

# Implementing Keychain Management

This module describes how to implement keychain management on. Keychain management is a common method of authentication to configure shared secrets on all entities that exchange secrets such as keys, before establishing trust with each other. Routing protocols and network management applications on Cisco IOS XR software often use authentication to enhance security while communicating with peers.

**Feature History for Implementing Keychain Management**

| Release | Modification |
|---|---|
| Release 3.7.2 | This feature was introduced. |


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## Prerequisites for Configuring Keychain Management

You must be in a user group associated with a task group that includes the proper task IDs. The command reference guides include the task IDs required for each command. If you suspect user group assignment is preventing you from using a command, contact your AAA administrator for assistance.

## Restrictions for Implementing Keychain Management

You must be aware that changing the system clock impacts the validity of the keys in the existing configuration.

## Information About Implementing Keychain Management

The keychain by itself has no relevance; therefore, it must be used by an application that needs to communicate by using the keys (for authentication) with its peers. The keychain provides a secure mechanism to handle the keys and rollover based on the lifetime. Border Gateway Protocol (BGP), Open Shortest Path First (OSPF),

and Intermediate System-to-Intermediate System (IS-IS) use the keychain to implement a hitless key rollover for authentication. BGP uses TCP authentication, which enables the authentication option and sends the Message Authentication Code (MAC) based on the cryptographic algorithm configured for the keychain. For information about BGP, OSPF, and IS-IS keychain configurations, see *Routing Configuration Guide for Cisco ASR 9000 Series Routers*.

- Resource Reservation Protocol (RSVP) uses keychain for authentication. For more information about RSVP, see the *Cisco ASR 9000 Series Aggregation Services Router MPLS Configuration Guide*.
- IP Service Level Agreements (IP SLAs) use a keychain for MD5 authentication for the IP SLA control message. For more information about IP SLAs, see the *Cisco ASR 9000 Series Aggregation Services Router System Monitoring Configuration Guide* and the **key-chain** command in the *Cisco ASR 9000 Series Aggregation Services Router System Monitoring Comand Reference*.

To implement keychain management, you must understand the concept of key lifetime, which is explained in the next section.

# Lifetime of Key

If you are using keys as the security method, you must specify the lifetime for the keys and change the keys on a regular basis when they expire. To maintain stability, each party must be able to store and use more than one key for an application at the same time. A keychain is a sequence of keys that are collectively managed for authenticating the same peer, peer group, or both.

Keychain management groups a sequence of keys together under a keychain and associates each key in the keychain with a lifetime.



**Note** Any key that is configured without a lifetime is considered invalid; therefore, the key is rejected during configuration.

The lifetime of a key is defined by the following options:

- Start-time—Specifies the absolute time.
- End-time—Specifies the absolute time that is relative to the start-time or infinite time.

Each key definition within the keychain must specify a time interval for which that key is activated; for example, lifetime. Then, during a given key's lifetime, routing update packets are sent with this activated key. Keys cannot be used during time periods for which they are not activated. Therefore, we recommend that for a given keychain, key activation times overlap to avoid any period of time for which no key is activated. If a time period occurs during which no key is activated, neighbor authentication cannot occur; therefore, routing updates can fail.

Multiple keychains can be specified.

# How to Implement Keychain Management

This section contains the following procedures:

# Configuring a Keychain

This task configures a name for the keychain.

You can create or modify the name of the keychain.

### SUMMARY STEPS

1. **configure**
2. **key chain** *key-chain-name*
3. **commit**
4. **show key chain** *key-chain-name*
5. **show run**

### DETAILED STEPS

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br>**Example:**<br>`RP/0/RSP0/CPU0:router# configure` | Enters global configuration mode. |
| **Step 2** | **key chain** *key-chain-name*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config)# key chain isis-keys`<br>`RP/0/RSP0/CPU0:router(config-isis-keys)#` | Creates a name for the keychain.<br>**Note** Configuring only the keychain name wit exit the configuration, the router does no identifier and at least one of the global c attributes (for example, lifetime or key s |
| **Step 3** | **commit** | Commits the configuration changes and remains within the configuration session. |
| **Step 4** | **show key chain** *key-chain-name*<br>**Example:**<br>`RP/0/RSP0/CPU0:router# show key chain isis-keys`<br>`Key-chain: isis-keys/ -`<br>`accept-tolerance -- infinite`<br>`Key 8 -- text "1104000E120B520005282820"`<br>`  cryptographic-algorithm -- MD5`<br>`  Send lifetime:   01:00:00, 29 Jun 2006 - Always valid  [Valid now]`<br>`  Accept lifetime: 01:00:00, 29 Jun 2006 - Always valid [Valid now]` | (Optional) Displays the name of the keychain.<br>**Note** The *key-chain-name* argument is optiona all the keychains are displayed. |
| **Step 5** | **show run** | |

| | Command or Action | Purpose |
|---|---|---|
| | **Example:**<br><br>`key chain isis-keys`<br>`  accept-tolerance infinite`<br>`  key 8`<br>`   key-string mykey91abcd`<br>`   cryptographic-algorithm MD5`<br>`   send-lifetime 1:00:00 june 29 2006 infinite`<br>`   accept-lifetime 1:00:00 june 29 2006 infinite`<br>`   !`<br>`  !`<br>`!` | |

