User Security Configuration Guide Cisco IOS Release 12.4T

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Cisco IOS Login Enhancements-Login Block

The Cisco IOS Login Enhancements (Login Block) feature allows users to enhance the security of a router by configuring options to automatically block further login attempts when a possible denial-of-service (DoS) attack is detected.

The login block and login delay options introduced by this feature can be configured for Telnet or SSH virtual connections. By enabling this feature, you can slow down “dictionary attacks” by enforcing a “quiet period” if multiple failed connection attempts are detected, thereby protecting the routing device from a type of denial-of-service attack.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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Information About Cisco IOS Login Enhancements

Protecting Against Denial of Service and Dictionary Login Attacks

Connecting to a routing device for the purposes of administering (managing) the device, at either the User or Executive level, is most frequently performed using Telnet or SSH (secure shell) from a remote console (such as a PC). SSH provides a more secure connection option because communication traffic between the user’s device and the managed device are encrypted. The Login Block capability, when enabled, applies to

both Telnet connections and SSH connections. Beginning in Release versions 12.3(33)SRB2, 12.2(33)SXH2, and 12.4(15)T1, the Login Block capability also applies to HTTP connections."

The automated activation and logging of the Login Block and Quiet Period capabilities introduced by this feature are designed to further enhance the security of your devices by specifically addressing two well known methods that individuals use to attempt to disrupt or compromise network devices.

If the connection address of a device is discovered and is reachable, a malicious user may attempt to interfere with the normal operations of the device by flooding it with connection requests. This type of attack is referred to as an attempted Denial-of-Service, because it is possible that the device may become too busy trying to process the repeated login connection attempts to properly handle normal routing services or are not able to provide the normal login service to legitimate system administrators.

The primary intention of a dictionary attack, unlike a typical DoS attack, is to actually gain administrative access to the device. A dictionary attack is an automated process to attempt to login by attempting thousands, or even millions, of username/password combinations. (This type of attack is called a "dictionary attack" because it typically uses, as a start, every word found in a typical dictionary as a possible password.) As scripts or programs are used to attempt this access, the profile for such attempts is typically the same as for DoS attempts; multiple login attempts in a short period of time.

By enabling a detection profile, the routing device can be configured to react to repeated failed login attempts by refusing further connection request (login blocking). This block can be configured for a period of time, called a "quiet period". Legitimate connection attempts can still be permitted during a quiet period by configuring an access-list (ACL) with the addresses that you know to be associated with system administrators.

Login Enhancements Functionality Overview

Delays Between Successive Login Attempts

A Cisco IOS device can accept virtual connections as fast as they can be processed. Introducing a delay between login attempts helps to protect the Cisco IOS software-based device against malicious login connections such as dictionary attacks and DoS attacks. Delays can be enabled in one of the following ways:

- Through the **auto secure** command. If you enable the AutoSecure feature, the default login delay time of one second is automatically enforced.
- Through the **login block-for** command. You must enter this command before issuing the **login delay** command. If you enter only the **login block-for** command, the default login delay time of one second is automatically enforced.
- Through the new global configuration mode command, **login delay**, which allows you to specify login delay time to be enforced, in seconds.

Login Shutdown If DoS Attacks Are Suspected

If the configured number of connection attempts fail within a specified time period, the Cisco IOS device does not accept any additional connections for a "quiet period." (Hosts that are permitted by a predefined access-control list [ACL] are excluded from the quiet period.)

The number of failed connection attempts that trigger the quiet period can be specified through the new global configuration mode command **login block-for**. The predefined ACL that is excluded from the quiet

period can be specified through the new global configuration mode command **login quiet-mode access-class**.

This functionality is disabled by default, and it is not enabled if AutoSecure if enabled.

How to Configure Cisco IOS Login Enhancements

Configuring Login Parameters

Use this task to configure your Cisco IOS device for login parameters that help detect suspected DoS attacks and slow down dictionary attacks.

All login parameters are disabled by default. You must issue the **login block-for** command, which enables default login functionality, before using any other login commands. After the **login block-for** command is enabled, the following defaults are enforced:

- A default login delay of one second
- All login attempts made through Telnet or SSH are denied during the quiet period; that is, no ACLs are exempt from the login period until the **login quiet-mode access-class** command is issued.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **login block-for** *seconds* **attempts** *tries* **within** *seconds*
4. **login quiet-mode access-class** {*acl-name* | *acl-number*}
5. **login delay** *seconds*
6. **exit**
7. **show login failures**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Command or Action	Purpose
Step 3 **login block-for** *seconds* **attempts** *tries* **within** *seconds* **Example:** `Router(config)# login block-for 100 attempts 2 within 100`	Configures your Cisco IOS device for login parameters that help provide DoS detection. **Note** This command must be issued before any other login command can be used.

Step 4 **login quiet-mode access-class** {*acl-name* | *acl-number*}
 	
Example:
`Router(config)# login quiet-mode access-class myacl`
	(Optional) Although this command is optional, it is recommended that it be configured to specify an ACL that is to be applied to the router when the router switches to quiet mode. When the router is in quiet mode, all login requests are denied and the only available connection is through the console.
	If this command is not configured, then the default ACL **sl_def_acl** is created on the router. This ACL is hidden in the running configuration. Use the **show access-list sl_def_acl** to view the parameters for the default ACL.
	For example:
	`Router#show access-lists sl_def_acl`
	
	`Extended IP access list sl_def_acl`
	`10 deny tcp any any eq telnet`
	`20 deny tcp any any eq www`
	`30 deny tcp any any eq 22`
	`40 permit ip any any`

Step 5 **login delay** *seconds* **Example:** `Router(config)# login delay 10`	(Optional) Configures a delay between successive login attempts.
Step 6 **exit** **Example:** `Router# exit`	Exits to privileged EXEC mode.

	Command or Action	Purpose
Step 7	**show login failures** **Example:** `Router# show login`	Displays login parameters. • **failures** --Displays information related only to failed login attempts.

Configuration Examples for Login Parameters

Setting Login Parameters Example

The following example shows how to configure your router to enter a 100 second quiet period if 15 failed login attempts is exceeded within 100 seconds; all login requests are denied during the quiet period except hosts from the ACL “myacl.”

```
Router(config)# login block-for 100 attempts 15 within 100
Router(config)# login quiet-mode access-class myacl
```

Showing login Parameters Example

The following sample output from the **show login** command verifies that no login parameters have been specified:

```
Router# show login
No login delay has been applied.
No Quiet-Mode access list has been configured.
All successful login is logged and generate SNMP traps.
All failed login is logged and generate SNMP traps
Router NOT enabled to watch for login Attacks
```

The following sample output from the **show login** command verifies that the **login block-for**command is issued. In this example, the command is configured to block login hosts for 100 seconds if 16 or more login requests fail within 100 seconds; five login requests have already failed.

```
Router# show login
A default login delay of 1 seconds is applied.
No Quiet-Mode access list has been configured.
All successful login is logged and generate SNMP traps.
All failed login is logged and generate SNMP traps.
Router enabled to watch for login Attacks.
If more than 15 login failures occur in 100 seconds or less, logins will be disabled for
100 seconds.
Router presently in Watch-Mode, will remain in Watch-Mode for 95 seconds.
Present login failure count 5.
```

The following sample output from the **show login** command verifies that the router is in quiet mode. In this example, the **login block-for** command was configured to block login hosts for 100 seconds if 3 or more login requests fail within 100 seconds.

```
Router# show login
```

```
A default login delay of 1 seconds is applied.
No Quiet-Mode access list has been configured.
All successful login is logged and generate SNMP traps.
All failed login is logged and generate SNMP traps.
Router enabled to watch for login Attacks.
If more than 2 login failures occur in 100 seconds or less, logins will be disabled for
100 seconds.
Router presently in Quiet-Mode, will remain in Quiet-Mode for 93 seconds.
Denying logins from all sources.
```

The following sample output from **show login failures** command shows all failed login attempts on the router:

```
Router# show login failures
Information about login failure's with the device
Username      Source IPAddr  lPort Count  TimeStamp
try1          10.1.1.1        23    1     21:52:49 UTC Sun Mar 9 2003
try2          10.1.1.2        23    1     21:52:52 UTC Sun Mar 9 2003
```

The following sample output from **show login failures** command verifies that no information is presently logged:

```
Router# show login failures
*** No logged failed login attempts with the device.***
```

Additional References

Related Documents

Related Topic	Document Title
AutoSecure	AutoSecure feature module.
Secure Management/Administrative Access	Role-Based CLI Access feature module.

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Cisco IOS Login Enhancements-Login Block

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software

release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

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Table 1 Feature Information for Cisco IOS Login Enhancements (Login Block)

Feature Name	Releases	Feature Information
Cisco IOS Login Enhancements (Login Block)	12.3(4)T 12.2(25)S 12.2(33)SRA 12.2(33)SRB 12.2(33)SXH 12.4(15)T1	The Cisco IOS Login Enhancements (Login Block) feature allows users to enhance the security of a router by configuring options to automatically block further login attempts when a possible DoS attack is detected. This feature was introduced in Cisco IOS Release 12.3(4)T. This feature was integrated into Cisco IOS Release 12.2(25)S. This feature was integrated into Cisco IOS Release 12.2(33)SRA. Support for HTTP login blocking was integrated into Cisco IOS Release 12.2(33)SRB, 12.2(33)SXH, 12.4(15)T1.

Configuring Security with Passwords Privileges and Logins

Cisco IOS software-based networking devices provide several features that can be used to implement basic security for command-line sessions using only the operating system running on the device. These features include the following:

- Different levels of authorization for CLI sessions to control access to commands that can modify the status of the networking device versus commands that are used to monitor the device
- Assigning passwords to CLI sessions
- Requiring users to log in to a networking device with a username
- Changing the privilege levels of commands to create new authorization levels for CLI sessions

This module is a guide to implementing a baseline level of security for your networking devices. It focuses on the least complex options available for implementing a baseline level of security. If you have networking devices installed in your network with no security options configured, or you are about to install a networking device and you need help understanding how to implement a baseline of security, this document will help you.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

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Restrictions for Configuring Security with Passwords Privileges and Logins

Your networking device must not be configured to use any local or remote authentication, authorization, and accounting (AAA) security features. This document describes only the non-AAA security features that can be configured locally on the networking device.

For information on how to configure AAA security features that can be run locally on a networking device, or for information on how to configure remote AAA security using TACACS+ or RADIUS servers, see the *Cisco IOS Security Configuration Guide: Securing User Services, Cisco IOS Release 15.1M&T* .

Information About Configuring Security with Passwords Privileges and Logins

Benefits of Creating a Security Scheme

The foundation of a good security scheme in the network is the protection of the user interfaces of the networking devices from unauthorized access. Protecting access to the user interfaces on your networking devices prevents unauthorized users from making configuration changes that can disrupt the stability of your network or compromise your network security.

The features described in this document can be combined in many different ways to create a unique security scheme for each of your networking devices.

You can enable nonadministrative users to run a subset of the administrative commands available on the networking device by lowering the entitlement level for the commands to the nonadministrative privilege level. This can be useful for the following scenarios:

Cisco IOS CLI Modes

To aid in the configuration of Cisco devices, the Cisco IOS CLI is divided into different command modes. Each command mode has its own set of commands available for the configuration, maintenance, and monitoring of router and network operations. The commands available to you at any given time depending

on the mode you are in. Entering a question mark (**?**) at the system prompt (router prompt) allows you to obtain a list of commands available for each command mode.

The use of specific commands allows you to navigate from one command mode to another. The standard order in which a user would access the modes is as follows: user EXEC mode; privileged EXEC mode; global configuration mode; specific configuration modes; configuration submodes; and configuration subsubmodes.

Note The default configuration of a Cisco IOS software-based networking device allows you to configure passwords to protect access only to user EXEC mode (for local and remote CLI sessions) and privileged EXEC mode. This document describes how you can provide additional levels of security by protecting access to other modes, and commands, using a combination of usernames, passwords and the **privilege** command.

Most EXEC mode commands are one-time commands, such as **show** or **more** commands, which show the current configuration status, and **clear** commands, which clear counters or interfaces. EXEC mode commands are not saved across reboots of the router.

From privileged EXEC mode, you can enter global configuration mode. In this mode, you can enter commands that configure general system characteristics. You also can use global configuration mode to enter specific configuration modes. Configuration modes, including global configuration mode, allow you to make changes to the running configuration. If you later save the configuration, these commands are stored across router reboots.

From global configuration mode you can enter a variety of protocol-specific or feature-specific configuration modes. The CLI hierarchy requires that you enter these specific configuration modes only through global configuration mode. For example, interface configuration mode is a commonly used configuration mode.

From configuration modes, you can enter configuration submodes. Configuration submodes are used for the configuration of specific features within the scope of a given configuration mode. For example, the subinterface configuration mode is a submode of the interface configuration mode.

ROM monitor mode is a separate mode used when the router cannot boot properly. If your system (router, switch, or access server) does not find a valid system image to load when it is booting, the system will enter ROM monitor mode. ROM monitor (ROMMON) mode can also be accessed by interrupting the boot sequence during startup.

The following sections contain detailed information on these command modes:

- User EXEC Mode, page 11
- Privileged EXEC Mode, page 12
- Global Configuration Mode, page 13
- Interface Configuration Mode, page 14
- Subinterface Configuration Mode, page 14

User EXEC Mode

When you start a session on a router, you generally begin in user EXEC mode, which is one of two access levels of the EXEC mode. For security purposes, only a limited subset of EXEC commands are available in user EXEC mode. This level of access is reserved for tasks that do not change the configuration of the router, such as determining the router status.

If your device is configured to require users to log in the login process will require a username and a password. If you enter incorrect password three times, the connection attempt is refused.

User EXEC mode is set by default to privilege level 1. Privileged EXEC mode is set by default to privilege level 15. For more information see the Privileged EXEC Mode, page 12. When you are logged in to a networking device in user EXEC mode your session is running at privilege level 1. When you are logged in to a networking device in privileged EXEC mode your session is running at privilege level 15. You can move commands to any privilege level between 1 and 15 using the **privilege** command. See the Cisco IOS Privilege Levels, page 17 for more information on privilege levels and the **privilege** command.

In general, the user EXEC commands allow you to connect to remote devices, change terminal line settings on a temporary basis, perform basic tests, and list system information.

To list the available user EXEC commands, enter a question mark (**?**). The list of commands will vary depending on the software feature set and router platform you are using.

The user EXEC mode prompt consists of the hostname of the device followed by an angle bracket (>), for example, Router>.

The default hostname is generally Router, unless it has been changed during initial configuration using the **setup** EXEC command. You can also change the hostname using the **hostname** global configuration command.

Note Examples in Cisco IOS documentation assume the use of the default name of “Router.” Different devices (for example, access servers) may use a different default name. If the routing device (router, access server, or switch) has been named with the **hostname** command, that name will appear as the prompt instead of the default name.

Note You can enter commands in uppercase, lowercase, or mixed case. Only passwords are case-sensitive. However, Cisco IOS documentation convention is to always present commands in lowercase.

Privileged EXEC Mode

In order to have access to all commands, you must enter privileged EXEC mode, which is the second level of access for the EXEC mode. Normally, you must enter a password to enter privileged EXEC mode. In privileged EXEC mode, you can enter any EXEC command, because privileged EXEC mode is a superset of the user EXEC mode commands.

Because many privileged EXEC mode commands set operating parameters, privileged EXEC level access should be password protected to prevent unauthorized use. The privileged EXEC command set includes those commands contained in user EXEC mode. Privileged EXEC mode also provides access to configuration modes through the **configure**command, and includes advanced testing commands, such as **debug**.

Privileged EXEC mode is set by default to privilege level 15. User EXEC mode is set by default to privilege level 1. For more information see the User EXEC Mode, page 11. By default the EXEC commands at privilege level 15 are a superset of those available at privilege level 1. You can move commands to any privilege level between 1 and 15 using the **privilege** command. See the Cisco IOS Privilege Levels, page 17 for more information on privilege levels and the **privilege** command.

The privileged EXEC mode prompt consists of the hostname of the device followed by a pound sign (#), for example, Router#.

To access privileged EXEC mode, use the **enable** command. If a privileged EXEC mode password has been configured the system will prompt you for a password after you issue the **enable** command. Use the **exit** command to leave privileged EXEC mode.

Note Privileged EXEC mode is sometimes referred to as "enable mode," because the **enable** command is used to enter the mode.

If a password has been configured on the system, you will be prompted to enter it before being allowed access to privileged EXEC mode. The password is not displayed on the screen and is case-sensitive. If an enable password has not been set, privileged EXEC mode can be accessed only by a local CLI session (terminal connected to the console port).

If you attempt to access privileged EXEC mode on a router over a remote connection, such as aTelnet connection, and you have not configured a password for privileged EXEC mode, you will see the **% No password set** error message. For more information on remote connections see the Remote CLI Sessions, page 15. The system administrator uses the **enable secret** or **enable password**global configuration command to set the password that restricts access to privileged EXEC mode. For information on configuring a password for privileged EXEC mode, see the Protecting Access to Privileged EXEC Mode, page 26.

To return to user EXEC mode, use the **disable** command:

Note that the password will not be displayed as you type, but is shown here for illustrational purposes. To list the commands available in privileged EXEC mode, issue question mark (**?)** at the prompt. From privileged EXEC mode you can access global configuration mode, which is described in the following section.

Note Because the privileged EXEC command set contains all of the commands available in user EXEC mode, some commands can be entered in either mode. In Cisco IOS documentation, commands that can be entered in either user EXEC mode or privileged EXEC mode are referred to as EXEC mode commands. If user or privileged is not specified in the documentation, assume that you can enter the referenced commands in either mode.

Global Configuration Mode

The term "global" is used to indicate characteristics or features that affect the system as a whole. Global configuration mode is used to configure your system globally, or to enter specific configuration modes to configure specific elements such as interfaces or protocols. Use the **configure terminal**privileged EXEC command to enter global configuration mode.

To access global configuration mode, use the **configure terminal** command in privileged EXEC mode:

Note that the system prompt changes to indicate that you are now in global configuration mode. The prompt for global configuration mode consists of the hostname of the device followed by (config) and the pound sign (#). To list the commands available in privileged EXEC mode, issue **?** at the prompt.

Commands entered in global configuration mode update the running configuration file as soon as they are entered. In other words, changes to the configuration take effect each time you press the Enter or Return key at the end of a valid command. However, these changes are not saved into the startup configuration file until you issue the **copy running-config startup-config** EXEC mode command.

The system dialog prompts you to end your configuration session (exit configuration mode) by pressing the Control (Ctrl) and "z" keys simultaneously; when you press these keys, **^Z** is printed to the screen. You

can actually end your configuration session by entering the Ctrl-Z key combination, using the **end** command, and using the Ctrl-C key combination. The **end** command is the recommended way to indicate to the system that you are done with the current configuration session.

Caution If you use Ctrl-Z at the end of a command line in which a valid command has been typed, that command will be added to the running configuration file. In other words, using Ctrl-Z is equivalent to hitting the Enter (Carriage Return) key before exiting. For this reason, it is safer to end your configuration session using the **end** command. Alternatively, you can use the Ctrl-C key combination to end your configuration session without sending a Carriage Return signal.

