponders
Specifies the address of an OCSP responder to use for checking certificate revocation when 'ocsp' is included in the RevocationCheckOrder list. Use an HTTP address to identify the responder. (For example: http://ocsp.myhost.com:1080.) This keyword can be configured multiple times outside of any stanza and multiple times per stanza. The values are cumulative.
**PolicyOID**

Specifies an allowed Policy Identifier (OID) to use when application policies are in force, either because `ExplicitPolicy` is 'yes' or because policies are required by the certificate being presented or by a certificate within the chain of trust. When `ExplicitPolicy` is 'yes', the specified OID must match at least one of the OIDs in the final policy set of the certificate chain. The value 2.5.29.32.0 allows use of any Policy Identifier. (Note: The default value is 'no-policy'. When `ExplicitPolicy` is set to 'yes', you must change `PolicyOID` to indicate which policy or policies are allowed; if `ExplicitPolicy` is set to 'yes' and `PolicyOID` is set to 'no-policy', no certificate can pass validation.) This keyword can be configured multiple times both outside any stanza and within a stanza. Configured values are cumulative.

**RevocationCheckOrder**

A comma-separated list that specifies which sources are used to check for certificate revocation and the order in which these checks occur. The options are 'ocsp', 'cdp', 'crlserver', 'local', and 'none'. The default is 'local'. Note: If you specify just 'none', no revocation checking occurs. If you specify 'none' with other options, PKI Services Manager attempts to determine the revocation status using the specified options until it reaches 'none'. If the certificate revocation status is still unknown at this point, authentication is allowed. This keyword can be configured once outside of any stanza and once per stanza.

**StrictMode**

Specifies whether strict checking rules (as defined in RFC 3280) are used when validating certificates. Many certificates cannot pass strict checks. The allowed values are 'yes' and 'no'. The default is 'no'. This keyword can be configured once outside of any stanza and once per stanza.

**TrustAnchor**

Specifies a certificate to use as the final trust point in a certificate chain of trust that Reflection for Secure IT validates. This can be an intermediate CA certificate, a root CA certificate, or a self-signed certificate (which can only validate itself). It can not be a user certificate or host certificate. The value can be either a certificate filename or the contents of the Subject field defined in the certificate (for example `TrustAnchor = "CN = Secure CA, O = Secure Corporation, C = US"`). If you specify a certificate filename and include full path information, the trust anchor is used regardless of how you configure the `CertSearchOrder` keyword. If you specify a certificate filename without including full path information, `CertSearchOrder` must include 'local'; and PKI Services Manager looks for the certificate in your local store. If you specify the contents of the certificate's Subject field, `CertSearchOrder` must include 'local' and/or 'windows'; and PKI Services Manager looks for the certificate in your local store and/or Windows certificate store. This setting is required. To configure multiple trust anchors, add additional `TrustAnchor` lines.

Note: On Windows systems, you can view the Subject value of certificates in your store using the PKI Services Manager console. On UNIX systems, you can use `ssh-certview(1)` to view this information.

Any keywords under a `TrustAnchor` setting create a stanza. The values you configure within a trust anchor stanza are specific to that trust anchor.

**pki_mapfile Map File Reference**

Reflection PKI Services Manager mapping binds certificates to one or more allowed identities using mapping rules. Typically, allowed identities are users or hosts. For SSH connections, to authenticate a user correctly, you need to define a rule that links information in the validated certificate to an allowed user account. The mapper provides flexible options for mapping certificates to names. You
can specify allowed names explicitly in your rules, or define rules that extract information, such as user or host name, from a certificate. By using these options, you can bind identities to certificates without having to create a separate rule for each certificate. Some PKI Services Manager client applications, including Reflection Security Gateway, use PKI Services Manager for certificate validation only, and do not require any identity mapping.