### What to do next

After completing keychain configuration, see the Configuring a Tolerance Specification to Accept Keys, on page 4 section.

# Configuring a Tolerance Specification to Accept Keys

This task configures the tolerance specification to accept keys for a keychain to facilitate a hitless key rollover for applications, such as routing and management protocols.

## SUMMARY STEPS

1. **configure**
2. **key chain** *key-chain-name*
3. **accept-tolerance** *value* [**infinite**]
4. **commit**

## DETAILED STEPS

### Procedure

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br>**Example:**<br><br>`RP/0/RSP0/CPU0:router# configure` | Enters global configuration mode. |
| **Step 2** | **key chain** *key-chain-name*<br>**Example:**<br><br>`RP/0/RSP0/CPU0:router(config)# key chain isis-keys` | Creates a name for the keychain. |

| | Command or Action | Purpose |
|---|---|---|
| **Step 3** | **accept-tolerance** *value* [**infinite]**<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys)# accept-tolerance infinite` | Configures an accept tolerance limit—duration for which an expired or soon-to-be activated keys can be used for validating received packets—for a key that is used by a peer.<br>• Use the *value* argument to set the tolerance range in seconds. The range is from 1 to 8640000.<br>• Use the **infinite** keyword to specify that an accept key is always acceptable and validated when used by a peer. |
| **Step 4** | **commit** | Commits the configuration changes and remains within the configuration session. |

# Configuring a Key Identifier for the Keychain

This task configures a key identifier for the keychain.

You can create or modify the key for the keychain.

### SUMMARY STEPS

1. **configure**
2. **key chain** *key-chain-name*
3. **key** *key-id*
4. **commit**

### DETAILED STEPS

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br>**Example:**<br>`RP/0/RSP0/CPU0:router# configure` | Enters global configuration mode. |
| **Step 2** | **key chain** *key-chain-name*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config)# key chain isis-keys` | Creates a name for the keychain. |
| **Step 3** | **key** *key-id*<br>**Example:** | Creates a key for the keychain. The key ID has to be unique within the specific keychain.<br>• Use the *key-id* argument as a 48-bit integer. |

| | Command or Action | Purpose |
|---|---|---|
| | `RP/0/RSP0/CPU0:router(config-isis-keys)# key 8` | |
| **Step 4** | **commit** | Commits the configuration changes and remains within the configuration session. |

### What to do next

After configuring a key identifier for the keychain, see the Configuring the Text for the Key String, on page 6 section.

# Configuring the Text for the Key String

This task configures the text for the key string.

## SUMMARY STEPS

1. **configure**
2. **key chain** *key-chain-name*
3. **key** *key-id*
4. **key-string** [**clear** | **password**] *key-string-text*
5. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br>**Example:**<br>`RP/0/RSP0/CPU0:router# configure` | Enters global configuration mode. |
| **Step 2** | **key chain** *key-chain-name*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config)# key chain isis-keys` | Creates a name for the keychain. |
| **Step 3** | **key** *key-id*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys)# key 8`<br>`RP/0/RSP0/CPU0:router(config-isis-keys-0x8)#` | Creates a key for the keychain. |
| **Step 4** | **key-string** [**clear** | **password**] *key-string-text*<br>**Example:** | Specifies the text string for the key. |

| | Command or Action | Purpose |
|---|---|---|
| | `RP/0/RSP0/CPU0:router(config-isis-keys-0x8)# key-string password 8` | • Use the **clear** keyword to specify the key string in clear text form; use the **password** keyword to specify the key in encrypted form.<br>• For a string to be a valid password, it must comply with the following rules:<br>  • It must contain an even number of characters.<br>  • The minumum length is 4.<br>  • The first two digits must be decimal numbers and the others must be hexadecimal numbers.<br>  • The first two digits must not be greater than 53.<br>Examples of valid passwords are:<br>  • 12abcd<br>  • 32986510<br>• |
| **Step 5** | Use the **commit** or **end** command. | **commit** —Saves the configuration changes and remains within the configuration session.<br>**end** —Prompts user to take one of these actions:<br>• **Yes** — Saves configuration changes and exits the configuration session.<br>• **No** —Exits the configuration session without committing the configuration changes.<br>• **Cancel** —Remains in the configuration session, without committing the configuration changes. |

### What to do next

After configuring the text for the key string, see the Configuring the Keys to Generate Authentication Digest for the Outbound Application Traffic, on page 9 section.