You can also use the **exit** command to return from global configuration mode to EXEC mode, but this only works in global configuration mode. Pressing Ctrl-Z or entering the **end** command will always take you back to EXEC mode regardless of which configuration mode or configuration submode you are in.

To exit global configuration command mode and return to privileged EXEC mode, use the **end** or **exit** command.

From global configuration mode, you can enter a number of protocol-specific, platform-specific, and feature-specific configuration modes.

Interface configuration mode, described in the following section, is an example of a configuration mode you can enter from global configuration mode.

Interface Configuration Mode

One example of a specific configuration mode you can enter from global configuration mode is interface configuration mode.

Many features are enabled on a per-interface basis. Interface configuration commands modify the operation of an interface such as an Ethernet, FDDI, or serial port. Interface configuration commands always follow an **interface** global configuration command, which defines the interface type.

For details on interface configuration commands that affect general interface parameters, such as bandwidth or clock rate, refer to the *Cisco IOS Interface Configuration Guide* .

To access and list the interface configuration commands, use the interface type number command.

To exit interface configuration mode and return to global configuration mode, enter the **exit** command.

Configuration submodes are configuration modes entered from other configuration modes (besides global configuration mode). Configuration submodes are for the configuration of specific elements within the configuration mode. One example of a configuration submode is subinterface configuration mode, described in the following section.

Subinterface Configuration Mode

From interface configuration mode, you can enter subinterface configuration mode. Subinterface configuration mode is a submode of interface configuration mode. In subinterface configuration mode you can configure multiple virtual interfaces (called subinterfaces) on a single physical interface. Subinterfaces appear to be distinct physical interfaces to the various protocols.

For detailed information on how to configure subinterfaces, refer to the appropriate documentation module for a specific protocol in the Cisco IOS software documentation set.

To exit subinterface configuration mode and return to interface configuration mode, use the **exit** command. To end your configuration session and return to privileged EXEC mode, press Ctrl-Z or enter the **end** command.

Cisco IOS CLI Sessions

Local CLI Sessions

Local CLI sessions require direct access to the console port of the networking device. Local CLI sessions start in user EXEC mode. See the Cisco IOS CLI Modes, page 10 for more information on the different modes that are supported on your networking device. All of the tasks required to configure and manage a networking device can be done using a local CLI session. The most common method for establishing a local CLI session is to connect the serial port on a PC to the console port of the networking device and then to launch a terminal emulation application on the PC. The type of cable and connectors required and the settings for the terminal emulation application on the PC depend on the type of networking device that you are configuring. See the documentation for your networking device for more information on setting it up for a local CLI session.

Remote CLI Sessions

Remote CLI sessions are created between a host such as a PC and a networking device such as a router over a network using a remote terminal access application such as Telnet and SSH. Local CLI sessions start in user EXEC mode. See the Cisco IOS CLI Modes, page 10 for more information on the different modes that are supported on your networking device. Most of the tasks required to configure and manage a networking device can be done using a remote CLI session. The exceptions are tasks that interact directly with the console port (such as recovering from a corrupted operating system (OS) by uploading a new OS image over the console port) and interacting with the networking device when it is in ROMMON mode.

Telnet is the most common method for accessing a remote CLI session on a networking device.

Note SSH is a more secure alternative to Telnet. SSH provides encryption for the session traffic between your local management device such as a PC and the networking device that you are managing. Encrypting the session traffic with SSH prevents hackers that might intercept the traffic from being able to decode it. See Secure Shell Version 2 Support feature module for more information on using SSH.

Terminal Lines Used for Local and Remote CLI Sessions

Cisco networking devices use the word “lines” to refer to the software components that manage local and remote CLI sessions. You use the **line console 0** global configuration command to enter line configuration mode to configure options, such as a password, for the console port.

Remote CLI sessions use lines that are referred to as vty lines. You use the **line vty** *line-number*[*ending-line-number*]global configuration command to enter line configuration mode to configure options, such as a password, for remote CLI sessions.

Protection of Access to Cisco IOS EXEC Modes

Protection of Access to User EXEC Mode

The first step in creating a secure environment for your networking device is protecting access to user EXEC mode by configuring passwords for local and remote CLI sessions.

You can protect access to user EXEC mode for local CLI sessions by configuring a password on the console port. See the Configuring a Password for Local CLI Sessions, page 24.

You can protect access to user EXEC mode for remote CLI sessions by configuring a password on the vtys. See the Configuring a Password for Remote CLI Sessions, page 22 for instructions on how to configure passwords for remote CLI sessions.

Protection of Access to Privileged EXEC Mode

The second step in creating a secure environment for your networking device is protecting access to privileged EXEC mode with a password. The method for protecting access to privileged EXEC mode is the same for local and remote CLI sessions.

You can protect access to privileged EXEC mode by configuring a password for it. This is sometimes referred to as the enable password because the command to enter privileged EXEC mode is **enable**.

Cisco IOS Password Encryption Levels

Some of the passwords that you configure on your networking device are saved in the configuration in plain text. This means that if you store a copy of the configuration file on a disk, anybody with access to the disk can discover the passwords by reading the configuration file. The following password types are stored as plain text in the configuration by default:

- Console passwords for local CLI sessions.
- Virtual terminal line passwords for remote CLI sessions.
- Username passwords using the default method for configuring the password.
- Privileged EXEC mode passwords when they are configured with the **enable password** *password* command.
- Authentication key chain passwords used by Routing Information Protocol version 2 (RIPv2) and Enhanced Interior Gateway Routing Protocol (EIGRP).
- BGP passwords for authenticating BGP neighbors.
- Open Shortest Path First (OSPF) authentication keys for authenticating OSPF neighbors.
- Intermediate System-Intermediate System (IS-IS) passwords for authenticating ISIS neighbors.

The following excerpt from a router configuration file shows examples of passwords and authentication keys that are stored as clear text:

```
!
enable password O9Jb6D
!
username username1 password 0 kV9sIj3
!
```

```
key chain trees
 key 1
  key-string key1
!
interface Ethernet1/0.1
 ip address 172.16.6.1 255.255.255.0
 ip router isis
 ip rip authentication key-chain key2
 ip authentication key-chain eigrp 1 key2
 ip ospf authentication-key j7876
 no snmp trap link-status
 isis password u7865k
!
line vty 0 4
 password V9jA5M
!
```

You can encrypt these clear text passwords in the configuration file by using the **service password-encryption** command. This should be considered as a minimal level of security because the encryption algorithm used by the **service password-encryption** command to encrypt passwords creates text strings that can be decrypted using tools that are publicly available. You should still protect access to any electronic or paper copies of your configuration files after you use the **service password-encryption** command.

The **service password-encryption** command does not encrypt the passwords when they are sent to the remote device. Anybody with a network traffic analyzer who has access to you network can capture these passwords from the packets as they are transmitted between the devices. See the Configuring Password Encryption for Clear Text Passwords, page 28 for more information on encrypting clear text passwords in configuration files.

Many of the Cisco IOS features that use clear text passwords can also be configured to use the more secure message digest algorithm 5 (MD5). The MD5 algorithm creates a text string in the configuration file that is much more difficult to decrypt. The MD5 algorithm does not send the password to the remote device. This prevents people using a traffic analyzer to capture traffic on your network from being able to discover your passwords.

You can determine the type of password encryption that has been used by the number that is stored with the password string in the configuration file of the networking device.

Cisco IOS CLI Session Usernames

After you have protected access to user EXEC mode and privileged EXEC mode by configuring passwords for them you can further increase the level of security on your networking device by configuring usernames to limit access to CLI sessions to your networking device to specific users.

Usernames that are intended to be used for managing a networking device can be modified with additional options such as:

See the *Cisco IOS Security Command Reference* for more information on how to configure the **username** command.

Cisco IOS Privilege Levels

The default configuration for Cisco IOS software-based networking devices uses privilege level 1 for user EXEC mode and privilege level 15 for privileged EXEC. The commands that can be run in user EXEC mode at privilege level 1 are a subset of the commands that can be run in privileged EXEC mode at privilege 15.

The **privilege** command is used to move commands from one privilege level to another. For example, some ISPs allow their first level technical support staff to enable and disable interfaces to activate new customer

connections or to restart a connection that has stopped transmitting traffic. See the Example Configuring a Device to Allow Users to Shut Down and Enable Interfaces, page 42 for an example of how to configure this option.

The **privilege** command can also be used to assign a privilege level to a username so that when a user logs in with the username, the session runs at the privilege level specified by the **privilege** command. For example, if you want your technical support staff to view the configuration on a networking device which will help them to troubleshoot network problems without being able to modify the configuration, you can create a username, configure it with privilege level 15, and configure it to run the **show running-config** command automatically. When a user logs in with the username the running configuration will be displayed automatically. The user's session will be logged out automatically after the user has viewed the last line of the configuration. See the Example Configuring a Device to Allow Users to View the Running Configuration, page 42 for an example of how to configure this option.

These command privileges can also be implemented when you are using AAA with TACACS+ and RADIUS. For example, TACACS+ provides two ways to control the authorization of router commands on a per-user or per-group basis. The first way is to assign privilege levels to commands and have the router verify with the TACACS+ server whether the user is authorized at the specified privilege level. The second way is to explicitly specify in the TACACS+ server, on a per-user or per-group basis, the commands that are allowed. For more information about implementing AAA with TACACS+ and RADIUS, see the technical note How to Assign Privilege Levels with TACACS+ and RADIUS .

Cisco IOS Password Configuration

Cisco IOS software does not prompt you to repeat any passwords that you configure to verify that you have entered the passwords exactly as you intended. New passwords, and changes to existing passwords, go into effect immediately after you press the Enter key at the end of a password configuration command string. If you make a mistake when you enter a new password and have saved the configuration on the networking device to its startup configuration file and exited privileged EXEC mode before you realize that you made a mistake, you may find that you are no longer able to manage the device.

The following are common situations that can happen:

- You make a mistake when configuring a password for local CLI sessions on the console port.
  - If you have properly configured access to your networking device for remote CLI sessions, you can Telnet to it and reconfigure the password on the console port.
- You make a mistake when configuring a password for remote Telnet or SSH sessions.
  - If you have properly configured access to your networking device for local CLI sessions, you can connect a terminal to it and reconfigure the password for the remote CLI sessions.
- You make a mistake when configuring a password for privileged EXEC mode (enable password or enable secret password).
  - You will have to perform a lost password recovery procedure.
- You make a mistake when configuring your username password, and the networking device requires that you log in to it with your username.
  - If you do not have access to another account name, you will have to perform a lost password recovery procedure.

To protect yourself from having to perform a lost password recovery procedure open two CLI sessions to the networking device and keep one of them in privileged EXEC mode while you reset the passwords using the other session. You can use the same device (PC or terminal) to run the two CLI sessions or two different devices. You can use a local CLI session and a remote CLI session or two remote CLI sessions for this procedure. The CLI session that you use to configure the password can also be used to verify that the

password was changed properly. The other CLI session that you keep in privileged EXEC mode can be used to change the password again if you made a mistake the first time you configured it.

You should not save password changes that you have made in the running configuration to the startup configuration until you have verified that your password was changed successfully. If you discover that you made a mistake configuring a password, and you were not able to correct the problem using the local and remote CLI session technique, you can power cycle the networking device so that it returns to the previous passwords that are stored in the startup configuration.

Product Security Baseline Password Encryption and Complexity Restrictions

Product security baseline (PSB) mandates basic security functions and features for all Cisco platforms and products.

There are 12 priority security requirements out of the 110 mandatory requirements in version 2.0 of the product security baseline that must be met to allow the shipping of any product.

The following two sections discuss restrictions that are relevant in AAA technology:

- Password complexity restrictions
- Protection of stored credentials

- Password Complexity Restrictions, page 19
- Protection of Stored Credentials, page 20

Password Complexity Restrictions

The PSB states the following requirements for password complexity restrictions on Cisco products:

- Whenever a user or an administrator wants to create or change a password, the following restrictions apply to the products:
  - The new password contains characters from at least three of the following classes: lowercase letters, uppercase letters, digits, and special characters.
  - No character in the new password should be repeated more than three times consecutively.
  - The new password should not be the same as the associated username, and should not be the username reversed. The password obtained by capitalization of the username or username reversed also is not accepted.
  - The new password should not be “cisco”, “ocsic”, or any variant obtained by changing the capitalization of letters therein, or by substituting “1”, “|”, or “!” for i, and substituting “0” for “o”, and substituting “$” for “s”.
- It must be possible to individually enable or disable each of these restrictions as part of the product configuration. A user interface should be available for one time to override the restrictions when a password is being set by an administrator.

The first restriction need not be applied to passwords that are expected to be used via a numerical pin pad; in this case, passwords consisting only of digits are permitted. However, such passwords must be used only for access to messaging services, and not for general computer networking services.

For an administrator to enable the restrictions, no particular default setting is required. Restrictions should be enabled by default on products that permit nonadministrative end users to change their own passwords.

AAA enforces these restrictions on creating passwords used in a AAA context which includes passwords created using the **username** command and passwords created to download authorization data.

The complexity restrictions are enabled or disabled using the **aaa password restriction** command. The behavior should be backward-compatible in allowing passwords that were configured before the complexity restrictions were enabled. The CLI should be disabled by default. When the CLI is enabled on a running router, the passwords configured prior to enabling the command should not be subject to the complexity restrictions. The passwords configured following the command should be subject to complexity restrictions. When a router is rebooted using a startup configuration containing the password complexity command enabled, the passwords present in the startup configuration should be allowed without the complexity restrictions; any passwords that are configured after the router has booted should be subject to the complexity restrictions.

Protection of Stored Credentials

The PSB states the following requirement for password complexity restrictions on Cisco products:

- If the product authenticates remote entities using protocols that do not require the product to possess recoverable copies of the remote entities' credentials, then no recoverable copies of credentials which are used only in this way are to be stored.
- In the specific case where the product authenticates remote entities using the traditional password interchange in which the remote entity discloses its credential to the product for direct comparison against a database, stored credentials must be protected by a method at least as strong as a SHA-1 digest. The use of SHA-256 or SHA-384 instead of SHA-1 is recommended.

To be compliant with the PSB, AAA enforces the protection of stored credentials using SHA-256.

Recovering from a Lost or Misconfigured Password for Local Sessions

Three methods can be used to recover a lost or misconfigured password for local CLI sessions over console port. The method that you will use depends on the current configuration of your networking device.

The following sections describes the three methods that can be used to recover a lost or misconfigured password:

- Networking Device Is Configured to Allow Remote CLI Sessions, page 20
- Networking Device Is Not Configured to Allow Remote CLI Sessions, page 20

Networking Device Is Configured to Allow Remote CLI Sessions

The fastest method to recover from a lost or misconfigured password for local CLI sessions is to establish a remote CLI session with the networking device and repeat the steps in the Configuring a Password for Local CLI Sessions, page 24. Your networking device must be configured to allow remote CLI sessions and you must know the remote CLI session password to perform this procedure.

Networking Device Is Not Configured to Allow Remote CLI Sessions

- If you cannot establish a remote session to your networking device, and you have not saved the misconfigured local CLI session password to the startup configuration, you can restart the networking device. When the networking device starts up again it will read the startup configuration file. The previous local CLI session password is restored.

Caution Restarting a networking device will cause it to stop forwarding traffic. This will also cause an interruption in any services that are running on the networking device, such as a DHCP server service. You should restart a networking device only during a period of time that has been allocated for network maintenance.

Recovering from a Lost or Misconfigured Password for Remote Sessions

Three methods that can be used to recover from a lost or misconfigured remote CLI session password. The method that you will use depends on the current configuration of your networking device.

- Networking Device Is Configured to Allow Local CLI Sessions, page 21
- Networking Device Is Not Configured to Allow Local CLI Sessions, page 21

Networking Device Is Configured to Allow Local CLI Sessions

The fastest method to recover from a lost or misconfigured password for remote CLI sessions is to establish a local CLI session with the networking device and repeat the steps in the Configuring a Password for Remote CLI Sessions, page 22. Your networking device must be configured to allow local CLI sessions and you must know the local CLI session password to perform this procedure.

Networking Device Is Not Configured to Allow Local CLI Sessions

- If you cannot establish a local CLI session to your networking device, and you have not saved the misconfigured remote CLI session password to the startup configuration, you can restart the networking device. When the networking device starts up again it will read the startup configuration file. The previous remote CLI session password is restored.

Caution Restarting a networking device will cause it to stop forwarding traffic. This will also cause an interruption in any services that are running on the networking device, such as a DHCP server service. You should restart a networking device only during a period of time that has been allocated for network maintenance.

Recovering from Lost or Misconfigured Passwords for Privileged EXEC Mode

Two methods can be used to recover from a lost or misconfigured privileged EXEC mode password. The method that you will use depends on the current configuration of your networking device.

- A Misconfigured Privileged EXEC Mode Password Has Not Been Saved, page 21

A Misconfigured Privileged EXEC Mode Password Has Not Been Saved

- If you have not saved the misconfigured privileged EXEC mode password to the startup configuration, you can restart the networking device. When the networking device starts up again it will read the startup configuration file. The previous privileged EXEC mode password is restored.

Caution Restarting a networking device will cause it to stop forwarding traffic. This will also cause an interruption in any services that are running on the networking device, such as a DHCP server service. You should restart a networking only device during a period of time that has been allocated for network maintenance.

How to Configure Security with Passwords Privileges and Logins

Protecting Access to User EXEC Mode

Configuring a Password for Remote CLI Sessions

This task will assign a password for remote CLI sessions. After you have completed this task the networking device will prompt you for a password the next time that you start a remote CLI session with it.

Cisco IOS software-based networking devices require that you have a password configured for remote CLI sessions. If you attempt to start a remote CLI session with a device that does not have a password configured for remote CLI sessions you will see a message that a password is required and the password is not set. The remote CLI session will be terminated by the remote host.

If you have not previously configured a password for remote CLI sessions, you must perform this task over a local CLI session using a terminal or a PC running a terminal emulation application attached to the console port.

Your terminal, or terminal emulation application, must be configured with the settings that are used by the console port on the networking device. The console ports on most Cisco networking devices require the following settings: 9600 baud, 8 data bits, 1 stop bit, no parity, and flow control is set to “none”. See the documentation for your networking device if these settings do not work for your terminal.

Note If you have not previously configured a password for remote CLI sessions, you must perform this task over a local CLI session using a terminal attached to the console port.

>

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **line vty** *line-number* [*ending-line-number*]
4. **password** *password*
5. **end**
6. **telnet** *ip-address*
7. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**line vty** *line-number* [*ending-line-number*] **Example:** `Router(config)# line vty 0 4`	Enters line configuration mode.
Step 4	**password** *password* **Example:** `Router(config-line)# password H7x3U8`	Assigns a password for remote CLI session. • The argument *password* is a character string that specifies the line password. The following rules apply to the *password* argument: ◦ The first character cannot be a number. ◦ The string can contain any alphanumeric characters, including spaces, up to 80 characters. You cannot specify the password in the format number-space-anything. ◦ Passwords are case-sensitive.