The default map filename and location is:

- UNIX
  /opt/attachmate/pkid/config/pki_mapfile
- Windows:
  \ProgramData\Attachmate\ReflectionPKI\config\pki_mapfile

**NOTE:** On Windows systems, you can modify the map file from the Reflection PKI Services Manager console using the **Identity Mapper** pane.

**File Format**

The map file consists of keyword settings and rules. Each rule is a single line and is independent of other rules. The format of a rule is:

```
{ Allowed-Identity } [ Conditional Expression ]
```

After a certificate is determined to be valid, rules are processed in order (based on rule type then sequence). If the certificate meets the requirements defined in the conditional expression (or if the rule has no condition), the allowed identities specified in that rule are allowed to authenticate. No additional rules are applied after the first match.

Within the map file, you can use the **RuleType** keyword to apply different mapping criteria based on whether a user or host presents the certificate. Note: Rule type determines the order in which rules are processed. The order for processing user certificates is: user-address, user, none. The order for processing host certificates is: host, none. Within each rule type, rules are processed in order from top to bottom.

**Allowed Identity Set**

The allowed identity set is a required component of a rule. Allowed identities can be specified using a combination of constant values and values extracted from the certificate. The set of allowed identities can take multiple constant values, extracted values, or a combination of both. The identity mapping requirements for PKI Services Manager clients vary. For example: The Reflection for Secure IT server supports multiple formats for specifying domain user names in map rules. The Reflection for Secure IT User Manager requires that only one user be allowed for any valid certificate. For additional information refer to information about configuring validation using Reflection for Secure IT in your product documentation.

**Using constant values to define allowed identities**

Constant values are literal strings. Use white space to delimit separate values. (If an allowed name includes spaces, enclose it in quotes.) For example, the following rule uses literal strings to allow root, joe, and fred smith to authenticate with any valid certificate:

```
{ root joe "fred smith" }
```
NOTE: After PKI Services Manager determines that a certificate meets the condition defined in a rule, rule processing stops. In the example above, no conditions are defined. This means the rule will be applied to any valid certificate and no subsequent rules will be processed. To create a similar rule, you would need to include all allowed identities within the same rule.

Two asterisks used alone { ** } act as a wildcard for defining the allowed identity set. This option may be useful for testing, but should otherwise be used only with extreme caution. If you use this wildcard in a user rule, any user presenting a valid certificate is allowed to authenticate to any user account on the server. This creates a major security risk by allowing access to accounts with root, administrator, or power user privileges without requiring a password. If you use this wildcard in a host rule, any server with a valid certificate is accepted by the client. If you do choose to use the wildcard, consider limiting access using other options:

- Use the wildcard only with certificates signed by Certification Authorities that you control.
- Use the wildcard only in rules that have very restrictive conditions.
- Use the wildcard only in server-specific user rules (those whose RuleType is user-address).
- Limit user account access on the server side. For example, on a Secure Shell server, you might define sftp chroot jails and allow no command shell or remote command access.

Using values extracted from the certificate

Use extracted values to construct the allowed identity set based on the contents of the certificate presented for authentication. Extracted values must be preceded and followed by "%". For example, to allow authentication by the host specified in the Host portion of the UPN field:

{ %UPN.Host% }

You can also combine literal strings with extracted identities. (You can prepend a literal string to an extracted identity, and/or append a literal string, but you cannot combine more than one extracted value to form a single identity.) The following example adds a Windows domain name to an extracted user identity:

{ windomain\%UPN.User% }

Note: If the extracted identity evaluates to an empty result, the entire concatenated string is deemed to be empty and is not included in the set of allowed identities. If the entire set of allowed identities is empty, the rule is deemed to have failed and processing continues to the next rule.

Supported certificate fields are:

**Subject**

The Subject field defined in the certificate. The comparison is done following X.500 rules (not as a string comparison). For a successful match, the format must follow standards described in RFC 2253. To be compliant with this standard, Subject and Issuer fields start with the Common Name (for example, "CN = Secure CA, O = Secure Corporation, C = US"). On UNIX systems, you can use the ssh-certview utility to obtain the Subject value in this format. On Windows systems, copy the Subject contents from the Details tab of the certificate viewer, paste to an editor, and then replace new line characters with commas.