# Determining the Valid Keys

This task determines the valid keys for local applications to authenticate the remote peers.

### SUMMARY STEPS

1. **configure**
2. **key chain** *key-chain-name*
3. **key** *key-id*
4. **accept-lifetime** *start-time* [**duration** *duration-value* | **infinite** | *end-time*]

5. Use the **commit** or **end** command.

## DETAILED STEPS

### Procedure

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br>**Example:**<br>`RP/0/RSP0/CPU0:router# configure` | Enters global configuration mode. |
| **Step 2** | **key chain** *key-chain-name*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config)# key chain isis-keys` | Creates a a name for the keychain. |
| **Step 3** | **key** *key-id*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys)# key 8`<br>`RP/0/RSP0/CPU0:router(config-isis-keys-0x8)#` | Creates a key for the keychain. |
| **Step 4** | **accept-lifetime** *start-time* [**duration** *duration-value* \| **infinite** \| *end-time*]<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys-0x8)# accept-lifetime 1:00:00 october 24 2005 infinite` | (Optional) Specifies the validity of the key lifetime in terms of clock time. You can specify the *start-time* and *end-time* in *hh:mm:ss month DD YYYY* format or *hh:mm:ss DD month YYYY* format. |
| **Step 5** | Use the **commit** or **end** command. | **commit** —Saves the configuration changes and remains within the configuration session.<br>**end** —Prompts user to take one of these actions:<br>• **Yes** — Saves configuration changes and exits the configuration session.<br>• **No** —Exits the configuration session without committing the configuration changes.<br>• **Cancel** —Remains in the configuration session, without committing the configuration changes. |

# Configuring the Keys to Generate Authentication Digest for the Outbound Application Traffic

This task configures the keys to generate authentication digest for the outbound application traffic.

## SUMMARY STEPS

1. **configure**
2. **key chain** *key-chain-name*
3. **key** *key-id*
4. **send-lifetime** *start-time* [**duration** *duration-value* | **infinite** | *end-time*]
5. Use the **commit** or **end** command.

## DETAILED STEPS

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br>**Example:**<br>`RP/0/RSP0/CPU0:router# configure` | Enters global configuration mode. |
| **Step 2** | **key chain** *key-chain-name*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config)# key chain isis-keys` | Creates a name for the keychain. |
| **Step 3** | **key** *key-id*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys)# key 8`<br>`RP/0/RSP0/CPU0:router(config-isis-keys-0x8)#` | Creates a key for the keychain. |
| **Step 4** | **send-lifetime** *start-time* [**duration** *duration-value* \| **infinite** \| *end-time*]<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys-0x8)#`<br>`send-lifetime 1:00:00 october 24 2005 infinite` | (Optional) Specifies the set time period during which an authentication key on a keychain is valid to be sent. You can specify the validity of the key lifetime in terms of clock time.<br>In addition, you can specify a start-time value and one of the following values:<br>• **duration** keyword (seconds)<br>• **infinite** keyword<br>• *end-time* argument |

| | Command or Action | Purpose |
|---|---|---|
| | | If you intend to set lifetimes on keys, Network Time Protocol (NTP) or some other time synchronization method is recommended. |
| **Step 5** | Use the **commit** or **end** command. | **commit** —Saves the configuration changes and remains within the configuration session.<br>**end** —Prompts user to take one of these actions:<br>• **Yes** — Saves configuration changes and exits the configuration session.<br>• **No** —Exits the configuration session without committing the configuration changes.<br>• **Cancel** —Remains in the configuration session, without committing the configuration changes. |

# Configuring the Cryptographic Algorithm

This task allows the key chain configuration to accept the choice of the cryptographic algorithm.

From Cisco IOS XR Software Release 7.1.2 and later, you must follow the below guidelines while configuring the key chain. These are applicable only for FIPS mode (that is, when **crypto fips-mode** is configured).

- You must configure the session with a FIPS-approved cryptographic algorithm. A session configured with non-approved cryptographic algorithm for FIPS (such as, **MD5** and **HMAC-MD5**) does not work. This is applicable for OSPF, BGP, RSVP, ISIS, or any application using key chain with non-approved cryptographic algorithm.
- If you are using any **HMAC-SHA** algorithm for a session, then you must ensure that the configured *key-string* has a minimum length of 14 characters. Otherwise, the session goes down.