	Command or Action	Purpose
Step 5	**end** **Example:** `Router(config-line)# end`	Exits the current configuration mode and returns to privileged EXEC mode.
Step 6	**telnet** *ip-address* **Example:** `Router# telnet 172.16.1.1`	Start a remote CLI session with the networking device from your current CLI session using the IP address of an interface in the networking device that is in an operational state (interface up, line protocol up). • Enter the password that you configured is Step 4 when prompted. • To perform this step, your networking device must have an interface that is in an operational state. The interface must have a valid IP address. **Note** This procedure is often referred to as a starting recursive Telnet session because you are initiating a remote Telnet session with the networking device from the networking device itself.
Step 7	**exit** **Example:** `Router# exit`	Terminates the remote CLI session (recursive Telnet session) with the networking device.

• Troubleshooting Tips, page 24

Troubleshooting Tips

Repeat this task if you made a mistake when configuring the remote CLI session password.

Configuring a Password for Local CLI Sessions

This task will assign a password for local CLI sessions over the console port. After you have completed this task, the networking device will prompt you for a password the next time that you start a local CLI session on the console port.

This task can be performed over a local CLI session using the console port or a remote CLI session. If you want to perform the optional step of verifying that you have configured the password correctly you should perform this task using a local CLI session using the console port.

If you want to perform the optional step of verifying the local CLI session password, you must perform this task using a local CLI session. You must have a terminal or a PC running a terminal emulation program connected to the console port of the networking device. Your terminal must be configured with the settings that are used by the console port on the networking device. The console ports on most Cisco networking devices require the following settings: 9600 baud, 8 data bits, 1 stop bit, no parity, and flow control set to “none”. See the documentation for your networking device if these settings do not work for your terminal.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **line console** *line-number*
4. **password** *password*
5. **end**
6. **exit**
7. Press the Enter key, and enter the password from Step 4 when prompted.

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**line console** *line-number* **Example:** `Router(config)# line console 0`	Enters line configuration mode and selects the console port as the line that you are configuring.
Step 4	**password** *password* **Example:** `Router(config-line)# password Ji8F5Z`	Assigns a password for local CLI session over the console port. • The argument *password* is a character string that specifies the line password. The following rules apply to the *password* argument: ◦ The first character cannot be a number. ◦ The string can contain any alphanumeric characters, including spaces, up to 80 characters. You cannot specify the password in the format number-space-anything. ◦ Passwords are case-sensitive.
Step 5	**end** **Example:** `Router(config-line)# end`	Exits the current configuration mode and returns to privileged EXEC mode.

	Command or Action	Purpose
Step 6	**exit** **Example:** `Router# exit`	Exits privileged EXEC mode.
Step 7	Press the Enter key, and enter the password from Step 4 when prompted.	(Optional) Initiates the local CLI session on the console port. • Enter the password that you configured is Step 4 when prompted to verify that it was configured correctly. **Note** This step can be performed only if you are using a local CLI session to perform this task.

- Troubleshooting Tips, page 26

Troubleshooting Tips

If your new password is not accepted proceed to the Configuration Examples for Configuring Security with Passwords Privileges and Logins for instructions on what to do next.

Protecting Access to Privileged EXEC Mode

Configuring the Enable Password

Cisco no longer recommends that you use the **enable password** command to configure a password for privileged EXEC mode. The password that you enter with the **enable password**command is stored as plain text in the configuration file of the networking device. You can encrypt the password for the **enable password**command in the configuration file of the networking device using the **service password-encryption** command. However the encryption level used by the **service password-encryption** command can be decrypted using tools available on the Internet.

Instead of using the **enable password**command, Cisco recommends using the **enable secret** commandbecause it encrypts the password that you configure with strong encryption. For more information on password encryption issues see the Cisco IOS Password Encryption Levels, page 16. For information on configuring the **enable secret**command see the Configuring the Enable Secret Password, page 29.

Note The networking device must not have a password configured by the **enable secret** command in order for you to perform this task successfully. If you have already configured a password for privileged EXEC mode using the **enable secret**command, that the password configured takes precedences over the password that you configure in this task using the **enable password** command.

You cannot use the same password for the **enable secret**command and the **enable** *password* command.

>

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **enable password** *password*
4. **end**
5. **exit**
6. **enable**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose
Step 3	**enable password** *password* **Example:** `Router(config)# enable password t6D77CdKq`	Configures a password for privileged EXEC mode. • The argument *password* is a character string that specifies the enable password. • The argument *password*must contain from 1 to 25 uppercase and lowercase alphanumeric characters. • The argument *password*must not have a number as the first character. • The argument *password*can have leading spaces, but they are ignored. However, intermediate and trailing spaces are recognized. • The argument *password*can contain the question mark (?) character if you precede the question mark with the key combination Crtl-v when you create the password; for example, to create the password abc?123, do the following: ◦ Enter abc ◦ Type Crtl-v ◦ Enter ?123
Step 4	**end** **Example:** `Router(config)# end`	Exits the current configuration mode and returns to privileged EXEC mode.
Step 5	**exit** **Example:** `Router# exit`	Exits privileged EXEC mode.
Step 6	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter the password you configured in Step 3.

• Troubleshooting Tips, page 28

Troubleshooting Tips

If your new password is not accepted, proceed to the Recovering from Lost or Misconfigured Passwords for Privileged EXEC Mode section for instructions on what to do next.

Configuring Password Encryption for Clear Text Passwords

Cisco IOS software stores passwords in clear text in network device configuration files for several features such as passwords for local and remote CLI sessions, and passwords for neighbor authentication for routing protocols. Clear text passwords are a security risk because anybody with access to archived copies of the

configuration files can discover the passwords that are stored as clear text. The **service password-encryption**command can be used to encrypt clear text commands in the configuration files of networking devices. See the Cisco IOS Password Encryption Levels, page 16 for more information.

Complete the following steps to configure password encryption for passwords that are stored as clear text in the configuration files of your networking device.

You must have at least one feature that uses clear text passwords configured on your networking device for the **service password-encryption**command to have any immediate effect.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **service password-encryption**
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**service password-encryption** **Example:** `Router(config)# service password-encryption`	Configures password encryption for all passwords, clear text passwords, including username passwords, authentication key passwords, the privileged command password, console and virtual terminal line access passwords, and BGP neighbor passwords.
Step 4	**end** **Example:** `Router(config)# end`	Exits the current configuration mode and returns to privileged EXEC mode.

Configuring the Enable Secret Password

Cisco recommends that you use the **enable secret** command, instead of the **enable** *password* command to configure a password for privileged EXEC mode. The password created by the **enable secret** command is encrypted with the more secure MD5 algorithm.

Note You cannot use the same password for the **enable secret**command and the **enable** *password* command.

>

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. Do one of the following:
   - **enable secret** *unencrypted-password*
   -
   - **enable secret** *encryption-type encrypted-password*
4. **end**
5. **exit**
6. **enable**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

	Command or Action	Purpose

Step 3	Do one of the following:
	• **enable secret** *unencrypted-password*
	•
	• **enable secret** *encryption-type encrypted-password*
	Example:
	`Router(config)# enable secret t6D77CdKq`
	Example:
	Example:
	`Router(config)# enable secret 5 $1$/x6H $RhnDI3yLC4GA01aJnHLQ4/`
		Configures a password for privileged EXEC mode.
		• The argument *password* is a character string that specifies the **enable secret** password. The following rules apply to the *password* argument:
		• The argument *password*must contain from 1 to 25 uppercase and lowercase alphanumeric characters.
		• The argument *password*must not have a number as the first character.
		• The argument *password*can have leading spaces, but they are ignored. However, intermediate and trailing spaces are recognized.
		• The argument *password*can contain the question mark (?) character if you precede the question mark with the key combination Crtl-v when you create the password; for example, to create the password abc?123, do the following:
		◦ Enter abc
		◦ Type Crtl-v
		◦ Enter ?123
		or
		Sets a previously encrypted password for privileged EXEC mode by entering the number 5 before the previously encrypted string.
		• You must enter an exact copy of a password from a configuration file that was previously encrypted by the **enable secret** command to use this method.

Step 4	**end** **Example:** `Router(config)# end`	Exits the current configuration mode and returns to privileged EXEC mode.
Step 5	**exit** **Example:** `Router# exit`	Exits privileged EXEC mode.
Step 6	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter the password that you configured in Step 3.

• Troubleshooting Tips, page 32

Troubleshooting Tips

If your new password is not accepted proceed to the Recovering from Lost or Misconfigured Passwords for Privileged EXEC Mode, page 21 for instructions on what to do next.

Configuring Security Options to Manage Access to CLI Sessions and Commands

The tasks in this section describe how to configure your networking device to permit the use of a subset of privileged EXEC mode commands by users who should not have access to all of the commands that are available in privileged EXEC mode.

These tasks are beneficial for companies that have multiple levels of network support staff and the company wants the staff at each level to have access to a different subset of the privileged EXEC mode commands.

In this task the users who should not have access to all of the commands that are available in privileged EXEC mode are referred to as the first-line technical support staff.

This section contains the following procedures:

Configuring the Networking Device for the First-Line Technical Support Staff

This task describes how to configure the networking device for first-line technical support users. First-line technical support staff are usually not allowed to run all of the commands available in privileged EXEC mode (privilege level 15) on a networking device. They are prevented from running commands that they are not authorized for by not being granted access to the password assigned to privileged EXEC mode or to other roles that have been configured on the networking device.

The **privilege** command is used to move commands from one privilege level to another in order to create the additional levels of administration of a networking device that is required by companies that have different levels of network support staff with different skill levels.

The default configuration of a Cisco IOS device permits two types of users to access the CLI. The first type of user is allowed to access only user EXEC mode. The second type of user is allowed access to privileged EXEC mode. A user who is allowed to access only user EXEC mode is not allowed to view or change the configuration of the networking device, or to make any changes to the operational status of the networking device. However, a user who is allowed access to privileged EXEC mode can make any change to a networking device that is allowed by the CLI.

In this task the two commands that normally run at privilege level 15 are reset to privilege level 7 using the **privilege** command so that first-line technical support users will be allowed to run the two commands. The two commands for which the privilege levels will be reset are the **clear counters** command and **reload** command.

- The **clear counters** command is used to reset the counter fields on interfaces for statistics such as packets received, packets transmitted, and errors. When a first-line technical support user is troubleshooting an interface-related connectivity issue between networking devices, or with remote users connecting to the network, it is useful to reset the interface statistics to zero and then monitor the interfaces for a period of time to see if the values in the interface statistics counters change.

- The **reload** command is used initiate a reboot sequence for the networking device. One common use of the reload command by the first-line technical support staff is to cause the networking device to reboot during a maintenance window so that it loads a new operating system that was previously copied onto the networking device's file system by a user with a higher level of authority.

Any user that is permitted to know the **enable secret** password that is assigned to the first-line technical support user role privilege level can access the networking device as a first-line technical support user. You can add a level of security by configuring a username on the networking device and requiring that the users know the username and the password. Configuring a username as an additional level of security is described in the Configuring a Device to Require a Username for the First-Line Technical Support Staff, page 37.

Before Cisco IOS Releases 12.0(22)S and 12.2(13)T, each command in a privilege level had to be specified with a separate **privilege** command. In Cisco IOS Releases 12.0(22)S, 12.2(13)T, and later releases, a "wildcard" option specified by the new keyword **all** was introduced that allows you to configure access to multiple commands with only one **privilege** command. By using the new **all** keyword, you can specify a privilege level for all commands which begin with the string you enter. In other words, the **all** keyword allows you to grant access to all command-line options and suboptions for a specified command.

For example, if you wanted to create a privilege level to allow users to configure all commands which begin with **service-module t1** (such as **service-module t1 linecode** or **service-module t1 clock source**) you can use the **privilege interface all level 2 service-module t1** command instead of having to specify each **service-module t1** command separately.

If the command specified in the **privilege** command (used with the **all** keyword) enables a configuration submode, all commands in the submode of that command will also be set to the specified privilege level.

Note The **all** "wildcard" keyword option for the **privilege** command is not supported in versions of Cisco IOS software prior to Cisco IOS Releases 12.0(22)S and, 12.2(13)T.

You must not have the **aaa new-model** command enabled on the networking device. You must not have the **login local** command configured for the local CLI sessions over the console port or the remote CLI sessions.

Note For clarity, only the arguments and keywords that are relevant for each step are shown in th steps in this task. See the Cisco IOS command reference book for your Cisco IOS release fo information on the additional arguments and keywords that can be used with these comman

Caution Do not use the **no** form of the **privilege** command to reset the privilege level of a command because it might not return the configuration to the correct default state. Use the **reset** keyw **privilege** command instead to return a command to its default privilege level. For example, **privilege exec level** *reload* command from the configuration and return the **reload** comman privilege of 15, use the **privilege exec reset** *reload*command.

>

SUMMARY STEPS

1. **enable** *password*
2. **configure terminal**
3. **enable secret level** *level password*
4. **privilege exec level** *level command-string*
5. **privilege exec all level** *level command-string*
6. **end**

DETAILED STEPS

Step 1 **enable** *password*
Enters privileged EXEC mode. Enter the password when prompted.

Example:

```
Router> enable
```

Step 2 **configure terminal**
Enters global configuration mode.

Example:

```
Router# configure
 terminal
```

Step 3 **enable secret level** *level password*
Configures a new enable secret password for privileged EXEC mode.

Example:

```
Router(config)# enable secret level 7 Zy72sKj
```

Step 4 **privilege exec level** *level command-string*
Changes the privilege level of the **clear counters** command from one privilege level to another.

Example:

```
Router(config)# privilege exec level 7 clear counters
```

Step 5 **privilege exec all level** *level command-string*
Changes the privilege level of the **reload** command from one privilege level to another.

Example:

```
Router(config)# privilege
 exec
 all
 level
```

```
7 reload
```

Step 6 **end**
Exits global configuration mode.

Example:

```
Router(config)# end
```

Verifying the Configuration for the First-Line Technical Support Staff

This task describes how to verify that the network device is configured correctly for the first-line technical support staff.

The following commands must have been modified to run at privilege level 7 for this task:

- **clear counters**
- **reload**

SUMMARY STEPS

1. **enable** *level password*
2. **show privilege**
3. **clear counters**
4. **clear ip route ***
5. **reload in** *time*
6. **reload cancel**
7. **disable**
8. **show privilege**

DETAILED STEPS

Step 1 **enable** *level password*
Logs the user in into the networking device at the privilege level specified for the *level* argument.

Example:

```
Router> enable 7 Zy72sKj
```

Step 2 **show privilege**
Displays the privilege level of the current CLI session.

Example:

```
Router# show privilege
Current privilege level is 7
```

Step 3 **clear counters**

Clears the interface counters.

Example:

```
Router# clear
 counters
Clear "show interface" counters on all interfaces [confirm]
Router#
02:41:37: %CLEAR-5-COUNTERS: Clear counter on all interfaces by console
```

Step 4 **clear ip route ***

The **clear ip route**command should not be allowed because it was never changed from the default privilege 15 to the privilege level 7.

Example:

```
Router# clear
 ip
 route
 *
        ^
% Invalid input detected at '^' marker.
Router#
```

Step 5 **reload in** *time*

Causes the networking device to reboot.

Example:

```
Router# reload in 10
Reload scheduled in 10 minutes by console
Proceed with reload? [confirm]
Router#
***
*** --- SHUTDOWN in 0:10:00 ---
***
02:59:50: %SYS-5-SCHEDULED_RELOAD: Reload requested for 23:08:30 PST Sun Mar 20
```

Step 6 **reload cancel**

The **reload cancel** command terminates a reload that was previously set up with the **reload in** *time* command.

Example:

```
Router# reload
 cancel
***
*** --- SHUTDOWN ABORTED ---
***
04:34:08: %SYS-5-SCHEDULED_RELOAD_CANCELLED:  Scheduled reload cancelled at 15:38:46 PST Sun Mar
27 2005
```

Step 7 **disable**

Exits the current privilege level and returns to privilege level 1.

Example:

```
Router# disable
```

Step 8 **show privilege**

Displays the privilege level of the current CLI session.

Example:

```
Router> show privilege
Current privilege level is 1
```

- Troubleshooting Tips, page 37

Troubleshooting Tips

If your configuration does not work the way that you want it to and you want to remove the privilege commands from the configuration, use the **reset** keyword for the **privilege** command to return the commands to their default privilege level. For example, to remove the command **privilege exec level** *reload* command from the configuration and return the **reload** command to its default privilege of 15 use the **privilege exec reset** *reload*command.

Configuring a Device to Require a Username for the First-Line Technical Support Staff

This task configures the networking device to require that the first-line technical support staff log in to the networking device with a login name of admin. The admin username configured in this task is assigned the privilege level of 7, which will allow users who log in with this name to run the commands that were reassigned to privilege level 7 in the Configuring the Networking Device for the First-Line Technical Support Staff, page 32 task. When a user successfully logs in with the admin username, the CLI session will automatically enter privilege level 7.

Before Cisco IOS Releases 12.0(18)S and 12.2(8)T, two types of passwords were associated with usernames: Type 0, which is a clear text password visible to any user who has access to privileged mode on the router, and type 7, which has a password encrypted by the **service password encryption** command.

In Cisco IOS Releases 12.0(18)S, 12.2(8)T, and later releases, the new **secret** keyword for the **username** command allows you to configure MD5 encryption for username passwords.

The following commands must have been modified to run at privilege level 7 for this task:

- **clear counters**
- **reload**

See the Configuring the Networking Device for the First-Line Technical Support Staff, page 32 for instructions on how to change the privilege level for a command.

Note MD5 encryption for the **username** command is not supported in versions of Cisco IOS software prior to Cisco IOS Releases 12.0(18)S and 12.2(8)T.

You must not have the **aaa-new model** command enabled on the networking device. You must not have the **login local** command configured for the local CLI sessions over the console port or the remote CLI sessions.

Note For clarity, only the arguments and keywords that are relevant for each step are shown in the sy steps in this task. Refer to the Cisco IOS command reference book for your Cisco IOS release f information on the additional arguments and keywords that can be used with these commands.

>

SUMMARY STEPS

1. **enable** *password*
2. **configure terminal**
3. **username** *username* **privilege** *level* **secret** *password*
4. **end**
5. **disable**
6. **login**
7. **show privilege**
8. **clear counters**
9. **clear ip route ***
10. **reload in** *time*
11. **reload cancel**
12. **disable**
13. **show privilege**

DETAILED STEPS

Step 1 **enable** *password*
Enters privileged EXEC mode. Enter the password when prompted.

Example:

```
Router> enable
```

Step 2 **configure terminal**
Enters global configuration mode.

Example:

```
Router# configure
 terminal
```

Step 3 **username** *username* **privilege** *level* **secret** *password*
Creates a username and applies MD5 encryption to the *password* text string.

Example:

```
Router(config)# username admin privilege 7 secret Kd65xZa
```

Step 4 **end**
Exits global configuration mode.

Example:

```
Router(config)# end
```

Step 5 **disable**
Exits the current privilege level and returns to user EXEC mode.

Example:

```
Router# disable
```

Step 6 **login**
Logs in the user. Enter the username and password you configured in Step 3 when prompted.

Example:

```
Router# login
```

Step 7 **show privilege**
The **show privilege** command displays the privilege level of the CLI session.

Example:

```
Router# show privilege
Current privilege level is 7
```

Step 8 **clear counters**
The **clear counters** command clears the interface counters.

Example:

```
Router# clear
 counters
Clear "show interface" counters on all interfaces [confirm]
Router#
02:41:37: %CLEAR-5-COUNTERS: Clear counter on all interfaces by console
```

Step 9 **clear ip route ***
The **clear ip route**command is not allowed because because it was never changed from the default privilege 15 to the privilege level 7.