**Subject.CN**

The Common Name portion of the Subject field, if present.

**Subject.Email**

The email attribute part of the Subject, if present.
DNS
The DNS part of a SubjectAltName, if present.

IPAddress
The IP Address part of a SubjectAltName, if present. (PKI Services Manager version 1.2 and later.)

UPN
The "otherName" representation of the SubjectAltName field, with the OID of 1.3.6.1.4.1.311.20.2.3 (UPN OID), if present.

UPN.User
The userID portion of the UPN field.

UPN.Host
The host portion of the UPN field.

Email
The representation of SubjectAltName as defined in RFC 822.

Email.User
The userID portion of Email.

Email.Host
The host portion of Email.

SerialAndIssuer
The certificate serial number (hex encoded) and value of the certificate's Issuer field in this format:

<serial_number> Issuer
Use white space to separate the serial number from the issuer. For example:

461D07A8 CN = Secure CA, O = Secure Corporation, C = US

Cert
This indicates the entire certificate. The Operation must be Equals and the argument must be a file path to a certificate. Note: The Mapper does not use the certificate store defined by Reflection PKI Services Manager.

subst
This option is available when the conditional expression within a rule uses either Regex or Extern.

With Regex, use subst in combination with any regular expression that has a capturing group, which has been identified using round brackets (). If the regular expression includes an exact match to a specified certificate field, the value of the first capturing group in the expression replaces %subst% in the allowed identity set.

With Extern, use subst as a placeholder for the value returned by the external application.
Conditional Expression

When a conditional expression follows the {Allowed-Identity}, the allowed identities can authenticate only if the conditional expression is true. The use of a conditional expression is optional, but in most cases is recommended. If no conditional expression is included, the allowed identities can authenticate with any valid certificate.

After a certificate is determined to be valid, rules are processed in order (based on rule type then sequence). If the certificate meets the requirements defined in the conditional expression (or if the rule has no condition), the allowed identities specified in that rule are allowed to authenticate. No additional rules are applied after the first match.

The syntax for a conditional expression is:

Field Operation Argument

For Field, specify any of these supported certificate fields (described above): Subject, Subject.CN, Subject.Email, DNS, IPAddress, UPN, UPN.User, UPN.Host, Email, Email.Host, SerialAndIssuer, Cert, or subst.

For Argument, specify a string value.

For Operation, use one of the following:

Equals
Checks for absolute equality between the Field value and the Argument string. For DNS, UPN and Email options, the comparison is case-insensitive.

Contains
Checks if the Field value is contained anywhere within the Argument string. For DNS, UPN and Email options, the comparison is case-insensitive.

Regex
Applies the Argument as a regular expression to the Field. If the regular expression includes an exact match to the Field contents, the condition is true. If the set of allowed identities contains the string %subst%, the first capturing group (if defined) of the Regex match is inserted.

Extern
Uses an external application to test the condition. Use Argument to point to the application. Use %subst% in the allowed identity set as a placeholder for the value returned by the external application. PKI Services Manager sends the Field value you specify to the external application. If the test within the external application is successful, it should exit with status 0; a non-zero return means an unsuccessful match.

If the Field value you specify is Cert, PKI Services Manager passes two arguments to your external application. The first contains the contents of the certificate in PEM format (text). The second argument contains the path to a temporary file that contains a copy of the certificate in DER format (binary). PKI Services Manager deletes the temporary DER formatted certificate when the external application exits.

Sample rules with conditional expressions:

{ %UPN.Email% } Subject.CN Equals acme.com

{ joep } Subject Contains "Joe Plumber"
Rule Type Stanzas

Rule types apply different mapping criteria based on whether the validated certificate is a user certificate or a host certificate. Use the RuleType keyword to create a new stanza for each supported type. A stanza ends at the next RuleType keyword or the end of the file. The format is:

```
RuleType type
```

Valid rule types are:

- **none**
  The rule applies to both hosts and user certificates.