### SUMMARY STEPS

1. **configure**
2. **key chain** *key-chain-name*
3. **key** *key-id*
4. **cryptographic-algorithm** [**HMAC-MD5** | **HMAC-SHA1-12** | **HMAC-SHA1-20** | **MD5** | **SHA-1** | **AES-128-CMAC-96** | **HMAC-SHA-256** | **HMAC-SHA1-96**]
5. Use the **commit** or **end** command.

### DETAILED STEPS

**Procedure**

| | Command or Action | Purpose |
|---|---|---|
| **Step 1** | **configure**<br>**Example:** | Enters global configuration mode. |

| | Command or Action | Purpose |
|---|---|---|
| | `RP/0/RSP0/CPU0:router# configure` | |
| **Step 2** | **key chain** *key-chain-name*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config)# key chain isis-keys`<br>`RP/0/RSP0/CPU0:router(config-isis-keys)#` | Creates a name for the keychain. |
| **Step 3** | **key** *key-id*<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys)# key 8`<br>`RP/0/RSP0/CPU0:router(config-isis-keys-0x8)#` | Creates a key for the keychain. |
| **Step 4** | **cryptographic-algorithm** [**HMAC-MD5** \| **HMAC-SHA1-12** \| **HMAC-SHA1-20** \| **MD5** \| **SHA-1** \| **AES-128-CMAC-96** \| **HMAC-SHA-256** \| **HMAC-SHA1-96**]<br>**Example:**<br>`RP/0/RSP0/CPU0:router(config-isis-keys-0x8)# cryptographic-algorithm MD5` | Specifies the choice of the cryptographic algorithm. You can choose from the following list of algorithms:<br>• HMAC-MD5<br>• HMAC-SHA1-12<br>• HMAC-SHA1-20<br>• MD5<br>• SHA-1<br>• HMAC-SHA-256<br>• HMAC-SHA1-96<br>• AES-128-CMAC-96<br>The routing protocols each support a different set of cryptographic algorithms:<br>• Border Gateway Protocol (BGP) supports HMAC-MD5, HMAC-SHA1-12, HMAC-SHA1-96 and AES-128-CMAC-96.<br>• Intermediate System-to-Intermediate System (IS-IS) supports HMAC-MD5, SHA-1, MD5, AES-128-CMAC-96, HMAC-SHA-256, HMAC-SHA1-12, HMAC-SHA1-20, and HMAC-SHA1-96.<br>• Open Shortest Path First (OSPF) supports MD5, HMAC-MD5, HMAC-SHA-256, HMAC-SHA1-12, HMAC-SHA1-20, and HMAC-SHA1-96. |
| **Step 5** | Use the **commit** or **end** command. | **commit** —Saves the configuration changes and remains within the configuration session.<br>**end** —Prompts user to take one of these actions: |

| | Command or Action | Purpose |
|---|---|---|
| | | • **Yes** — Saves configuration changes and exits the configuration session.<br>• **No** —Exits the configuration session without committing the configuration changes.<br>• **Cancel** —Remains in the configuration session, without committing the configuration changes. |

# Configuration Examples for Implementing Keychain Management

This section provides the following configuration example:

## Configuring Keychain Management: Example

The following example shows how to configure keychain management:

```
configure
 key chain isis-keys
  accept-tolerance infinite
  key 8
   key-string mykey91abcd
   cryptographic-algorithm MD5
   send-lifetime 1:00:00 june 29 2006 infinite
   accept-lifetime 1:00:00 june 29 2006 infinite


Router#show key chain isis-keys

Key-chain: isis-keys/ -

accept-tolerance -- infinite
Key 8 -- text "1104000E120B520005282820"
  cryptographic-algorithm -- MD5
  Send lifetime:   01:00:00, 29 Jun 2006 - Always valid  [Valid now]
  Accept lifetime: 01:00:00, 29 Jun 2006 - Always valid [Valid now]
```

# Additional References

The following sections provide references related to implementing keychain management.

### Related Documents

| Related Topic | Document Title |
|---|---|
| Keychain management commands: complete command syntax, command modes, command history, defaults, usage guidelines, and examples | *Keychain Management Commands in the System Security Command Reference for Cisco ASR 9000 Series Routers* |

### Standards

| Standards | Title |
|---|---|
| No new or modified standards are supported by this feature, and support for existing standards has not been modified by this feature. | — |

### MIBs

| MIBs | MIBs Link |
|---|---|
| — | To locate and download MIBs using Cisco IOS XR software, use the Cisco MIB Locator found at the following URL and choose a platform under the Cisco Access Products menu: http://cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml |

### RFCs

| RFCs | Title |
|---|---|
| No new or modified RFCs are supported by this feature. | — |

### Technical Assistance

| Description | Link |
|---|---|
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