Example:

```
Router# clear ip route
 *
        ^
% Invalid input detected at '^' marker.
Router#
```

Step 10 **reload in** *time*

The reload command causes the networking device to reboot.

Example:

```
Router# reload in 10
Reload scheduled in 10 minutes by console
Proceed with reload? [confirm]
Router#
***
*** --- SHUTDOWN in 0:10:00 ---
***
02:59:50: %SYS-5-SCHEDULED_RELOAD: Reload requested for 23:08:30 PST Sun Mar 20
```

Step 11 **reload cancel**

Terminates a reload that was previously set up with the **reload in** *time* command.

Example:

```
Router# reload
 cancel
***
*** --- SHUTDOWN ABORTED ---
***
04:34:08: %SYS-5-SCHEDULED_RELOAD_CANCELLED:  Scheduled reload cancelled at 15:38:46 PST Sun Mar
27 2005
```

Step 12 **disable**

Exits the current privilege level and returns to user EXEC mode.

Example:

```
Router# disable
```

Step 13 **show privilege**

Displays the privilege level of the current CLI session.

Example:

```
Router> show
 privilege
Current privilege level is 1
```

Configuration Examples for Configuring Security with Passwords Privileges and Logins

Example Configuring a Device to Allow Users to Clear Remote Sessions

The following example shows how to configure a networking device to allow a nonadministrative user to clear remote CLI session vty lines.

The first section is an excerpt of the running configuration for this example. The following sections show you how this example is used.

The following section is an excerpt of the running configuration:

```
!
privilege exec level 7 clear line
!
no aaa new-model
!
!
username admin privilege 7 secret 5 $1$tmIw$1aM7sadKhWMpkVTzxNw1J.
!
privilege exec level 7 clear line
!
! the privilege exec level 7 clear command below is entered automatically
! when you enter the privilege exec level 7 clear line command above, do
! not enter it again
!
privilege exec level 7 clear
!
```

The following section using the **login** command shows the user logging in to the networking device with the username of admin:

```
Router> login
Username: admin
Password:
```

The following section using the **show privilege** command shows that the current privilege level is 7:

```
Router# show privilege

Current privilege level is 7
Router#
```

The following section using the **show user** command shows that two users (admin and root) are currently logged in to the networking device:

```
Router# show user

    Line       User       Host(s)              Idle       Location
*  0 con 0     admin      idle                 00:00:00
   2 vty 0     root       idle                 00:00:17 172.16.6.2
  Interface    User               Mode         Idle     Peer Address
```

The following section using the **clear line** command terminates the remote CLI session in use by the username root:

```
Router# clear line 2

[confirm]
 [OK]
```

The following section using the **show user** command shows that admin is the only user logged in to the networking device:

```
Router# show user
    Line       User       Host(s)              Idle       Location
*  0 con 0     admin      idle                 00:00:00
  Interface    User               Mode         Idle     Peer Address
```

Example Configuring a Device to Allow Users to View the Running Configuration

The following example shows how to configure a networking device to allow a nonadministrative users (no access to privileged EXEC mode) to view the running configuration automatically. This example requires that the username is configured for privilege level 15 because many of the commands in the configuration file can be viewed only by users who have access to privilege level 15.

The solution is to temporarily allow the user access to privilege level 15 while running the **show running-config** command and then terminating the CLI session when the configuration file has been viewed. In this example the networking device will automatically terminate the CLI session when the end of the configuration file has been viewed. No further configuration steps are required.

Caution You must include the **noescape** keyword for the **username** command to prevent the user from entering an escape character that will terminate viewing the configuration file and leave the session running at privilege level 15.

```
!
!
username viewconf privilege 15 noescape secret 5 $1$zA9C$TDWD/Q0zwp/5xRwRqdgc/.
username viewconf autocommand show running-config
!
```

Example Configuring a Device to Allow Users to Shut Down and Enable Interfaces

The following example shows how to configure a networking device to allow nonadministrative users to shut down and enable interfaces.

The first section is an excerpt of the running configuration for this example. The following sections show you how this example is used.

The following section is an excerpt of the running configuration:

```
!
no aaa new-model
!
username admin privilege 7 secret 5 $1$tmIw$1aM7sadKhWMpkVTzxNw1J.
!
```

```
privilege interface all level 7 shutdown
privilege interface all level 7 no shutdown
privilege configure level 7 interface
privilege exec level 7 configure terminal
!
! the privilege exec level 7 configure command below is entered automatically
! when you enter the privilege exec level 7 configure terminal command above, do
! not enter it again
!
privilege exec level 7 configure
!
```

The following section using the **login** command shows the user logging in to the networking device with the username of admin:

```
Router> login
Username: admin
Password:
```

The following section using the **show privilege** command shows that the current privilege level is 7:

```
Router# show privilege
Current privilege level is 7
```

The following section using the **show user** command shows that admin is the only user logged in to the networking device:

```
Router# show user
    Line       User       Host(s)              Idle       Location
*  0 con 0     admin      idle                 00:00:00
  Interface    User               Mode         Idle     Peer Address
```

The following section shows that the admin user is permitted to shut down and enable an interface:

```
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# interface ethernet 1/0
Router(config-if)# shutdown
Router(config-if)# no shutdown
Router(config-if)# exit
Router#
```

Where to Go Next

Once you have established a baseline of security for your networking devices you can consider more advanced options such as:

- Role-based CLI access--The role-based CLI access feature offers a more comprehensive set of options than the **privilege** command (described in this document) for network managers who want to allow different levels of technical support staff to have different levels of access to CLI commands.
- AAA security--Many Cisco networking devices offer an advanced level of security using AAAfeatures. All of the tasks described in this document, and other--more advanced security features--can be implemented using AAA on the networking device in conjunction with a remote TACACS+ or RADIUS server. For information how to configure AAA security features that can be run locally on a networking device, or for information on how to configure remote AAA security using TACACS+ or RADIUS servers, see the *Cisco IOS Security Configuration Guide: Securing User Services, Cisco IOS Release 15.1M&T* .

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Security commands	*Cisco IOS Security Command Reference*
Managing user access to CLI commands and configuration information	Role-Based CLI Access
Configuring MD5 secure neighbor authentication for protocols such as OSPF and BGP	Neighbor Router Authentication: Overview and Guidelines
Assigning privilege levels with TACACS+ and RADIUS	How to Assign Privilege Levels with TACACS+ and RADIUS

Standards

Standard	Title
No new or modified RFCs are supported by this functionality, and support for existing RFCs has not been modified.	--

MIBs

MIBs	MIBs Link
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
No new or modified RFCs are supported by this functionality, and support for existing RFCs has not been modified.	--

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Configuring Security with Passwords Privileges and Logins

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 2 Feature Information for Configuring Security with Passwords, Privilege Levels and, Login Usernames for CLI Sessions on Networking Devices

Feature Name	Releases	Feature Configuration Information
Enhanced Password Security	12.0(18)S 12.2(8)T	Using the Enhanced Password Security feature, you can configure MD5 encryption for username passwords. MD5 encryption is a one-way hash function that makes reversal of an encrypted password impossible, providing strong encryption protection. Using MD5 encryption, you cannot retrieve clear text passwords. MD5 encrypted passwords cannot be used with protocols that require that the clear text password be retrievable, such as Challenge Handshake Authentication Protocol (CHAP).

Feature Name	Releases	Feature Configuration Information
Privilege Command Enhancement	12.0(22)S 12.2(13)T	The **all**keyword was added to the **privilege** command as a wild card to reduce the number of times that the **privilege** command is entered when you are changing the privilege level of several keywords for the same command.
Product Security Baseline: Password Encryption and Complexity Restrictions	15.0(1)S	This feature enforces restrictions on creating passwords used in a AAA context that includes passwords created through the **username** command and passwords created to download authorization data. The following commands were introduced or modified: **aaa password restriction**, **enable secret**, **username secret**.

No Service Password-Recovery

The No Service Password-Recovery feature is a security enhancement that prevents anyone with console access from accessing the router configuration and clearing the password. It also prevents anyone from changing the configuration register values and accessing NVRAM.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for No Service Password-Recovery

You must download and install ROM monitor (ROMMON) version 12.2(11)YV1 before you can use this feature.

Information About No Service Password-Recovery

Cisco Password Recovery Procedure

The Cisco IOS software provides a password recovery procedure that relies upon gaining access to ROMMON mode using the Break key during system startup. When the router software is loaded from ROMMON mode, the configuration is updated with the new password.

The password recovery procedure enables anyone with console access, the ability to access the router and its network. The No Service Password-Recovery feature prevents the completion of the Break key sequence and the entering of ROMMON mode during system startups and reloads.

Configuration Registers and System Boot Configuration

The lowest four bits of the configuration register (bits 3, 2, 1, and 0) form the boot field. The boot field determines if the router boots manually from ROM or automatically from flash or the network. For example, when the configuration register boot field value is set to any value from 0x2 to 0xF, the router uses the boot field value to form a default boot filename for autobooting from a network server.

Bit 6, when set, ignores the startup configuration, while bit 8 enables a break. To use the No Security Password Recovery feature, you must set the configuration register to autoboot before it can be enabled. Any other configuration register setting will prevent the feature from being enabled.

Note By default, the no confirm prompt and message are not displayed after reloads.

How to Enable No Service Password-Recovery

Upgrading the ROMMON Version

If your router or access server does not find a valid system image to load, the system will enter ROMMON mode. ROMMON mode can also be accessed by interrupting the boot sequence during startup.

Another method for entering ROMMON mode is to set the configuration register so that the router automatically enters ROMMON mode when it boots. For information about setting the configuration register value, refer to the *Cisco IOS Configuration Fundamentals Configuration Guide* and *Cisco IOS Network Management Configuration Guide* .

Perform this task to upgrade your version of ROMMON.

SUMMARY STEPS

1. **reload**
2. **set** *tftp-file ip-address ip-subnet-mask default-gateway tftp-server*
3. **sync**
4. **tftpdnld -u**
5. **boot**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**reload** **Example:** `Router> reload`	Reloads a Cisco IOS image. After you issue this command and respond to the system prompts as necessary, the system will begin reloading the system software image. • While the system is reloading, press the Break key or a Break key-combination just after the "Compiled <date> by" message appears. Pressing the Break key interrupts the boot sequence and puts the router into ROMMON mode. **Note** The default Break key combination is Ctrl-C, but this may be configured differently on your system.
Step 2	**set** *tftp-file ip-address ip-subnet-mask default-gateway tftp-server* **Example:** `ROMMON> set tftpabc 10.10.0.0 255.0.0.0 10.1.1.0 10.29.32.0`	Displays all the created variables. The arguments are as follows: • *tftp-file* --Location of the new ROMMON image on the TFTP server. The length of the filename is a maximum of 45 characters. • *ip-address* --IP address on the router to connect to the TFTP server. • *ip-subnet-mask* --IP subnet mask of the router. • *default-gateway* --IP address of the gateway of the TFTP server. • *tftp-server* --IP address of the TFTP server from which the image will be downloaded. **Note** This command is not supported on the Cisco 800 series routers.
Step 3	**sync** **Example:** `ROMMON> sync`	Saves the changes to the image.
Step 4	**tftpdnld -u** **Example:** `ROMMON> tftpdnld -u`	Downloads the new ROMMON image from the TFTP server. • Reset if prompted.

	Command or Action	Purpose
Step 5	**boot** **Example:** `ROMMON> boot`	Boots the router with the Cisco IOS image in flash memory.

Verifying the Upgraded ROMMON Version

To verify that you have an upgraded version of ROMMON, use the show version command:

```
Router# show version
Cisco IOS Software, C828 Software (C828-K9OS&6-M), Version 12.3 (20040702:094716)
[userid 168]
Copyright (c) 1986-2004 by Cisco Systems, Inc.
ROM: System Bootstrap, Version 12.2(11)YV1, Release Software (fc1)
Router uptime is 22 minutes
System returned to ROM by reload
.
.
.
```

Enabling No Service Password-Recovery

Perform this task to enable the No Service Password-Recovery feature.

Note As a precaution, a valid Cisco IOS image should reside in flash memory before this feature is enabled.

If you plan to enter the **no service password-recovery** command, Cisco recommends that you save a copy of the system configuration file in a location away from the switch or router. If you are using a switch that is operating in VLAN Trunking Protocol (VTP) transparent mode, Cisco recommends that you also save a copy of the vlan.dat file in a location away from the switch.

Always disable the feature before downgrading to an image that does not support this feature, because you cannot reset after the downgrade.

The configuration register boot bit must be enabled so that there is no way to break into ROMMON when this command is configured. Cisco IOS software should prevent the user from configuring the boot field in the config register.

Bit 6, which ignores the startup configuration, and bit 8, which enables a break, should be set.

The Break key should be disabled while the router is booting up and disabled in Cisco IOS software when this feature is enabled.

SUMMARY STEPS

1. **enable**
2. **show version**
3. **configure terminal**
4. **config-register** *value*
5. **no service password-recovery**
6. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show version** **Example:** `Router# show version`	Displays information about the system software, including configuration register settings. • The configuration register must be set to autoboot before entering the **no service password-recovery** command.
Step 3	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 4	**config-register** *value* **Example:** `Router(config)# config-register 0x2012`	(Optional) Changes the configuration register setting. • If necessary, change the configuration register setting so the router is set to autoboot.
Step 5	**no service password-recovery** **Example:** `Router(config)# no service password-recovery`	Disables password-recovery capability at the system console.

Command or Action	Purpose
Step 6 **exit** **Example:** `Router(config)# exit`	Exits global configuration mode and returns to EXEC mode.

Recovering a Device from the No Service Password-Recovery Feature

To recover a device once the No Service Password-Recovery feature has been enabled, press the Break key just after the 'Compiled <date> by' message appears during the boot. You are prompted to confirm the Break key action. When you confirm the action, the startup configuration is erased, the password-recovery procedure is enabled, and the router boots with the factory default configuration.

If you do not confirm the Break key action, the router boots normally with the No Service Password-Recovery feature enabled.

- Examples, page 52

Examples

This section provides the following examples of the process:

- Confirmed Break, page 52
- Unconfirmed Break, page 53

Confirmed Break

```
PASSWORD RECOVERY FUNCTIONALITY IS DISABLED
program load complete, entry point: 0x80013000, size: 0x8396a8
Self decompressing the image :
################################################################################
################################################################################ [OK]
telnet> send break
telnet> send break
telnet> send break
Restricted Rights Legend
Use, duplication, or disclosure by the Government is subject to restrictions as set forth
in subparagraph (c) of the Commercial Computer Software - Restricted Rights clause at FAR
sec. 52.227-19 and subparagraph (c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, California 95134-1706
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-IPBASE-M), Version 12.3(26), RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by cisco Systems, Inc.
Compiled Mon 17-Mar-08 15:24 by dchih
PASSWORD RECOVERY IS DISABLED.
Do you want to reset the router to factory default configuration and proceed [y/n] ?
Reset router configuration to factory default.
This product contains cryptographic features and is subject to United States and local
country laws governing import, export, transfer and use. Delivery of Cisco cryptographic
products does not imply third-party authority to import, export, distribute or use
encryption.
Importers, exporters, distributors and users are responsible for compliance with U.S. and
```

```
local country laws. By using this product you agree to comply with applicable laws and
regulations. If you are unable to comply with U.S. and local laws, return this product
immediately.
A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html
If you require further assistance please contact us by sending email to export@cisco.com.
Cisco C831 (MPC857DSL) processor (revision 0x00) with 46695K/2457K bytes of memory.
Processor board ID 0000 (1314672220), with hardware revision 0000 CPU rev number 7
3 Ethernet interfaces
4 FastEthernet interfaces
128K bytes of NVRAM.
24576K bytes of processor board System flash (Read/Write)
2048K bytes of processor board Web flash (Read/Write)
         --- System Configuration Dialog ---
Would you like to enter the initial configuration dialog? [yes/no]: no
!Start up configuration is erased.
SETUP: new interface FastEthernet1 placed in “up” state
SETUP: new interface FastEthernet2 placed in “up” state
SETUP: new interface FastEthernet3 placed in “up” state
SETUP: new interface FastEthernet4 placed in “up” state
Press RETURN to get started!
Router>
Router> enable
Router# show startup configuration
startup-config is not present
Router# show running-conf ig | in
cl service
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!The “no service password-recovery” is disabled.
```

Unconfirmed Break

```
PASSWORD RECOVERY FUNCTIONALITY IS DISABLED
telnet> send break
program load complete, entry point: 0x80013000, size: 0x8396a8
Self decompressing the image :
################################################################################################ [OK]
telnet> send break
telnet> send break
Restricted Rights Legend
Use, duplication, or disclosure by the Government is subject to restrictions as set forth
in subparagraph (c) of the Commercial Computer Software - Restricted Rights clause at FAR
sec. 52.227-19 and subparagraph (c) (1) (ii) of the Rights in Technical Data and Computer
Software clause at DFARS sec. 252.227-7013.
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, California 95134-1706
Cisco Internetwork Operating System Software
IOS (tm) C2600 Software (C2600-IPBASE-M), Version 12.3(26), RELEASE SOFTWARE (fc2)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by cisco Systems, Inc.
Compiled Mon 17-Mar-08 15:24 by dchih
PASSWORD RECOVERY IS DISABLED.
Do you want to reset the router to factory default configuration and proceed [y/n] ?
PASSWORD RECOVERY IS DISABLED.
Do you want to reset the router to factory default configuration and proceed [y/n] ?
!The user enters “N” here.
This product contains cryptographic features and is subject to United States and local
country laws governing import, export, transfer and use. Delivery of Cisco cryptographic
products does not imply third-party authority to import, export, distribute or use
encryption.
Importers, exporters, distributors and users are responsible for compliance with U.S. and
local country laws. By using this product you agree to comply with applicable laws and
regulations. If you are unable to comply with U.S. and local laws, return this product
immediately.
A summary of U.S. laws governing Cisco cryptographic products may be found at: http://
www.cisco.com/wwl/export/crypto/tool/stqrg.html
If you require further assistance please contact us by sending email to export@cisco.com.
Cisco C831 (MPC857DSL) processor (revision 0x00) with 46695K/2457K bytes of memory.
```

```
Processor board ID 0000 (1314672220), with hardware revision 0000
CPU rev number 7
3 Ethernet interfaces
4 FastEthernet interfaces
128K bytes of NVRAM.
24576K bytes of processor board System flash (Read/Write)
2048K bytes of processor board Web flash (Read/Write)
Press RETURN to get started!
!The Cisco IOS software boots as if it is not interrupted.
Router> enable
Router#
Router# show startup config
Using 984 out of 131072 bytes
!
version 12.3
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
no service password-recovery
!
hostname Router
!
boot-start-marker
boot-end-marker
!
memory-size iomem 5
!
no aaa new-model
ip subnet-zero
!
ip ips po max-events 100
no ftp-server write-enable
!
interface Ethernet0
 no ip address
 shutdown
!
interface Ethernet1
 no ip address
 shutdown
 duplex auto
!
interface Ethernet2
 no ip address
 shutdown
!
interface FastEthernet1
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet2
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet3
 no ip address
 duplex auto
 speed auto
!
interface FastEthernet4
 no ip address
 duplex auto
 speed auto
!
ip classless
!
ip http server
no ip http secure-server
!
control-plane
```

```
!
line con 0
 no modem enable
 transport preferred all
 transport output all
line aux 0
line vty 0 4
!
scheduler max-task-time 5000
end
Router# show running-config | incl service
no service pad
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
no service password-recovery
end
```

Configuration Examples for No Service Password-Recovery

Disabling Password Recovery Example

The following example shows how to obtain the configuration register setting (which is set to autoboot), disable password recovery capability, and then verify that the configuration persists through a system reload:

```
Router# show version
Cisco Internetwork Operating System Software
IOS (tm) 5300 Software (C7200-P-M), Version 12.3(8)YA, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 1986-2004 by Cisco Systems, Inc.
Compiled Wed 05-Mar-04 10:16 by xxx
Image text-base: 0x60008954, data-base: 0x61964000
ROM: System Bootstrap, Version 12.3(8)YA, RELEASE SOFTWARE (fc1)
.
.
.
125440K bytes of ATA PCMCIA card at slot 0 (Sector size 512 bytes).
8192K bytes of Flash internal SIMM (Sector size 256K).
Configuration register is 0x2102
Router# configure terminal
Router(config)# no service password-recovery
WARNING:
Executing this command will disable the password recovery mechanism.
Do not execute this command without another plan for password recovery.
Are you sure you want to continue? [yes/no]: yes
.
.
.
Router(config)# exit
Router#
Router# reload
Proceed with reload? [confirm] yes
00:01:54: %SYS-5-RELOAD: Reload requested
System Bootstrap, Version 12.3...
Copyright (c) 1994-2004 by cisco Systems, Inc.
C7400 platform with 262144 Kbytes of main memory
PASSWORD RECOVERY FUNCTIONALITY IS DISABLED
.
.
.
```

Additional References

The following sections provide references related to the No Service Password-Recovery feature.