- **host**
  The rule applies to host certificates only.

- **user**
  The rule applies to user certificates only.

- **user-address= server**
  The rule applies only to user certificates authenticating to the specified server. Note: When PKI Services Manager evaluates a user-address rule, it uses the server name (not the DNS host name) of the server the user is connecting to. The server sends its name to PKI Services Manager when it requests validation of a user certificate, and PKI Services Manager uses that name when applying the user-address rule. To determine the host name that is sent, you can enter the `hostname` command from a Windows DOS window or from a UNIX terminal session.
  
  For example, to create rules that apply only to users connecting to the server acme:

  ```
  RuleType user-address=acme
  ```

  Note: Rule type determines the order in which rules are processed. The order for processing user certificates is: user-address, user, none. The order for processing host certificates is: host, none. Within each rule type, rules are processed in order from top to bottom.

Keywords

**DynamicFile**

Specifies whether PKI Services Manager reloads the map file every time it checks for allowed identities. The allowed values are 'yes' and 'no'. The default is 'no'.

**ExternTimeout**

Sets the timeout for rules that use the Extern option. The default is 0 (zero), which sets no time out.

**RuleType**

Marks the beginning of a rule type stanza, which can be used to apply different mapping criteria based on whether a user or host presents the certificate. The allowed values are 'user', 'host', 'none', and 'user-address = server'. The default is 'none'.
Sample Mapping Rules

<table>
<thead>
<tr>
<th>Rule</th>
<th>What happens</th>
</tr>
</thead>
<tbody>
<tr>
<td>{ guest }</td>
<td>Because no condition is included, all valid certificates are mapped to the user &quot;guest&quot;. This can serve as a default rule. A rule like this should go at the end of the rule list to ensure that all other rules are processed first.</td>
</tr>
<tr>
<td>{ fred.jones } UPN.user Equals &quot;fred&quot;</td>
<td>If the UPN representation of SubjectAltName is present, and the user part is equal to &quot;fred&quot;, the set of allowed identities is fred.jones.</td>
</tr>
<tr>
<td>{ %UPN.user% } UPN.host Equals &quot;acme.com&quot;</td>
<td>If a certificate has a UPN representation of SubjectAltName, and the host name part is &quot;acme.com&quot;, the user name part of the UPN is returned as the set of allowed identities.</td>
</tr>
<tr>
<td>{ guest %UPN.user% }</td>
<td>If the UPN is set, the user part is included in the set of allowed identities (along with &quot;guest&quot;). Otherwise the set of allowed identities is &quot;guest&quot;. Because there is no condition, this rule applies to any valid certificate.</td>
</tr>
<tr>
<td>{ fred root } Subject.CN Contains &quot;Fred Jones&quot;</td>
<td>If the CN of the certificate contains &quot;Fred Jones&quot;, the set of allowed identities has two values: &quot;fred&quot; and &quot;root&quot;.</td>
</tr>
<tr>
<td>{ %subst% } Subject.CN Regex [a-zA-Z.]*([0-9]+)</td>
<td>Sets the allowed identity equal to the first numerical string within the common name portion of the Subject field. For example, if the CN is &quot;joe.smith.12345&quot;, the allowed identity is set to &quot;12345&quot;.</td>
</tr>
<tr>
<td>{ elmer.foo.com } Subject.CN Contains &quot;elmer&quot;</td>
<td>Sets the allowed identity to the fully-qualified domain name &quot;elmer.foo.com&quot; from a certificate that contains the short name &quot;elmer&quot;.</td>
</tr>
<tr>
<td>{ bob } Cert Equals /temp/certs/bob_cert.crt</td>
<td>Compares the incoming certificate to the one locally stored. If they are equal, the allowed identity set is &quot;bob&quot;.</td>
</tr>
<tr>
<td>{ %subst% } Cert Extern /bin/myapp</td>
<td>PKI Services Manager sends two values to the application &quot;/bin/myapp&quot;. The first argument contains the contents of the certificate in PEM format (text). The second contains the path to a temporary file that contains a copy of the certificate in DER format (binary). The external application can be configured to use either of these formats. If the exit code of the called application equals 0, the allowed identity is set equal to the returned result.</td>
</tr>
</tbody>
</table>
Sample Map File with RuleType Stanzas