Related Documents

Related Topic	Document Title
Setting, changing, and recovering lost passwords	" Configuring Security with Passwords, Privilege Levels, and Login Usernames for CLI Sessions on Networking Devices " feature module
Loading system images and rebooting	" Using the Cisco IOS Integrated File System " feature module
Security commands: complete command syntax, command mode, command history, defaults, usage guidelines, and examples	*Cisco IOS Security Command Reference*
Cisco IOS commands	Cisco IOS Master Commands List, All Releases

Standards

Standards	Title
None	--

MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

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

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for No Service Password-Recovery

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 3 Feature Information for No Service Password-Recovery

Feature Name	Releases	Feature Information
No Service Password-Recovery	12.3(8)YA 12.3(14)T	The No Service Password-Recovery feature is a security enhancement that prevents anyone with console access from accessing the router configuration and clearing the password. It also prevents anyone from changing the configuration register values and accessing NVRAM. This feature was introduced in Cisco IOS Release 12.3(8)YA. This feature was integrated into Cisco IOS Release 12.3(14)T. The following command was introduced: **service password-recovery**.

IP Traffic Export

The IP Traffic Export feature allows users to configure their router to export IP packets that are received on multiple, simultaneous WAN or LAN interfaces. The unaltered IP packets are exported on a single LAN or VLAN interface, thereby, easing deployment of protocol analyzers and monitoring devices in the following ways:

- Filter copied packets through an access control list (ACL)
- Filter copied packets through sampling, which allows you to export one in every few packets in which you are interested. Use this option when it is not necessary to export all incoming traffic. Also, sampling is useful when a monitored ingress interface can send traffic faster than the egress interface can transmit it.
- Configure bidirectional traffic on an interface. (By default, only incoming traffic is exported.)

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for IP Traffic Export

Platform Restriction

IP traffic export is intended only for software switching platforms; distributed architectures are not supported.

IP Packet Forwarding Performance Impact

When IP traffic export is enabled, a delay is incurred on the outbound interface when packets are captured and transmitted across the interface. Performance delays increase with the increased number of interfaces that are monitored and the increased number of destination hosts.

Exported Traffic Limitation

- The MAC address of the device that is receiving the exported traffic must be on the same VLAN or directly connected to one of the router interfaces. (Use the **show arp** command to determine the MAC address of device that is directly connected to an interface.)
- The outgoing interface for exported traffic must be Ethernet (10/100/1000). (Incoming (monitored) traffic can traverse any interface.)

Information About IP Traffic Export

Simplified IDS Deployment

Without the ability to export IP traffic, the Intrusion Detection System (IDS) probe must be inline with the network device to monitor traffic flow. IP traffic export eliminates the probe placement limitation, allowing users to place an IDS probe in any location within their network or direct all exported traffic to a VLAN that is dedicated for network monitoring. Allowing users to choose the optimal location of their IDS probe reduces processing burdens.

Also, because packet processing that was once performed on the network device can now be performed away from the network device, the need to enable IDS with the Cisco IOS software can be eliminated.

IP Traffic Export Profiles

All packet export configurations are specified through IP traffic export profiles, which consist of IP-traffic-export-related command-line interfaces (CLIs) that control various attributes for both incoming and outgoing exported IP traffic. You can configure a router with multiple IP traffic export profiles. (Each profile must have a different name.) You can apply different profiles on different interfaces.

The two different IP traffic export profiles are as follows:

- The global configuration profile, which is configured through the **ip traffic-export profile** command.
- The IP traffic export submode configuration profile, which is configured through any of the following router IP Traffic Export (RITE) commands--**bidirectional**, **incoming**, **interface**, **mac-address**, and **outgoing**.

How to Use IP Traffic Export

Configuring IP Traffic Export

Use this task to configure IP traffic export profiles, which enable IP traffic to be exported on an ingress interface and allow you to specify profile attributes, such as the outgoing interface for exporting traffic.

Note Packet exporting is performed before packet switching or filtering.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip traffic-export profile** *profile-name*
4. **interface** *interface-name*
5. **bidirectional**
6. **mac-address** *H.H.H*
7. **incoming** {**access-list**{*standard* | *extended* | *named*} | **sample one-in-every** *packet-number*}
8. **outgoing** {**access-list**{*standard* | *extended* | *named*} | **sample one-in-every** *packet-number*}
9. **exit**
10. **interface** *type number*
11. **ip traffic-export apply** *profile-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 3	**ip traffic-export profile** *profile-name*
	
	Example:
	`Router(config)#`
	`ip traffic-export profile my_rite`
		Creates or edits an IP traffic export profile, enables the profile on an ingress interface, and enters RITE configuration mode.

	Command or Action	Purpose
Step 4	**interface** *interface-name* **Example:** `Router(config-rite)# interface FastEthernet 0/1`	Specifies the outgoing (monitored) interface for exported traffic. **Note** If you do not issue this command, the profile does not recognize the interface on which to send the captured IP traffic.
Step 5	**bidirectional** **Example:** `Router(config-rite)# bidirectional`	(Optional) Exports incoming and outgoing IP traffic on the monitored interface. **Note** If this command is not enabled, only incoming traffic is exported.
Step 6	**mac-address** *H.H.H* **Example:** `Router(config-rite)# mac-address 00a.8aab. 90a0`	Specifies the 48-bit address of the destination host that is receiving the exported traffic. **Note** If you do not issue this command, the profile does not recognize a destination host on which to send the exported packets.
Step 7	**incoming** {**access-list**{*standard* | *extended* | *named*} | **sample one-in-every** *packet-number*} **Example:** `Router(config-rite)# incoming access-list my_acl`	(Optional) Configures filtering for incoming traffic. After you have created a profile through the **ip traffic-export profile,**this functionality is enabled by default.
Step 8	**outgoing** {**access-list**{*standard* | *extended* | *named*} | **sample one-in-every** *packet-number*} **Example:** `Router(config-rite)# outgoing sample one-in-every 50`	(Optional) Configures filtering for outgoing export traffic. **Note** If you issue this command, you must also issue the **bidirectional** command, which enables outgoing traffic to be exported. However, only routed traffic (such as passthrough traffic) is exported; that is, traffic that originates from the network device is not exported.
Step 9	**exit**	Exits RITE configuration mode.
Step 10	**interface** *type number* **Example:** `Router(config)# interface FastEthernet0/0`	Configures an interface type and enters interface configuration mode.

	Command or Action	Purpose
Step 11	**ip traffic-export apply** *profile-name* **Example:** `Router(config-if)# ip traffic-export apply my_rite`	Enables IP traffic export on an ingress interface.

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- What to Do Next, page 63

Troubleshooting Tips

Creating an IP Traffic Export Profile

The **interface** and **mac-address** commands are required to successfully create a profile. If these commands are not issued, then the following profile incomplete message is displayed in the **show running config** command output:

```
ip traffic-export profile newone
! No outgoing interface configured
! No destination mac-address configured
```

Applying an IP Traffic Export Profile to an interface

The following system logging messages should appear immediately after you activate and deactivate a profile from an interface (through the **ip traffic-export apply profile** command):

- Activated profile:

```
%RITE-5-ACTIVATE: Activated IP traffic export on interface FastEthernet 0/0.
```

- Deactivated profile:

```
%RITE-5-DEACTIVATE: Deactivated IP traffic export on interface FastEthernet 0/0.
```

If an incomplete profile is applied to an interface, the following message displays:

```
Router(config-if)# ip traffic-export apply newone
RITE: profile newone has missing outgoing interface
```

What to Do Next

After you have configured a profile and enabled the profile on an ingress interface, you can monitor IP traffic exporting events and verify your profile configurations. To complete these steps, refer to the following task "Displaying IP Traffic Export Configuration Data, page 63."

Displaying IP Traffic Export Configuration Data

This task allows you to verify IP traffic export parameters such as the monitored ingress interface, which is where the IP traffic is exported, and outgoing and incoming IP packet information, such as configured

ACLs. You can also use this task to monitor packets that are captured and then transmitted across an interface to a destination host. Use this optional task to help you troubleshoot any problems with your exported IP traffic configurations.

SUMMARY STEPS

1. **enable**
2. **debug ip traffic-export events**
3. **show ip traffic-export** [**interface** *interface-name*| **profile** *profile-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**debug ip traffic-export events** **Example:** `Router# debug ip traffic-export events`	Enables debugging messages for exported IP traffic packets events.
Step 3	**show ip traffic-export** [**interface** *interface-name*| **profile** *profile-name* **Example:** `Router# show ip traffic-export`	Displays information related to exported IP traffic events. • **interface** *interface-name* --Only data associated with the monitored ingress interface is shown. • **profile** *profile-name* --Only flow statistics, such as exported packets and the number of bytes, are shown.

Example

The following sample output from the **show ip traffic-export**command is for the profile “one.” This example is for a single, configured interface. If multiple interfaces are configured, the information shown below is displayed for each interface.

```
Router# show ip traffic-export
Router IP Traffic Export Parameters
Monitored Interface FastEthernet0/0
Export Interface FastEthernet0/1
Destination MAC address 0030.7131.abfc
bi-directional traffic export is off
Input IP Traffic Export Information Packets/Bytes Exported 0/0
Packets Dropped 0
```

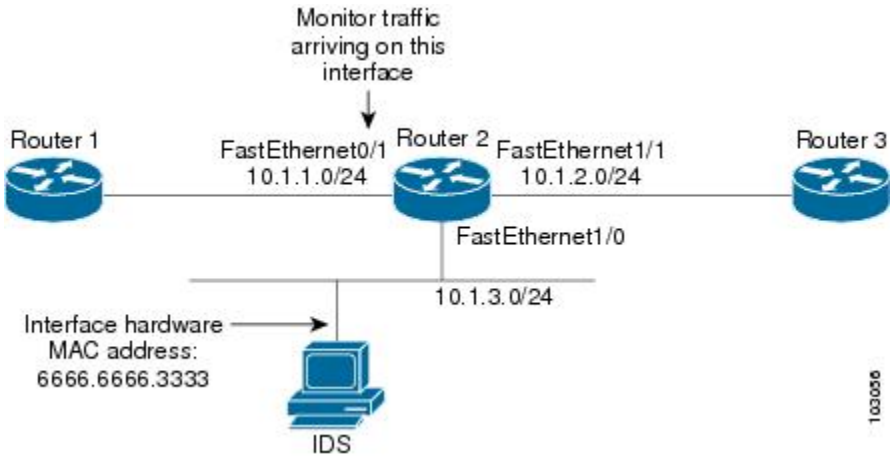
Sampling Rate one-in-every 1 packets

```
No Access List configured
Profile one is Active
```

Configuration Examples for IP Traffic Export

Example Exporting IP Traffic Configuration

The figure below and the following the **show running-config** command output describes how to configure Router 2 to export the incoming traffic from Router 1 to IDS.




```
Router2# show running-config
Building configuration...
Current configuration :2349 bytes
! Last configuration change at 20:35:39 UTC Wed Oct 8 2003
! NVRAM config last updated at 20:35:39 UTC Wed Oct 8 2003
!
version 12.3
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
service internal
service udp-small-servers
!
hostname rite-3745
!
boot system flash:c3745-js-mz.123-1.8.PI2d
no logging console
enable password lab
!
no aaa new-model
ip subnet-zero
!
no ip domain lookup
!
ip cef
!
ip traffic-export profile my_rite
  interface FastEthernet1/0
```

```
  mac-address 6666.6666.3333
!
interface FastEthernet0/0
 ip address 10.0.0.94 255.255.255.0
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 10.1.1.2 255.255.255.0
 duplex auto
 speed auto
 ip traffic-export apply my_rite
!
interface FastEthernet1/0
 ip address 10.1.3.2 255.255.255.0
 no ip redirects
 no cdp enable
!
interface FastEthernet1/1
 ip address 10.1.2.2 255.255.255.0
 duplex auto
 speed auto
!
router ospf 100
 log-adjacency-changes
 network 10.1.0.0 0.0.255.255 area 0
!
ip http server
ip classless
!
snmp-server engineID local 0000000902000004C1C59140
snmp-server community public RO
snmp-server enable traps tty
!
control-plane
!
dial-peer cor custom
!
gateway
!
line con 0
 exec-timeout 0 0
 stopbits 1
line aux 0
line vty 0 4
 password lab
 login
!
ntp clock-period 17175608
ntp server 10.0.0.2
!
end
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Configuring IDS	“ Configuring Cisco IOS Firewall Intrusion Detection System ” feature module.

Standards

Standard	Title
None	--

MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
None	--

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for IP Traffic Export

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 4 Feature Information for IP Traffic Export

Feature Name	Releases	Feature Information
IP Traffic Export	12.3(4)T 12.2(25)S	The IP Traffic Export feature allows users to configure their router to export IP packets that are received on multiple, simultaneous WAN or LAN interfaces. The unaltered IP packets are exported on a single LAN or VLAN interface, thereby, easing deployment of protocol analyzers and monitoring devices. This feature was introduced in Cisco IOS Release 12.3(4)T. This feature was integrated into Cisco IOS Release 12.2(25)S. The following commands were introduced or modified: **bidirectional**, **debug ip traffic-export events**, **incoming**, **interface (RITE)**, **ip traffic-export apply**, **ip traffic-export profile**, **mac-address (RITE)**, **outgoing**, **show ip traffic-export**

Role-Based CLI Access

First Published: February 24, 2004

Last Updated: March 30, 2011

The Role-Based CLI Access feature allows the network administrator to define “views,” which are a set of operational commands and configuration capabilities that provide selective or partial access to Cisco IOS EXEC and configuration (config) mode commands. Views restrict user access to Cisco IOS command-line interface (CLI) and configuration information; that is, a view can define what commands are accepted and what configuration information is visible. Thus, network administrators can exercise better control over access to Cisco networking devices.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Role-Based CLI Access

Your image must support CLI views.

Restrictions for Role-Based CLI Access

Lawful Intercept Images Limitation

CLI views are a part of all platforms and Cisco IOS images because they are a part of the Cisco IOS parser. However, the lawful intercept view is available only in images that contain the lawful intercept subsystem.

Maximum Number of Allowed Views

The maximum number of CLI views and superviews, including one lawful intercept view, that can be configured is 15. (This does not include the root view.)

Information About Role-Based CLI Access

Benefits of Using CLI Views

Although users can control CLI access via both privilege levels and enable mode passwords, these functions do not provide network administrators with the necessary level of detail needed when working with Cisco IOS routers and switches. CLI views provide a more detailed access control capability for network administrators, thereby, improving the overall security and accountability of Cisco IOS software.

As of Cisco IOS Release 12.3(11)T, network administrators can also specify an interface or a group of interfaces to a view; thereby, allowing access on the basis of specified interfaces.

Root View

When a system is in “root view,” it has all of the access privileges as a user who has level 15 privileges. If the administrator wishes to configure any view to the system (such as a CLI view, a superview, or a lawful intercept view), the system must be in root view.

The difference between a user who has level 15 privileges and a root view user is that a root view user can configure a new view and add or remove commands from the view. Also, when you are in a CLI view, you have access only to the commands that have been added to that view by the root view user.

About Lawful Intercept Views

Like a CLI view, a lawful intercept view restricts access to specified commands and configuration information. Specifically, a lawful intercept view allows a user to secure access to lawful intercept commands that are held within the TAP-MIB, which is a special set of simple network management protocol (SNMP) commands that store information about calls and users.

Commands available in lawful intercept view belong to one of the these categories:

- Lawful intercept commands that should not be made available to any other view or privilege level
- CLI views that are useful for lawful intercept users but do not have to be excluded from other views or privilege levels

About Superviews

A superview consists of one or more CLI views, which allow users to define what commands are accepted and what configuration information is visible. Superviews allow a network administrator to easily assign all users within configured CLI views to a superview instead of having to assign multiple CLI views to a group of users.

Superviews contain these characteristics:

- A CLI view can be shared among multiple superviews.
- Commands cannot be configured for a superview; that is, you must add commands to the CLI view and add that CLI view to the superview.
- Users who are logged into a superview can access all of the commands that are configured for any of the CLI views that are part of the superview.
- Each superview has a password that is used to switch between superviews or from a CLI view to a superview.
- If a superview is deleted, all CLI views associated with that superview will not be deleted too.

View Authentication via a New AAA Attribute

View authentication is performed by an external authentication, authorization, and accounting (AAA) server via the new attribute “cli-view-name.”

AAA authentication associates only one view name to a particular user; that is, only one view name can be configured for a user in an authentication server.

How to Use Role-Based CLI Access

Configuring a CLI View

Perform this task to create a CLI view and add commands or interfaces to the view, as appropriate.

Before you create a view, you must perform the following tasks:

- Enable AAA via the **aaa new-model**command .
- Ensure that your system is in root view--not privilege level 15.

SUMMARY STEPS

1. **enable view**
2. **configure terminal**
3. **parser view** *view-name*
4. **secret 5** *encrypted-password*
5. **commands** *parser-mode* {**include** | **include-exclusive** | **exclude**} [**all**] [**interface** *interface-name* | *command*]
6. **exit**
7. **exit**
8. **enable** [*privilege-level*] [**view** *view-name*
9. **show parser view all**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable view** **Example:** `Router> enable view`	Enables root view. • Enter your privilege level 15 password (for example, root password) if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**parser view** *view-name* **Example:** `Router(config)# parser view first`	Creates a view and enters view configuration mode.
Step 4	**secret 5** *encrypted-password* **Example:** `Router(config-view)# secret 5 secret`	Associates a command-line interface (CLI) view or superview with a password. **Note** You must issue this command before you can configure additional attributes for the view.

	Command or Action	Purpose
Step 5	**commands** *parser-mode* {**include** | **include-exclusive** | **exclude**} [**all**] [**interface** *interface-name* | *command*] **Example:** `Router(config-view)# commands exec include show version`	Adds commands or interfaces to a view. • *parser-mode* --The mode in which the specified command exists. • **include** --Adds a command or an interface to the view and allows the same command or interface to be added to an additional view. • **include-exclusive** --Adds a command or an interface to the view and excludes the same command or interface from being added to all other views. • **exclude** --Excludes a command or an interface from the view; that is, customers cannot access a command or an interface. • **all** --A "wildcard" that allows every command in a specified configuration mode that begins with the same keyword or every subinterface for a specified interface to be part of the view. • **interface** *interface-name* -- Interface that is added to the view. • *command* --Command that is added to the view.
Step 6	**exit** **Example:** `Router(config-view)# exit`	Exits view configuration mode.
Step 7	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.
Step 8	**enable** [*privilege-level*] [**view** *view-name* **Example:** `Router# enable view first`	Prompts the user for a password, which allows the user to access a configured CLI view, and is used to switch from one view to another view. After the correct password is given, the user can access the view.
Step 9	**show parser view all** **Example:** `Router# show parser view`	(Optional) Displays information about the view that the user is currently in. • **all** --Displays information for all views that are configured on the router. **Note** Although this command is available for both root and lawful intercept users, the **all** keyword is available only to root users. However, the **all** keyword can be configured by a user in root view to be available for users in lawful intercept view and CLI view.

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Troubleshooting Tips

After you have successfully created a view, a system message such as the following is displayed:

```
%PARSER-6-VIEW_CREATED: view ‘first’ successfully created.
```

After you have successfully deleted a view, a system message such as the following is displayed:

%PARSER-6-VIEW_DELETED: view ‘first’ successfully deleted.

You must associate a password with a view. If you do not associate a password, and you attempt to add commands to the view via the **commands** command, a system message such as the following will be displayed:

```
%Password not set for view <viewname>.
```

Configuring a Lawful Intercept View

Perform this task to initialize and configure a view for lawful-intercept-specific commands and configuration information.

Before you initialize a lawful intercept view, ensure that the privilege level is set to 15 via the **privilege** command.

Note Only an administrator or a user who has level 15 privileges can initialize a lawful intercept view.

>

SUMMARY STEPS

1. **enable view**
2. **configure terminal**
3. **li-view** *li-password* **user** *username* **password** *password*
4. **username lawful-intercept** [*name*] [**privilege** *privilege-level* | **view** *view-name*] **password** *password*
5. **parser view** *view-name*
6. **secret 5** *encrypted-password*
7. **name** *new-name*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable view** **Example:** `Router> enable view`	Enables root view. • Enter your privilege level 15 password (for example, root password) if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**li-view** *li-password* **user** *username* **password** *password* **Example:** `Router(config)# li-view lipass user li_admin password li_adminpass`	Initializes a lawful intercept view. After the li-view is initialized, you must specify at least one user via **user** *username* **password** *password* options.
Step 4	**username lawful-intercept** [*name*] [**privilege** *privilege-level* | **view** *view-name*] **password** *password* **Example:** `Router(config)# username lawful-intercept li-user1 password li-user1pass`	Configures lawful intercept users on a Cisco device.
Step 5	**parser view** *view-name* **Example:** `Router(config)# parser view li view name`	(Optional) Enters view configuration mode, which allows you to change the lawful intercept view password or the lawful intercept view name.
Step 6	**secret 5** *encrypted-password* **Example:** `Router(config-view)# secret 5 secret`	(Optional) Changes an existing password for a lawful intercept view.
Step 7	**name** *new-name* **Example:** `Router(config-view)# name second`	(Optional) Changes the name of a lawful intercept view. If this command is not issued, the default name of the lawful intercept view is “li-view.”

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Troubleshooting Tips

To display information for all users who have access to a lawful intercept view, issue the **show users lawful-intercept** command. (This command is available only to authorized lawful intercept view users.)

Configuring a Superview

Perform this task to create a superview and add at least one CLI view to the superview.

Before adding a CLI view to a superview, ensure that the CLI views that are added to the superview are valid views in the system; that is, the views have been successfully created via the **parser view** command.

Note You can add a view to a superview only after a password has been configured for the superview (via the **secret 5** command). Thereafter, issue the **view** command in view configuration mode to add at least one CLI view to the superview.

>

SUMMARY STEPS

1. **enable view**
2. **configure terminal**
3. **parser view** *superview-name* **superview**
4. **secret 5** *encrypted-password*
5. **view** *view-name*
6. **exit**
7. **exit**
8. **show parser view all**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable view** **Example:** `Router> enable view`	Enables root view. • Enter your privilege level 15 password (for example, root password) if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**parser view** *superview-name* **superview** **Example:** `Router(config)# parser view su_view1 superview`	Creates a superview and enters view configuration mode.

	Command or Action	Purpose
Step 4	**secret 5** *encrypted-password* **Example:** `Router(config-view)# secret 5 secret`	Associates a CLI view or superview with a password. **Note** You must issue this command before you can configure additional attributes for the view.
Step 5	**view** *view-name* **Example:** `Router(config-view)# view view_three`	Adds a normal CLI view to a superview. Issue this command for each CLI view that is to be added to a given superview.
Step 6	**exit** **Example:** `Router(config-view)# exit`	Exits view configuration mode.
Step 7	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode.
Step 8	**show parser view all** **Example:** `Router# show parser view`	(Optional) Displays information about the view that the user is currently in. • **all** --Displays information for all views that are configured on the router. **Note** Although this command is available for both root and lawful intercept users, the **all** keyword is available only to root users. However, the **all** keyword can be configured by a user in root view to be available for users in lawful intercept view and CLI view.

Monitoring Views and View Users

To display debug messages for all views--root, CLI, lawful intercept, and super--use the **debug parser view** command in privileged EXEC mode.

Configuration Examples for Role-Based CLI Access

Example Configuring a CLI View

The following example shows how to configure two CLI views, “first” and “second.” Thereafter, you can verify the CLI view in the running configuration.

```
Router(config)# parser view first
00:11:40:%PARSER-6-VIEW_CREATED:view 'first' successfully created.
Router(config-view)# secret 5 firstpass
Router(config-view)# command exec include show version
Router(config-view)# command exec include configure terminal
Router(config-view)# command exec include all show ip
Router(config-view)# exit
Router(config)# parser view second
00:13:42:%PARSER-6-VIEW_CREATED:view 'second' successfully created.
Router(config-view)# secret 5 secondpass
Router(config-view)# command exec include-exclusive show ip interface
Router(config-view)# command exec include logout
Router(config-view)# exit
!
!
Router(config-view)# do show run | beg view
parser view first
 secret 5 $1$MCmh$QuZaU8PIMPlff9sFCZvgW/
 commands exec include configure terminal
 commands exec include configure
 commands exec include all show ip
 commands exec include show version
 commands exec include show
!
parser view second
 secret 5 $1$iP2M$R16BXKecMEiQesxLyqygW.
 commands exec include-exclusive show ip interface
 commands exec include show ip
 commands exec include show
 commands exec include logout
!
```

Example Verifying a CLI View

After you have configured the CLI views “first” and “second,” you can issue the **enable view**command to verify which commands are available in each view. The following example shows which commands are available inside the CLI view “first” after the user has logged into this view. (Because the **show ip** command is configured with the all option, a complete set of suboptions is shown, except the **show ip interface** command, which is using the include-exclusive keyword in the second view.)

```
Router# enable view first
Password:
00:28:23:%PARSER-6-VIEW_SWITCH:successfully set to view 'first'.
Router# ?
Exec commands:
  configure  Enter configuration mode
  enable     Turn on privileged commands
  exit       Exit from the EXEC
  show       Show running system information
Router# show ?
  ip       IP information
  parser   Display parser information
  version  System hardware and software status
Router# show ip ?

  access-lists           List IP access lists
```

```
  accounting              The active IP accounting database
  aliases                 IP alias table
  arp                     IP ARP table
  as-path-access-list     List AS path access lists
  bgp                     BGP information
  cache                   IP fast-switching route cache
  casa                    display casa information
  cef                     Cisco Express Forwarding
  community-list          List community-list
  dfp                     DFP information
  dhcp                    Show items in the DHCP database
  drp                     Director response protocol
  dvmrp                   DVMRP information
  eigrp                   IP-EIGRP show commands
  extcommunity-list       List extended-community list
  flow                    NetFlow switching
  helper-address          helper-address table
  http                    HTTP information
  igmp                    IGMP information
  irdp                    ICMP Router Discovery Protocol
.
.
.
```

Example Configuring a Lawful Intercept View

The following example shows how to configure a lawful intercept view, add users to the view, and verify the users that were added:

```
!Initialize the LI-View.
Router(config)# li-view lipass user li_admin password li_adminpass
00:19:25:%PARSER-6-LI_VIEW_INIT:LI-View initialized.
Router(config)# end
! Enter the LI-View; that is, check to see what commands are available within the view.
Router# enable view li-view
Password:
Router#
00:22:57:%PARSER-6-VIEW_SWITCH:successfully set to view 'li-view'.
Router# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
Router(config)# parser view li-view

Router(config-view)# ?
View commands:
  commands  Configure commands for a view
  default   Set a command to its defaults
  exit      Exit from view configuration mode
  name      New LI-View name      ===This option only resides in LI View.
  no        Negate a command or set its defaults
  password  Set a password associated with CLI views
Router(config-view)#
! NOTE:LI View configurations are never shown as part of ‘running-configuration’.
! Configure LI Users.
Router(config)# username lawful-intercept li-user1 password li-user1pass

Router(config)# username lawful-intercept li-user2 password li-user2pass
! Displaying LI User information.
Router# show users lawful-intercept
li_admin
li-user1
li-user2
Router#
```

Example Configuring a Superview

The following sample output from the **show running-config** command shows that “view_one” and “view_two” have been added to superview “su_view1,” and “view_three” and “view_four” have been added to superview “su_view2”:

```
!
parser view su_view1 superview
 secret 5 <encoded password>
 view view_one
 view view_two
!
parser view su_view2 superview
 secret 5 <encoded password>
 view view_three
 view view_four
!
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Security commands	*Cisco IOS Security Command Reference*
SNMP, MIBs, CLI configuration	*Cisco IOS Network Management Configuration Guide* , Release 15.0.
Privilege levels	Configuring Security with Passwords, Privilege Levels and, Login Usernames for CLI Sessions on Networking Devices” module.

MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Role-Based CLI Access

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 5 Feature Information for Role-Based CLI Access

Feature Name	Releases	Feature Information
Role-Based CLI Access	12.3(7)T 12.3(11)T 12.2(33)SRB 12.2(33)SB 12.2(33)SXI Cisco IOS XE 3.1.0SG	This feature enables network administrators to restrict user access to CLI and configuration information. In 12.3(11)T, the CLI view capability was extended to restrict user access on a per-interface level, and additional CLI views were introduced to support the extended view capability. Also, support to group configured CLI views into a superview was introduced. The following commands were introduced or modified: **commands (view) , enable , li-view , name (view) , parser view , parser view superview, secret , show parser view , show users , username , view**.

AutoSecure

The AutoSecure feature secures a router by using a single CLI command to disable common IP services that can be exploited for network attacks, enable IP services and features that can aid in the defense of a network when under attack, and simplify and harden the security configuration of the router.

AutoSecure enhances secure access to the router by configuring a required minimum password length to eliminate common passwords that can be common on many networks, such as “lab” and “company name.” Syslog messages are generated after the number of unsuccessful attempts exceeds the configured threshold.

AutoSecure also allows a router to revert (roll) back to its pre-AutoSecure configuration state if the AutoSecure configuration fails.

When AutoSecure is enabled, a detailed audit trail of system logging messages capture any changes or tampering of the AutoSecure configuration that may have been applied to the running configuration.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for AutoSecure

The AutoSecure configuration was unavailable before Cisco IOS Release 12.3(8)T. If the router were to revert to an image prior to Cisco IOS Release 12.3(8)T, then ensure that a copy of the running configuration is saved before configuring AutoSecure.

Restrictions for AutoSecure

The AutoSecure configuration can be configured at run time or setup time. If any related configuration is modified after AutoSecure has been enabled, the AutoSecure configuration may not be fully effective.

Information About AutoSecure

Securing the Management Plane

The management plane is secured by turning off certain global and interface services that can be potentially exploited for security attacks and turning on global services that help mitigate the threat of attacks. Secure access and secure logging are also configured for the router.

Caution If your device is managed by a network management (NM) application, securing the management plane could turn off some services like the HTTP server and disrupt the NM application support.

The following subsections define how AutoSecure helps to secure the management plane:

Disabling Global Services

After enabling this feature (through the **auto secure** command), the following global services are disabled on the router without prompting the user:

- Finger--Collects information about the system (reconnaissance) before an attack. If enabled, the information can leave your device vulnerable to attacks.
- PAD--Enables all packet assembler and disassembler (PAD) commands and connections between PAD devices and access servers. If enabled, it can leave your device vulnerable to attacks.
- Small Servers--Causes TCP and User Datagram Protocol (UDP) diagnostic port attacks: a sender transmits a volume of fake requests for UDP diagnostic services on the router, consuming all CPU resources.
- Bootp Server--Bootp is an insecure protocol that can be exploited for an attack.
- HTTP Server--Without secure-http or authentication embedded in the HTTP server with an associated ACL, the HTTP server is insecure and can be exploited for an attack. (If you must enable the HTTP server, you are prompted for the proper authentication or access list.)

Note If you are using Cisco Configuration Professional (CCP), you must manually enable the HTTP server through the **ip http server** command.

- Identification Service--An insecure protocol, defined in RFC 1413, that allows one to query a TCP port for identification. An attacker can access private information about the user from the ID server.
- CDP--If a large number of Cisco Discovery Protocol (CDP) packets are sent to the router, the available memory of the router can be consumed, causing the router to crash.

Caution NM applications that use CDP to discover network topology are not able to perform discovery.

- NTP--Without authentication or access-control, Network Time Protocol (NTP) is insecure and can be used by an attacker to send NTP packets to crash or overload the router. (If you want to turn on NTP, you must configure NTP authentication using Message Digest 5 (MD5) and the **ntp access-group** command. If NTP is enabled globally, disable it on all interfaces on which it is not needed.)
- Source Routing--Provided only for debugging purposes, so source routing should be disabled in all other cases. Otherwise, packets may slip away from some of the access control mechanisms that they should have gone through.

Disabling Per Interface Services

After enabling this feature, the following per interface services are disabled on the router without prompting the user:

- ICMP redirects--Disabled on all interfaces. Does not add a useful functionality to a correctly configured to network, but it could be used by attackers to exploit security holes.
- ICMP unreachables--Disabled on all interfaces. Internet Control Management Protocol (ICMP) unreachables are a known cause for some ICMP-based denial of service (DoS) attacks.
- ICMP mask reply messages--Disabled on all interfaces. ICMP mask reply messages can give an attacker the subnet mask for a particular subnetwork in the internetwork.
- Proxy-Arp--Disabled on all interfaces. Proxy-Arp requests are a known cause for DoS attacks because the available bandwidth and resources of the router can be consumed in an attempt to respond to the repeated requests that are sent by an attacker.
- Directed Broadcast--Disabled on all interfaces. Potential cause of SMURF attacks for DoS.
- Maintenance Operations Protocol (MOP) service--Disabled on all interfaces.

Enabling Global Services

After AutoSecure is enabled, the following global services are enabled on the router without prompting the user:

- The **service password-encryption** command--Prevents passwords from being visible in the configuration.
- The **service tcp-keepalives-in** and **service tcp-keepalives-out** commands--Ensures that abnormally terminated TCP sessions are removed.

Securing Access to the Router

Caution If your device is managed by an NM application, securing access to the router could turn off vital services and may disrupt the NM application support.

After enabling this feature, the following options in which to secure access to the router are available to the user:

- If a text banner does not exist, users are prompted to add a banner. This feature provides the following sample banner:

```
Authorized access only
This system is the property of ABC Enterprise
Disconnect IMMEDIATELY if you are not an authorized user!
Contact abc@xyz.com +99 876 543210 for help.
```

- The login and password (preferably a secret password, if supported) are configured on the console, AUX, vty, and tty lines. The **transport input** and **transport output**commandsare also configured on all of these lines. (Telnet and secure shell (SSH) are the only valid transport methods.) The **exec-timeout** command is configured on the console and AUX as 10.
- When the image on the device is a crypto image, AutoSecure enables SSH and secure copy (SCP) for access and file transfer to and from the router. The **timeout** *seconds* and **authentication-retries** *integer* options for the **ip ssh** command are configured to a minimum number. (Telnet and FTP are not affected by this operation and remain operational.)
- If the AutoSecure user specifies that their device does not use Simple Network Management Protocol (SNMP), one of the following functions occur:
  - In interactive mode, the user is asked whether to disable SNMP regardless of the values of the community strings, which act like passwords to regulate access to the agent on the router.
  - In non-interact mode, SNMP is disabled if the community string is “public” or “private.”

Note After AutoSecure has been enabled, tools that use SNMP to monitor or configure a device is unable to communicate with the device through SNMP.

- If authentication, authorization, and accounting (AAA) is not configured, configure local AAA. AutoSecure prompts users to configure a local username and password on the router.

Security Logging

The following logging options are available after AutoSecure is enabled. These options identify security incidents and provide ways to respond to them.

- Sequence numbers and time stamps for all debug and log messages. This option is useful when auditing logging messages.
- Logging messages can be generated for login-related events; for example, the message “Blocking Period when Login Attack Detected” is displayed when a login attack is detected and the router enters “quiet mode.” (Quiet mode means that the router does not allow any login attempts through Telnet, HTTP, or SSH.)

For more information on login system messages, see the Cisco IOS Release 12.3(4)T feature module Cisco IOS Login Enhancements .

- The **logging console critical**command, which sends system logging (syslog) messages to all available TTY lines and limits messages based on severity.
- The **logging buffered** command, which copies logging messages to an internal buffer and limits messages logged to the buffer based on severity.
- The **logging trap debugging** command, which allows all commands with a severity higher than debugging to be sent to the logging server.

Securing the Forwarding Plane

To minimize the risk of attacks on the router forward plane, AutoSecure provides the following functions:

- Cisco Express Forwarding (CEF)--AutoSecure enables CEF or distributed CEF (dCEF) on the router whenever possible. Because there is no need to build cache entries when traffic starts arriving for new destinations, CEF behaves more predictably than other modes when presented with large volumes of traffic addressed to many destinations. Thus, routers configured for CEF perform better under SYN attacks than routers using the traditional cache.

Note CEF consumes more memory than a traditional cache.

- If the TCP intercept feature is available, it can be configured on the router for connection timeout.
- If strict Unicast Reverse Path Forwarding (uRPF) is available, it can be configured on the router to help mitigate problems that are caused by the introduction of forged (spoofed) IP source addresses. uRPF discards IP packets that lack a verifiable IP source address.
- If the router is being used as a firewall, it can be configured for context-based access control (CBAC) on public interfaces that are facing the Internet.

Note At the beginning of the AutoSecure dialogue, you are prompted for a list of public interfaces.

How to Configure AutoSecure

Configuring AutoSecure

Caution Although the **auto secure**command helps to secure a router, it does not guarantee the complete security of the router.

SUMMARY STEPS

1. **enable**
2. auto secure [management | forwarding] [no-interact | full] [ntp | login | ssh | firewall | tcp-intercept]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables higher privilege levels, such as privileged EXEC mode. Enter your password if prompted.

Step 2	auto secure [management | forwarding] [no-interact | full] [ntp | login | ssh | firewall | tcp-intercept]
	
	Example:
	
	`Router#`
	`auto secure`
		A semi-interactive dialogue session begins to secure either the management or forwarding planes on the router when the **management** or **forwarding** keyword is selected. If neither option is selected, then the dialogue asks for both planes to be configured. If the **management** keyword is selected, then the management plane is secured only. If the **forwarding keyword is selected, then**the forwarding plane is secured only.
		
		If the **no-interact** keyword is selected, then the user is not prompted for any interactive configurations.
		
		If the **full** keyword is selected, then user is prompted for all interactive questions, which is the default.

Configuring Enhanced Security Access to the Router

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **security passwords min-length** *length*
4. **enable password** {*password* | [*encryption-type*] *encrypted-password* }
5. **security authentication failure rate** *threshold-rate* **log**
6. **exit** *threshold-rate* **log**
7. **show auto secure config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables higher privilege levels, such as privileged EXEC mode. Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**security passwords min-length** *length* **Example:** `Router(config)# security passwords min-length 6`	Ensures that all configured passwords are at least a specified length. • *length* --Minimum length of a configured password.
Step 4	**enable password** {*password* | [*encryption-type*] *encrypted-password* } **Example:** `Router(config)# enable password elephant`	Sets a local password to control access to various privilege levels.
Step 5	**security authentication failure rate** *threshold-rate* **log** **Example:** `Router(config)# security authentication failure rate 10 log`	Configures the number of allowable unsuccessful login attempts. • *threshold-rate* --Number of allowable unsuccessful login attempts. • **log** --Syslog authentication failures if the rate exceeds the threshold.
Step 6	**exit** *threshold-rate* **log** **Example:** `Router(config)# exit`	Exits configuration mode and enters privileged EXEC mode.
Step 7	**show auto secure config** **Example:** `Router# show auto secure config`	(Optional) Displays all configuration commands that have been added as part of the AutoSecure configuration.

Configuration Example for AutoSecure

The following example is a sample AutoSecure dialogue. After you enable the **auto secure** command, the feature automatically prompts you with a similar dialogue unless you enable the **no-interact** keyword. (For information on which services are disabled and which features are enabled, see the sections, "Securing the Management Plane, page 84" and "Securing the Forwarding Plane, page 87" earlier in this document.)

```
Router# auto secure
               --- AutoSecure Configuration ---
*** AutoSecure configuration enhances the security of the router but it will not make
router absolutely secure from all security attacks ***
All the configuration done as part of AutoSecure will be shown here. For more details of
why and how this configuration is useful, and any possible side effects, please refer to
Cisco documentation of AutoSecure.
At any prompt you may enter '?' for help.
Use ctrl-c to abort this session at any prompt.
Gathering information about the router for AutoSecure
Is this router connected to internet? [no]:y
Enter the number of interfaces facing internet [1]:
Interface                  IP-Address OK? Method Status
Protocol
FastEthernet0/1            10.1.1.1  YES NVRAM  up down
FastEthernet1/0            10.2.2.2  YES NVRAM  up down
FastEthernet1/1            10.0.0.1  YES NVRAM  up up
Loopback0                  unassigned YES NVRAM  up up
FastEthernet0/0            10.0.0.2  YES NVRAM  up down
Enter the interface name that is facing internet:FastEthernet0/0
Securing Management plane services..
Disabling service finger
Disabling service pad
Disabling udp & tcp small servers
Enabling service password encryption
Enabling service tcp-keepalives-in
Enabling service tcp-keepalives-out
Disabling the cdp protocol
Disabling the bootp server
Disabling the http server
Disabling the finger service
Disabling source routing
Disabling gratuitous arp
Enable secret is either not configured or is same as enable password
Enter the new enable secret:abc123
Configuring aaa local authentication
Configuring console, Aux and vty lines for
local authentication, exec-timeout, transport
Configure SSH server? [yes]:
Enter the domain-name:example.com
Configuring interface specific AutoSecure services
Disabling the following ip services on all interfaces:
 no ip redirects
 no ip proxy-arp
 no ip unreachables
 no ip directed-broadcast
 no ip mask-reply
Disabling mop on Ethernet interfaces
Securing Forwarding plane services..
Enabling CEF (it might have more memory requirements on some low end
platforms)
Enabling unicast rpf on all interfaces connected to internet
Configure CBAC Firewall feature? [yes/no]:yes
This is the configuration generated:
no service finger
no service pad
no service udp-small-servers
no service tcp-small-servers
service password-encryption
service tcp-keepalives-in
service tcp-keepalives-out
no cdp run
```

```
no ip bootp server
no ip http server
no ip finger
no ip source-route
no ip gratuitous-arps
no ip identd
security passwords min-length 6
security authentication failure rate 10 log
enable secret 5 $1$CZ6G$GkGOnHdNJCO3CjNHHyTUA.
aaa new-model
aaa authentication login local_auth local
line console 0
 login authentication local_auth
 exec-timeout 5 0
 transport output telnet
line aux 0
 login authentication local_auth
 exec-timeout 10 0
 transport output telnet
line vty 0 4
 login authentication local_auth
 transport input telnet
ip domain-name example.com
crypto key generate rsa general-keys modulus 1024
ip ssh time-out 60
ip ssh authentication-retries 2
line vty 0 4
 transport input ssh telnet
service timestamps debug datetime localtime show-timezone msec
service timestamps log datetime localtime show-timezone msec
logging facility local2
logging trap debugging
service sequence-numbers
logging console critical
logging buffered
int FastEthernet0/1
 no ip redirects
 no ip proxy-arp
 no ip unreachables
 no ip directed-broadcast
 no ip mask-reply
 no mop enabled
int FastEthernet1/0
 no ip redirects
 no ip proxy-arp
 no ip unreachables
 no ip directed-broadcast
 no ip mask-reply
 no mop enabled
int FastEthernet1/1
 no ip redirects
 no ip proxy-arp
 no ip unreachables
 no ip directed-broadcast
 no ip mask-reply
 no mop enabled
int FastEthernet0/0
 no ip redirects
 no ip proxy-arp
 no ip unreachables
 no ip directed-broadcast
 no ip mask-reply
 no mop enabled
ip cef
interface FastEthernet0/0
 ip verify unicast reverse-path
ip inspect audit-trail
ip inspect dns-timeout 7
ip inspect tcp idle-time 14400
ip inspect udp idle-time 1800
ip inspect name autosec_inspect cuseeme timeout 3600
ip inspect name autosec_inspect ftp timeout 3600
ip inspect name autosec_inspect http timeout 3600
```

```
ip inspect name autosec_inspect rcmd timeout 3600
ip inspect name autosec_inspect realaudio timeout 3600
ip inspect name autosec_inspect smtp timeout 3600
ip inspect name autosec_inspect tftp timeout 30
ip inspect name autosec_inspect udp timeout 15
ip inspect name autosec_inspect tcp timeout 3600
access-list 100 deny ip any any
interface FastEthernet0/0
 ip inspect autosec_inspect out
 ip access-group 100 in
!
end
Apply this configuration to running-config? [yes]:yes
Applying the config generated to running-config
The name for the keys will be:ios210.example.com
% The key modulus size is 1024 bits
% Generating 1024 bit RSA keys ...[OK]
Router#
```

Additional References

Related Documents

Related Topic	Document Title
Login functionality (such as login delays and login blocking periods)	Cisco IOS Login Enhancements feature module
Additional information regarding router configuration	*Cisco IOS Configuration Fundamentals Configuration Guide* , Release 12.4T
Additional router configuration commands	*Cisco IOS Configuration Fundamentals Command Reference Guide*

RFCs

RFCs	Title
RFC 1918	Address Allocation for Private Internets
RFC 2267	*Network Ingress Filtering: Defeating Denial of Service Attacks which employ IP Source Address Spoofing*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for AutoSecure

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 6 Feature Information for AutoSecure

Feature Name	Releases	Feature Information
AutoSecure	12.3(1) 12.2(18)S 12.3(8)T 12.2(27)SBC	The AutoSecure feature uses a single CLI command to disable common IP services that can be exploited for network attacks, enable IP services and features that can aid in the defense of a network when under attack, and simplify and harden the security configuration on the router. In Cisco IOS Release 12.3(1)S, this feature was introduced. This feature was integrated into Cisco IOS Release 12.2(18)S. In Cisco IOS Release 12.3(8)T, support for the roll-back functionality and system logging messages were added. This feature was integrated into Cisco IOS Release 12.(27)SBC. The following commands were introduced or modified: **auto secure , security passwords min-length**, **show auto secure config .**

Configuring Kerberos

Kerberos is a secret-key network authentication protocol, developed at the Massachusetts Institute of Technology (MIT), that uses the Data Encryption Standard (DES) cryptographic algorithm for encryption and authentication. Kerberos was designed to authenticate requests for network resources. Kerberos, like other secret-key systems, is based on the concept of a trusted third party that performs secure verification of users and services. In the Kerberos protocol, this trusted third party is called the key distribution center (KDC).

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Configuring Kerberos

- For hosts and the KDC in your Kerberos realm to communicate and mutually authenticate, you must identify them to each other. To do this, you add entries for the hosts to the Kerberos database on the KDC and add SRVTAB files generated by the KDC to all hosts in the Kerberos realm. You also make entries for users in the KDC database.
- The Kerberos administrative programs (known as the KDC) must be installed on a UNIX host and initialized on the database. A Kerberos realm name and password must also be configured. For instructions about completing these tasks, refer to the Kerberos software instructions.

Note Write down the host name or IP address of the KDC, the port number you want the KDC to monitor for queries, and the name of the Kerberos realm it will serve. This information is required to configure the router.

Information About Configuring Kerberos

The primary use of Kerberos is to verify that users and the network services they use are really who and what they claim to be. To accomplish this, a trusted Kerberos server issues tickets to users. These tickets, which have a limited lifespan, are stored in a user's credential cache and can be used in place of the standard username-and-password authentication mechanism.

The Kerberos credential scheme embodies a concept called "single logon." This process requires authenticating a user once, and then allows secure authentication (without encrypting another password) wherever that user's credential is accepted.

Starting with Cisco IOS Release 11.2, Cisco IOS software includes Kerberos 5 support, which allows organizations already deploying Kerberos 5 to use the same Kerberos authentication database on their routers that they are already using on their other network hosts (such as UNIX servers and PCs).

The following network services are supported by the Kerberos authentication capabilities in Cisco IOS software:

- Telnet
- rlogin
- rsh
- rcp

Note Cisco Systems' implementation of Kerberos client support is based on code developed by CyberSafe, which was derived from the MIT code. As a result, the Cisco Kerberos implementation has successfully undergone full compatibility testing with the CyberSafe Challenger commercial Kerberos server and MIT's server code, which is freely distributed.

The table below lists common Kerberos-related terms and their definitions.

Table 7 Kerberos Terminology

Term	Definition
authentication	A process by which a user or service identifies itself to another service. For example, a client can authenticate to a router or a router can authenticate to another router.
authorization	A means by which the router determines what privileges you have in a network or on the router and what actions you can perform.

Term	Definition
credential	A general term that refers to authentication tickets, such as ticket granting tickets (TGTs) and service credentials. Kerberos credentials verify the identity of a user or service. If a network service decides to trust the Kerberos server that issued a ticket, it can be used in place of retyping in a username and password. Credentials have a default lifespan of eight hours.
instance	An authorization level label for Kerberos principals. Most Kerberos principals are of the form user@REALM (for example, smith@EXAMPLE.COM). A Kerberos principal with a Kerberos instance has the form user/instance@REALM (for example, smith/admin@EXAMPLE.COM). The Kerberos instance can be used to specify the authorization level for the user if authentication is successful. It is up to the server of each network service to implement and enforce the authorization mappings of Kerberos instances. Note that the Kerberos realm name must be in uppercase characters.
Kerberized	Applications and services that have been modified to support the Kerberos credential infrastructure.
Kerberos realm	A domain consisting of users, hosts, and network services that are registered to a Kerberos server. The Kerberos server is trusted to verify the identity of a user or network service to another user or network service. Kerberos realms must always be in uppercase characters.
Kerberos server	A daemon running on a network host. Users and network services register their identity with the Kerberos server. Network services query the Kerberos server to authenticate to other network services.
key distribution center (KDC)	A Kerberos server and database program running on a network host.
principal	Also known as a Kerberos identity, this is who you are or what a service is according to the Kerberos server.
service credential	A credential for a network service. When issued from the KDC, this credential is encrypted with the password shared by the network service and the KDC, and with the user's TGT.

Term	Definition
SRVTAB	A password that a network service shares with the KDC. The network service authenticates an encrypted service credential by using the SRVTAB (also known as a KEYTAB) to decrypt it.
ticket granting ticket (TGT)	A credential that the key distribution center (KDC) issues to authenticated users. When users receive a TGT, they can authenticate to network services within the Kerberos realm represented by the KDC.

- Kerberos Client Support Operation, page 98

Kerberos Client Support Operation

The Kerberos security system works with a router functioning as the security server. Although (for convenience or technical reasons) you can customize Kerberos in a number of ways, remote users attempting to access network services must pass through three layers of security before they can access network services.

- Authenticating to the Boundary Router, page 98
- Obtaining a TGT from a KDC, page 98
- Authenticating to Network Services, page 99

Authenticating to the Boundary Router

The first step in the Kerberos authentication process is for remote users to authenticate themselves to the boundary router when they attempt to access a network. The following process describes how users authenticate to a boundary router:

1. The remote user opens a PPP connection to the corporate site router.
2. The router prompts the user for a username and password.
3. The router requests a TGT from the KDC for this particular user.
4. The KDC sends an encrypted TGT to the router that includes (among other things) the user's identity.
5. The router attempts to decrypt the TGT using the password the user entered. If the decryption is successful, the remote user is authenticated to the router.

A remote user who successfully initiates a PPP session and authenticates to the boundary router is inside the firewall but still must authenticate to the KDC directly before being allowed to access network services. This is because the TGT issued by the KDC is stored on the router and is not useful for additional authentication unless the user physically logs on to the router.

Obtaining a TGT from a KDC

This section describes how remote users who are authenticated to the boundary router authenticate themselves to a KDC.

When a remote user authenticates to a boundary router, that user technically becomes part of the network; that is, the network is extended to include the remote user and the user's machine or network. To gain access to network services, however, the remote user must obtain a TGT from the KDC. The following process describes how remote users authenticate to the KDC:

1. The remote user, at a workstation on a remote site, launches the KINIT program (part of the client software provided with the Kerberos protocol).
2. The KINIT program finds the user's identity and requests a TGT from the KDC.
3. The KDC creates a TGT, which contains the identity of the user, the identity of the KDC, and the expiration time of the TGT.
4. Using the user's password as a key, the KDC encrypts the TGT and sends the TGT to the workstation.
5. When the KINIT program receives the encrypted TGT, it prompts the user for a password (this is the password that is defined for the user in the KDC).
6. If the KINIT program can decrypt the TGT with the password the user enters, the user is authenticated to the KDC, and the KINIT program stores the TGT in the user's credential cache.

At this point, the user has a TGT and can communicate securely with the KDC.In turn, the TGT allows the user to authenticate to other network services.

Authenticating to Network Services

The following process describes how a remote user with a TGT authenticates to network services within a given Kerberos realm. Assume the user is on a remote workstation (Host A) and wants to log in to Host B.

1. The user on Host A initiates a Kerberized application (such as Telnet) to Host B.
2. The Kerberized application builds a service credential request and sends it to the KDC. The service credential request includes (among other things) the user's identity and the identity of the desired network service. The TGT is used to encrypt the service credential request.
3. The KDC tries to decrypt the service credential request with the TGT it issued to the user on Host A. If the KDC can decrypt the packet, it is assured that the authenticated user on Host A sent the request.
4. The KDC notes the network service identity in the service credential request.
5. The KDC builds a service credential for the appropriate network service on Host B on behalf of the user on Host A. The service credential contains the client's identity and the desired network service's identity.
6. The KDC then encrypts the service credential twice. It first encrypts the credential with the SRVTAB that it shares with the network service identified in the credential. It then encrypts the resulting packet with the TGT of the user (who, in this case, is on Host A).
7. The KDC sends the twice-encrypted credential to Host A.
8. Host A attempts to decrypt the service credential with the user's TGT. If Host A can decrypt the service credential, it is assured the credential came from the real KDC.
9. Host A sends the service credential to the desired network service. Note that the credential is still encrypted with the SRVTAB shared by the KDC and the network service.
10. The network service attempts to decrypt the service credential using its SRVTAB.
11. If the network service can decrypt the credential, it is assured the credential was in fact issued from the KDC. Note that the network service trusts anything it can decrypt from the KDC, even if it receives it indirectly from a user. This is because the user first authenticated with the KDC.

At this point, the user is authenticated to the network service on Host B. This process is repeated each time a user wants to access a network service in the Kerberos realm.

How to Configure Kerberos

- Configuring the KDC Using Kerberos Commands, page 100
- Configuring the Router to Use the Kerberos Protocol, page 102

Configuring the KDC Using Kerberos Commands

After a host is configured to function as the KDC in the Kerberos realm, entries must be made to the KDC database (and to modify existing database information) for all principals in the realm. Principals can be network services on routers and hosts or principals can be users.

Note All Kerberos command examples are based on Kerberos 5 Beta 5 of the original MIT implementation. Later versions use a slightly different interface.

Adding Users to the KDC Database

Follow these steps to add users to the KDC and create privileged instances for those users:

SUMMARY STEPS

1. Use the **su** command to become root on the host running the KDC.
2. Use the **kdb5_edit** program to configure the commands in the next steps.
3. Use the **ank** (add new key) command in privileged EXEC mode to add a user to the KDC. This command prompts for a password that the user must enter to authenticate the router. For example:
4. Use the **ank** command to add a privileged instance of a user. For example:

DETAILED STEPS

Step 1 Use the **su** command to become root on the host running the KDC.

Step 2 Use the **kdb5_edit** program to configure the commands in the next steps.
Note The Kerberos realm name in the following steps must be in uppercase characters.

Step 3 Use the **ank** (add new key) command in privileged EXEC mode to add a user to the KDC. This command prompts for a password that the user must enter to authenticate the router. For example:

Example:

```
Router# ank
username@REALM
```

Step 4 Use the **ank** command to add a privileged instance of a user. For example:

```
Router# ank username/instance@REALM
```

Example

The following example adds the user *loki* to the Kerberos realm COMPANY.COM:

```
ank loki@COMPANY.COM
```

Privileged instances can be created to allow network administrators to connect to the router at the enable level so that a clear text password is not used to avoid compromising security and to enter enabled modes. See the Enabling Kerberos Instance Mapping, page 106 for more information on mapping Kerberos instances to various Cisco IOS privilege levels.