RuleType user
# the following rules are evaluated for user certificates only:
{ scott } Subject.CN Contains acme
{ joe } Subject.CN Equals acme
{ guest }
RuleType host
# The following rule is evaluated for host certificates only:
{ elmer.acme } Subject.CN Contains elmer
RuleType user-address=myserver
# The following rule is evaluated only when myserver
# requests validation of a user certificate:
{ good %subst% } Regex UPN "([A-Za-z0-9\-\.]@[^.]+)" RuleType none
# "none" is the default if no RuleType is specified.
# If no rule is successfully applied from "user" or "host",
# this rule is evaluated.
{ good } SerialandIssuer contains 123 Subject.CN=foo

PKI Settings Migration

Review the information below if you configured certificate authentication using Reflection for Secure IT 6.x or F-Secure. Some certificate settings continue to be supported in Reflection for Secure IT, Client and Server for UNIX settings files. Others need to be migrated to the Reflection PKI Services Manager settings file. You can use the pkid command with the -m option to migrate settings from Reflection for Secure IT 6.x or F-Secure settings files.

NOTE: For details about the -m option, refer to the pkid command reference (page 157).

The following tables summarize how prior versions settings are handled. The entries under Status describe the effect of prior version keywords in your current version settings files. These entries have the following meanings:

- Supported: The keyword has the same meaning as it did in prior versions.
- Deprecated: The keyword continues to have an effect, but it's meaning may have changed.
- Ignored: The keyword has no effect in current Reflection for Secure IT settings file. These settings need to be migrated to PKI Services Manager settings files. Refer to the migration log for additional information.

- Not supported: The keyword cannot be used in current version settings files. It has no meaning and causes an error if present.

### Client Settings

<table>
<thead>
<tr>
<th>Prior version keyword</th>
<th>Status</th>
<th>Migrated?</th>
<th>Equivalent PKI Services Manager keyword</th>
</tr>
</thead>
<tbody>
<tr>
<td>HostCA</td>
<td>Not supported</td>
<td>No</td>
<td>TrustAnchor</td>
</tr>
<tr>
<td>HostCANoCRLs</td>
<td>Not supported</td>
<td>No</td>
<td>TrustAnchor RevocationCheckOrder = none</td>
</tr>
<tr>
<td>HostCertNameCheck</td>
<td>Supported</td>
<td>No</td>
<td>--</td>
</tr>
<tr>
<td>LDAPServers</td>
<td>Ignored</td>
<td>Yes</td>
<td>CertServers</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CRLServers (All servers are migrated to both keywords)</td>
</tr>
<tr>
<td>LocalPKI</td>
<td>Ignored</td>
<td>Yes</td>
<td>LocalStore</td>
</tr>
<tr>
<td>OCSPResponder</td>
<td>Ignored</td>
<td>Yes</td>
<td>OCSPResponders</td>
</tr>
<tr>
<td>RevocationChecks</td>
<td>Ignored</td>
<td>Yes</td>
<td>RevocationCheckOrder</td>
</tr>
<tr>
<td>RevocationCA</td>
<td>Ignored</td>
<td>Yes</td>
<td>OcspCertificate</td>
</tr>
</tbody>
</table>

### Server Settings

<table>
<thead>
<tr>
<th>Prior version keyword</th>
<th>Status</th>
<th>Migrated?</th>
<th>Equivalent PKI Services Manager keyword</th>
</tr>
</thead>
<tbody>
<tr>
<td>HostCertificateFile</td>
<td>Supported</td>
<td>No</td>
<td>--</td>
</tr>
<tr>
<td>DynamicMapFile</td>
<td>Ignored</td>
<td>Yes</td>
<td>DynamicFile (This keyword is configured in pki_mapfile.)</td>
</tr>
<tr>
<td>ExternalMapper</td>
<td>Ignored</td>
<td>Yes</td>
<td>Supported in map file rules by using the Extern option in the conditional expression.</td>
</tr>
<tr>
<td>ExternalMapperTimeout</td>
<td>Ignored</td>
<td>Yes</td>
<td>ExternTimeout (This keyword is configured in pki_mapfile.)</td>
</tr>
<tr>
<td>LDAPServers</td>
<td>Ignored</td>
<td>Yes</td>
<td>CertServers (All servers are migrated to both keywords)</td>
</tr>
<tr>
<td>LocalPKI</td>
<td>Ignored</td>
<td>Yes</td>
<td>LocalStore</td>
</tr>
<tr>
<td>OCSPResponder</td>
<td>Ignored</td>
<td>Yes</td>
<td>OCSPResponders</td>
</tr>
<tr>
<td>RevocationChecks</td>
<td>Ignored</td>
<td>Yes</td>
<td>RevocationCheckOrder</td>
</tr>
</tbody>
</table>
PKI Services Manager Return Codes

Reflection PKI Services Manager returns the following codes to the application requesting validation services.

- Code 0 = No errors, successful validation.
- Codes 1-10 = Command-line errors, either with `winpki` or `pkid`.
- Codes 11-19 = Network or protocol errors.
- Codes 21-29 = Validation errors.
- Codes 31-39 = Mapper errors (certificate is valid but could not be mapped).
- Codes 41-49 = CRL or other revocation errors.

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No errors.</td>
</tr>
<tr>
<td>1</td>
<td>General error, unknown cause.</td>
</tr>
<tr>
<td>2</td>
<td>Syntax error with the command, improper arguments.</td>
</tr>
<tr>
<td>3</td>
<td>PKI Services Manager is already running.</td>
</tr>
<tr>
<td>4</td>
<td>Error in the configuration file.</td>
</tr>
<tr>
<td>5</td>
<td>Timeout occurred while executing the command.</td>
</tr>
<tr>
<td>6</td>
<td>Network error (for example, cannot connect to PKI Services Manager).</td>
</tr>
<tr>
<td>7</td>
<td>Access denied, user does not have permission to run the command.</td>
</tr>
<tr>
<td>8</td>
<td>System error. This is an internal error. Re-run with --d switch to see what happened.</td>
</tr>
<tr>
<td>9</td>
<td>Migration or initialization failed. See migration error log.</td>
</tr>
<tr>
<td>11</td>
<td>Unknown command was requested by the calling application.</td>
</tr>
<tr>
<td>12</td>
<td>An exception was thrown by PKI Services Manager. For more information, see the PKI Services Manager event log.</td>
</tr>
<tr>
<td>13</td>
<td>Syntax error with the command or packet sent to PKI Services Manager.</td>
</tr>
<tr>
<td>14</td>
<td>Command was ignored (not currently used, internal error).</td>
</tr>
<tr>
<td>Code</td>
<td>Meaning</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
</tr>
<tr>
<td>15</td>
<td>Processing error. The certificate sent to PKI Services Manager is not encoded correctly.</td>
</tr>
<tr>
<td>16</td>
<td>Command failed (commands are: stop, reload, reconfigure).</td>
</tr>
<tr>
<td>17</td>
<td>Signature mismatch. Sender did not sign with a matching key.</td>
</tr>
<tr>
<td>18</td>
<td>Format error. The ASN protocol was not properly formatted</td>
</tr>
<tr>
<td>19</td>
<td>PKI Services Manager is in FIPS mode and the certificate is not valid in that mode</td>
</tr>
<tr>
<td>21</td>
<td>Certificate is invalid (expired, not signed, bad key, etc.)</td>
</tr>
<tr>
<td>22</td>
<td>No path. The issuing certificate could not be located.</td>
</tr>
<tr>
<td>23</td>
<td>Certificate is revoked.</td>
</tr>
<tr>
<td>24</td>
<td>No trust anchor. The path did not terminate to a known trust anchor.</td>
</tr>
<tr>
<td>25</td>
<td>Other validation error. Policy or other constraints failed.</td>
</tr>
<tr>
<td>26</td>
<td>Path length to the end certificate exceeded the CA path length constraint.</td>
</tr>
<tr>
<td>27</td>
<td>Certificate policy is invalid or does not match assertions in effect.</td>
</tr>
<tr>
<td>28</td>
<td>Invalid certificate signature.</td>
</tr>
<tr>
<td>29</td>
<td>Unknown critical extension was encountered in a certificate or CRL.</td>
</tr>
<tr>
<td>31</td>
<td>Identity requested did not match allowed identities.</td>
</tr>
<tr>
<td>32</td>
<td>No identities are allowed for this certificate (no maps exist that match).</td>
</tr>
<tr>
<td>33</td>
<td>Calling application did not send an identity for matching (client-side error).</td>
</tr>
<tr>
<td>34</td>
<td>Certificate is valid, but requested WhoAmI processing</td>
</tr>
<tr>
<td>41</td>
<td>Unknown CRL processing error</td>
</tr>
<tr>
<td>42</td>
<td>No base for a delta CRL.</td>
</tr>
<tr>
<td>43</td>
<td>CRL has expired.</td>
</tr>
<tr>
<td>44</td>
<td>Cannot verify signature or it is bad.</td>
</tr>
<tr>
<td>45</td>
<td>Unknown CRL extension that is marked critical.</td>
</tr>
<tr>
<td>46</td>
<td>Mismatch of IDP field in CRL.</td>
</tr>
<tr>
<td>47</td>
<td>No CRL available.</td>
</tr>
</tbody>
</table>
Glossary of Terms

**authentication.** The process of reliably determining the identity of a communicating party. Identity can be proven by something you know (such as a password), something you have (such as a private key or token), or something intrinsic about you (such as a fingerprint).

**bandwidth.** The rate of transmission of data across the network; the maximum amount of information (Kbits/second or Mbits/second) that can be transmitted along a channel.

**cipher.** A cipher is an encryption algorithm. The cipher you select determines which mathematical algorithm is used to obscure the data being sent after a successful Secure Shell connection has been established.

**data integrity.** The assurance that data has not been changed from its original source. Methods to preserve data integrity are designed to ensure that data has not been accidentally or maliciously modified, altered or destroyed.

**digital signature.** Used to confirm the authenticity and integrity of a transmitted message. Typically, the sender holds the private key of a public/private key pair and the recipient holds the public key. To create the signature, the sender computes a hash from the message, and then encrypts this value with its private key. The recipient decrypts the signature using the sender's public key, and independently computes the hash of the received message. If the decrypted and calculated values match, the recipient trusts that the sender holds the private key, and that the message has not been altered in transit.

**encryption.** Encryption is the process of scrambling data by use of a secret code or cipher so that it is unreadable except by authorized users. Encrypted data is far more secure than unencrypted data.

**GSSAPI (Generic Security Services Application Program Interface).** An application programming interface that provides programs with access to security services.

**hash.** Also called a message digest, a hash or hash value is a fixed-length number generated from variable-length digital data. The hash is substantially smaller than the original data, and is generated by a formula in such a way that it is statistically unlikely that some other data will produce the same hash value.

**Kerberos.** A protocol that uses a trusted third party to enable secure communications over a TCP/IP network. The protocol uses encrypted tickets rather than plain-text passwords for secure network authentication.

**latency.** The time delay between when an action is initiated and when its effect is detectable. In a network, a delay in the reception of data packets can be caused by several factors, such as the transmission medium, and the number of network devices between the sending and receiving points. In general, the greater the physical distance between your workstation and your host, the greater the chance of encountering latency.

**MAC (Message Authentication Code).** Used to verify that data is not changed in transit, a MAC is a hash created using an arbitrary-length packet of data and a shared secret key. The sending and receiving party compute the MAC independently for each packet of transferred data using the shared key and an agreed-upon algorithm. If the message has changed in transit, the hash values are different and the packet is rejected.
passphrase. A passphrase is similar to a password, except it can be a phrase with a series of words, punctuation, numbers, white space, or any string of characters. Passphrases improve security by limiting access to secure objects, such as private keys and/or a key agent.

PKCS. PKCS (Public Key Cryptography Standards) is a set of standards devised and published by RSA laboratories that enable compatibility among public key cryptography implementations. Different PKCS standards identify specifications for particular cryptographic uses. Reflection for Secure IT, Client and Server for UNIX uses the following PKCS standards:

- PKCS#7 can be used to sign and/or encrypt messages. It can also be used to store certificates and to disseminate certificates (for instance as a response to a PKCS#10 message). You can use ssh-keygen to extract certificates from a PKCS#7 file.
- PKCS#10 is used for certificate requests to a Certificate Authority (CA). You can use ssh-certtool to create PKCS#10 files.
- PKCS#12 is used for storage and transportation of certificates and associated private keys. Files in this format typically use a *.pfx or *.p12 extension. Reflection for Secure IT supports authentication using certificates and keys stored in this format.

port forwarding. A way to redirect unsecured traffic through a secure SSH tunnel. Two types of port forwarding are available: local and remote. Local (also called outgoing) port forwarding sends outgoing data sent from a specified local port through the secure channel to a specified remote port. You can configure a client application to exchange data securely with a server by configuring the client to connect to the redirected port instead of directly to the computer running the associated server. Remote (also called incoming) port forwarding sends incoming data from a specified remote port through the secure channel to a specified local port.

public key/private key. Public keys and private keys are pairs of cryptographic keys that are used to encrypt or decrypt data. Data encrypted with the public key can only be decrypted with the private key; and data encrypted with the private key can only be decrypted with the public key.

regular expression. Often abbreviated as regex, a regular expression is a string of characters that describes one or more matching strings. Within a regular expression, some characters have a predefined meaning that determines what qualifies as a match. For example, the regular expression "t.*t" matches any word that starts and ends in the letter t, while the regular expression "text" matches only itself.

Secure Shell. A protocol for securely logging onto a remote computer and executing commands. It provides a secure alternative to Telnet, FTP, rlogin, or rsh. Secure Shell connections require both server and user authentication, and all communications pass between hosts over an encrypted communication channel. You can also use Secure Shell connections to forward X11 sessions or specified TCP/IP ports through the secure tunnel.

socket. The combination of a host name (IP address or DNS name) and a port number. This creates a unique identifier that a client application uses as an end point of communications.

trust anchor. A certificate that can be used as the final trust point in a certificate chain of trust. Note: PKI Services Manager validates certificates using only those trust anchors that have been explicitly configured for use by PKI Services Manager. You can configure a trust anchor using a root CA certificate, an intermediate CA certificate, or a self-signed certificate (one which can only validate itself).

PKI Services Manager Data Directory. On UNIX: /opt/attachmate/pkid or /opt/microfocus/pkid. On Windows: \ProgramData\Attachmate\ReflectionPKI\ or \ProgramData\Micro Focus\ReflectionPKI\.
Reflection PKI Services Manager Configuration Directory. On UNIX: 
/opt/attachmate/pkid/config/ or /opt/microfocus/pkid/config/. On Windows: \\ProgramData\Attachmate\ReflectionPKI\config\ or \\ProgramData\Micro Focus\ReflectionPKI\config\.