Creating and Extracting a SRVTAB on the KDC

All routers authenticated through Kerberos must have a SRVTAB that contains the password or randomly generated key for the service principal key that was entered into the KDC database. A service principal key must be shared with the host running that service. To do this, the SRVTAB entry must be saved (extracted) to a file and copied to the router and all hosts in the Kerberos realm.

Follow these steps to make a SRVTAB entry and extract this SRVTAB to a file on the KDC in privileged EXEC mode:

SUMMARY STEPS

1. Use the **ark** (add random key) command to add a network service supported by a host or router to the KDC. For example:
2. Use the kdb5_edit command **xst** to write an SRVTAB entry to a file. For example:
3. Use the **quit** command to exit the kdb5_edit program.

DETAILED STEPS

Step 1 Use the **ark** (add random key) command to add a network service supported by a host or router to the KDC. For example:

Example:

```
Router# ark
SERVICE/HOSTNAME@REALM
```

Step 2 Use the kdb5_edit command **xst** to write an SRVTAB entry to a file. For example:

Example:

```
Router# xst
 router-name host
```

Step 3 Use the **quit** command to exit the kdb5_edit program.

Example

The following example shows how to add a Kerberized authentication service for a router called *router1* to the Kerberos realm COMPANY.COM:

```
ark host/router1.company.com@COMPANY.COM
```

The following example shows how to write an entry for all network services on all Kerberized hosts that use this KDC for authentication to a file:

```
xst router1.company.com@COMPANY.COM host
```

Configuring the Router to Use the Kerberos Protocol

Defining a Kerberos Realm

For a router to authenticate a user defined in the Kerberos database, it must know the host name or IP address of the host running the KDC, the name of the Kerberos realm and, optionally, be able to map the host name or Domain Name System (DNS) domain to the Kerberos realm.

To configure the router to authenticate to a specified KDC in a specified Kerberos realm, use the following commands in global configuration mode. Note that DNS domain names must begin with a leading dot (.):

SUMMARY STEPS

1. Router(config)# **kerberos local-realm***kerberos-realm*
2. Router(config)# **kerberos server***kerberos-realm* {*hostname* | *ip-address* } [*port-number*]
3. Router(config)# **kerberos realm** {*dns-domain* | *host* } *kerberos-realm*

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router(config)# **kerberos local-realm***kerberos-realm*	Defines the default realm for the router.
Step 2	Router(config)# **kerberos server***kerberos-realm* {*hostname* | *ip-address* } [*port-number*]	Specifies to the router which KDC to use in a given Kerberos realm and, optionally, the port number that the KDC is monitoring. (The default is 88.)
Step 3	Router(config)# **kerberos realm** {*dns-domain* | *host* } *kerberos-realm*	(Optional) Maps a host name or DNS domain to a Kerberos realm.

Note Because the machine running the KDC and all Kerberized hosts must interact within a 5-minute window or authentication fails, all Kerberized machines, and especially the KDC, should be running the Network Time Protocol (NTP).

The **kerberos local-realm**, **kerberos realm**, and **kerberos server** commands are equivalent to the UNIX krb.conf file. The table below identifies mappings from the Cisco IOS configuration commands to a Kerberos 5 configuration file (krb5.conf).

Table 8 Kerberos 5 Configuration File and Commands

krb5.conf File	Cisco IOS Configuration Command
[libdefaults] `default_realm = DOMAIN.COM`	(in configuration mode) **kerberos local-realm** *DOMAIN.COM*

[domain_realm]
 	
`.domain.com = DOMAIN.COM`
 	
`domain.com = DOMAIN.COM`
	(in configuration mode)
	
	kerberos realm
	.domain.com
	DOMAIN.COM
	kerberos realm
	domain.com DOMAIN.COM

[realms]
 	
`kdc = DOMAIN.PIL.COM:750`
 	
`admin_server = DOMAIN.PIL.COM`
 	
`default_domain = DOMAIN.COM`
	(in configuration mode)
	
	kerberos server
	DOMAIN.COM 172.65.44.2
	(*172.65.44.2*
	is the example IP address for
	DOMAIN.PIL.COM
	)

See Defining a Kerberos Realm Examples for a Kerberos realm configuration example.

Copying SRVTAB Files

To make it possible for remote users to authenticate to the router using Kerberos credentials, the router must share a secret key with the KDC. To do this, you must give the router a copy of the SRVTAB you extracted on the KDC.

The most secure method to copy an SRVTAB file to the hosts in your Kerberos realm is to copy it onto physical media and go to each host in turn and manually copy the files onto the system. To copy an SRVTAB file to the router, which does not have a physical media drive, it must be transfered over the network using TFTP.

To remotely copy an SRVTAB file to the router from the KDC, use the **kerberos srvtab remote**command in global configuration mode:

Router(config)# **kerberos srvtab remote** {*hostname* | *ip-address* } {*filename* }

When you copy the SRVTAB file from the router to the KDC, the **kerberos srvtab remote** command parses the information in this file and stores it in the router's running configuration in the **kerberos srvtab entry**format. To ensure that the SRVTAB is available (does not need to be acquired from the KDC) when you reboot the router, use the **write memory** configuration command to write your running configuration

(which contains the parsed SRVTAB file) to NVRAM. See Copying a SRVTAB File Example, page 107 for an example.

Specifying Kerberos Authentication

See the Configuring Authentication feature module for more information on configuring authentication on the router **aaa authentication** command is used to specify Kerberos as the authentication method.

Enabling Credentials Forwarding

With Kerberos configured thus far, a user authenticated to a Kerberized router has a TGT and can use it to authenticate to a host on the network. However, if the user tries to list credentials after authenticating to a host, the output will show no Kerberos credentials present.

You can optionally configure the router to forward users' TGTs with them as they authenticate from the router to Kerberized remote hosts on the network when using Kerberized Telnet, rcp, rsh, and rlogin (with the appropriate flags).

To force all clients to forward users' credentials as they connect to other hosts in the Kerberos realm, use the following command in global configuration mode:

Command	Purpose
`Router(config)#` **kerberos credentials forward**	Forces all clients to forward user credentials upon successful Kerberos authentication.

With credentials forwarding enabled, users' TGTs are automatically forwarded to the next host they authenticate to. In this way, users can connect to multiple hosts in the Kerberos realm without running the KINIT program each time to get a new TGT.

Opening a Telnet Session to the Router

To use Kerberos to authenticate users opening a Telnet session to the router from within the network, use the following command in global configuration mode:

Command	Purpose
`Router(config)#` **aaa authentication login** {**default** | *list-name* } **krb5_telnet**	Sets login authentication to use the Kerberos 5 Telnet authentication protocol when using Telnet to connect to the router.

Although Telnet sessions to the router are authenticated, users must still enter a clear text password if they want to enter enable mode. The **kerberos instance map** command, discussed in a later section, allows them to authenticate to the router at a predefined privilege level.

Establishing an Encrypted Kerberized Telnet Session

Another way for users to open a secure Telnet session is to use Encrypted Kerberized Telnet. With Encrypted Kerberized Telnet, users are authenticated by their Kerberos credentials before a Telnet session is established. The Telnet session is encrypted using 56-bit Data Encryption Standard (DES) encryption with 64-bit Cipher Feedback (CFB). Because data sent or received is encrypted, not clear text, the integrity of the dialed router or access server can be more easily controlled.

Note This feature is available only if you have the 56-bit encryption image. 56-bit DES encryption is subject to U.S. Government export control regulations.

To establish an encrypted Kerberized Telnet session from a router to a remote host, use either of the following commands in EXEC command mode:

Command	Purpose

`Router(config)# connect host [port] /encrypt kerberos`
 	
or
 	
`Router(config)# telnet host [port] /encrypt kerberos`
	Establishes an encrypted Telnet session.

When a user opens a Telnet session from a router to a remote host, the router and remote host negotiate to authenticate the user using Kerberos credentials. If this authentication is successful, the router and remote host then negotiate whether or not to use encryption. If this negotiation is successful, both inbound and outbound traffic is encrypted using 56-bit DES encryption with 64-bit CFB.

When a user dials in from a remote host to a router configured for Kerberos authentication, the host and router will attempt to negotiate whether or not to use encryption for the Telnet session. If this negotiation is successful, the router will encrypt all outbound data during the Telnet session.

If encryption is not successfully negotiated, the session will be terminated and the user will receive a message stating that the encrypted Telnet session was not successfully established.

For information about enabling bidirectional encryption from a remote host, refer to the documentation specific to the remote host device.

For an example of using encrypted Kerberized Telnet to open a secure Telnet session, see the section "Encrypting a Telnet Session Example, page 115" later in this chapter.

Enabling Mandatory Kerberos Authentication

As an added layer of security, you can optionally configure the router so that, after remote users authenticate to it, these users can authenticate to other services on the network only with Kerberized Telnet, rlogin, rsh, and rcp. If you do not make Kerberos authentication mandatory and Kerberos authentication fails, the application attempts to authenticate users using the default method of authentication for that network service; for example, Telnet and rlogin prompt for a password, and rsh attempts to authenticate using the local rhost file.

To make Kerberos authentication mandatory, use the following command in global configuration mode:

Command	Purpose
`Router(config)# kerberos clients mandatory`	Sets Telnet, rlogin, rsh, and rcp to fail if they cannot negotiate the Kerberos protocol with the remote server.

Enabling Kerberos Instance Mapping

As mentioned in the section "Creating and Extracting a SRVTAB on the KDC, page 101," you can create administrative instances of users in the KDC database. The **kerberos instance map** command allows you to map those instances to Cisco IOS privilege levels so that users can open secure Telnet sessions to the router at a predefined privilege level, obviating the need to enter a clear text password to enter enable mode.

To map a Kerberos instance to a Cisco IOS privilege level, use the following command in global configuration mode:

Command	Purpose
`Router(config)# kerberos instance map instance privilege-level`	Maps a Kerberos instance to a Cisco IOS privilege level.

If there is a Kerberos instance for user *loki* in the KDC database (for example, *loki/admin*), user *loki* can now open a Telnet session to the router as loki/admin and authenticate automatically at privilege level 15, assuming instance "admin" is mapped to privilege level 15. (See the section "Adding Users to the KDC Database, page 100" earlier in this chapter.)

Cisco IOS commands can be set to various privilege levels using the **privilege level**command.

After you map a Kerberos instance to a Cisco IOS privilege level, you must configure the router to check for Kerberos instances each time a user logs in. To run authorization to determine if a user is allowed to run an EXEC shell based on a mapped Kerberos instance, use the **aaa authorization** command with the **krb5-instance** keyword. For more information, refer to the chapter "Configuring Authorization."

Monitoring and Maintaining Kerberos

To display or remove a current user's credentials, use the following commands in EXEC mode:

SUMMARY STEPS

1. Router# **show kerberos creds**
2. Router# **clear kerberos creds**

DETAILED STEPS

	Command or Action	Purpose
Step 1	Router# **show kerberos creds**	Lists the credentials in a current user's credentials cache.
Step 2	Router# **clear kerberos creds**	Destroys all credentials in a current user's credentials cache, including those forwarded.

Configuration Examples for Kerberos

- Defining a Kerberos Realm Examples, page 107
- Copying a SRVTAB File Example, page 107
- Configuring Kerberos Examples, page 107

- Encrypting a Telnet Session Example, page 115

Defining a Kerberos Realm Examples

To define CISCO.COM as the default Kerberos realm, use the following command:

```
kerberos local-realm CISCO.COM
```

To tell the router that the CISCO.COM KDC is running on host 10.2.3.4 at port number 170, use the following Kerberos command:

```
kerberos server CISCO.COM 10.2.3.4 170
```

To map the DNS domain cisco.com to the Kerberos realm CISCO.COM, use the following command:

```
kerberos realm.cisco.com CISCO.COM
```

Copying a SRVTAB File Example

To copy over the SRVTAB file on a host named host123.cisco.com for a router named router1.cisco.com, the command would look like this:

```
kerberos srvtab remote host123.cisco.com router1.cisco.com-new-srvtab
```

Configuring Kerberos Examples

This section provides a typical non-Kerberos router configuration and shows output for this configuration from the **write term** command, then builds on this configuration by adding optional Kerberos functionality. Output for each configuration is presented for comparison against the previous configuration.

This example shows how to use the kdb5_edit program to perform the following configuration tasks:

- Adding user chet to the Kerberos database
- Adding a privileged Kerberos instance of user chet (chet/admin) to the Kerberos database
- Adding a restricted instance of chet (chet/restricted) to the Kerberos database
- Adding workstation chet-ss20.cisco.com
- Adding router chet-2500.cisco.com to the Kerberos database
- Adding workstation chet-ss20.cisco.com to the Kerberos database
- Extracting SRVTABs for the router and workstations
- Listing the contents of the KDC database (with the **ldb** command)

Note In this sample configuration, host chet-ss20 is also the KDC:

```
chet-ss20# sbin/kdb5_edit
kdb5_edit:  ank chet
Enter password:
Re-enter password for verification:
kdb5_edit:  ank chet/admin
Enter password:
Re-enter password for verification:
kdb5_edit:  ank chet/restricted
Enter password:
Re-enter password for verification:
kdb5_edit:  ark host/chet-ss20.cisco.com
```

```
kdb5_edit:  ark host/chet-2500.cisco.com
kdb5_edit:  xst chet-ss20.cisco.com host
'host/chet-ss20.cisco.com@CISCO.COM' added to keytab 'WRFILE:chet-ss20.cisco.com-new-
srvtab'
kdb5_edit:  xst chet-2500.cisco.com host
'host/chet-2500.cisco.com@CISCO.COM' added to keytab 'WRFILE:chet-2500.cisco.com-new-
srvtab'
kdb5_edit:  ldb
entry: host/chet-2500.cisco.com@CISCO.COM
entry: chet/restricted@CISCO.COM
entry: chet@CISCO.COM
entry: K/M@CISCO.COM
entry: host/chet-ss20.cisco.com@CISCO.COM
entry: krbtgt/CISCO.COM@CISCO.COM
entry: chet/admin@CISCO.COM
kdb5_edit:  q
chet-ss20#
```

The following example shows output from a **write term** command, which displays the configuration of router chet-2500. This is a typical configuration with no Kerberos authentication.

```
chet-2500# write term
Building configuration...
Current configuration:
!
! Last configuration
change at 14:03:55 PDT Mon May 13 1996
!
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname chet-2500
!
clock timezone PST -8
clock summer-time PDT recurring
aaa new-model
aaa authentication login console none
aaa authentication ppp local local
enable password sMudgKin
!
username chet-2500 password 7 sMudgkin
username chet-3000 password 7 sMudgkin
username chetin password 7 sMudgkin
!
interface Ethernet0
 ip address 172.16.0.0 255.255.255.0
!
interface Serial0
 no ip address
 shutdown
 no fair-queue
!
interface Serial1
 no ip address
 shutdown
 no fair-queue
!
interface Async2
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
interface Async3
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic address
```

```
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
router eigrp 109
 network 172.17.0.0
 no auto-summary
!
ip default-gateway 172.30.55.64
ip domain-name cisco.com
ip name-server 192.168.0.0
ip classless
!
!
line con 0
 exec-timeout 0 0
 login authentication console
line 1 16
 transport input all
line aux 0
 transport input all
line vty 0 4
 password sMudgKin
!
ntp clock-period 17179703
ntp peer 172.19.10.0
ntp peer 172.19.0.0
end
```

The following example shows how to enable user authentication on the router via the Kerberos database. To enable user authentication via the Kerberos database, you would perform the following tasks:

- Entering configuration mode
- Defining the Kerberos local realm
- Identifying the machine hosting the KDC
- Enabling credentials forwarding
- Specifying Kerberos as the method of authentication for login
- Exiting configuration mode (CTL-Z)
- Writing the new configuration to the terminal

```
chet-2500# configure term
Enter configuration commands, one per line. End with CNTL/Z.
chet-2500(config)# kerberos local-realm CISCO.COM
chet-2500(config)# kerberos server CISCO.COM chet-ss20
Translating "chet-ss20"...domain server (192.168.0.0) [OK]
chet-2500(config)# kerberos credentials forward

chet-2500(config)# aaa authentication login default krb5
chet-2500(config)#
chet-2500#
%SYS-5-CONFIG_I: Configured from console by console
chet-2500# write term
```

Compare the following configuration with the previous one. In particular, look at the lines beginning with the words “aaa,” “username,” and “kerberos” (lines 10 through 20) in this new configuration.

```
Building configuration...
Current configuration:
!
! Last configuration change at 14:05:54 PDT Mon May 13 1996
!
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname chet-2500
```

```
!
clock timezone PST -8
clock summer-time PDT recurring
aaa new-model
aaa authentication login default krb5
aaa authentication login console none
aaa authentication ppp local local
enable password sMudgKin
!
username chet-2500 password 7 sMudgkin
username chet-3000 password 7 sMudgkin
username chetin password 7 sMudgkin
kerberos local-realm CISCO.COM
kerberos server CISCO.COM 172.71.54.14
kerberos credentials forward
!
interface Ethernet0
 ip address 172.16.0.0 255.255.255.0
!
interface Serial0
 no ip address
 shutdown
 no fair-queue
!
interface Serial1
 no ip address
 shutdown
 no fair-queue
!
interface Async2
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
interface Async3
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic address
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
router eigrp 109
 network 172.17.0.0
 no auto-summary
!
ip default-gateway 172.30.55.64
ip domain-name cisco.com
ip name-server 192.168.0.0
ip classless
!
!
line con 0
 exec-timeout 0 0
 login authentication console
line 1 16
 transport input all
line aux 0
 transport input all
line vty 0 4
 password sMudgKin
!
ntp clock-period 17179703
ntp peer 172.19.10.0
```

```
ntp peer 172.19.0.0
end
```

With the router configured thus far, user chet can log in to the router with a username and password and automatically obtain a TGT, as illustrated in the next example. With possession of a credential, user chet successfully authenticates to host chet-ss20 without entering a username/password.

```
chet-ss20% telnet chet-2500
Trying 172.16.0.0 ...
Connected to chet-2500.cisco.com.
Escape character is '^]'.
User Access Verification
Username: chet
Password:
chet-2500> show kerberos creds

Default Principal:  chet@CISCO.COM
Valid Starting          Expires                 Service Principal
13-May-1996 14:05:39    13-May-1996 22:06:40    krbtgt/CISCO.COM@CISCO.COM
chet-2500> telnet chet-ss20
Trying chet-ss20.cisco.com (172.71.54.14)... Open
Kerberos:       Successfully forwarded credentials
SunOS UNIX (chet-ss20) (pts/7)
Last login: Mon May 13 13:47:35 from chet-ss20.cisco.c
Sun Microsystems Inc.   SunOS 5.4       Generic July 1994
unknown mode: new
chet-ss20%
```

The following example shows how to authenticate to the router using Kerberos credentials. To authenticate using Kerberos credentials, you would perform the following tasks:

- Entering configuration mode
- Remotely copying over the SRVTAB file from the KDC
- Setting authentication at login to use the Kerberos 5 Telnet authentication protocol when using Telnet to connect to the router
- Writing the configuration to the terminal

Note that the new configuration contains a **kerberos srvtab entry** line. This line is created by the **kerberos srvtab remote**command.

```
chet-2500# configure term
Enter configuration commands, one per line.  End with CNTL/Z.
chet-2500(config)# kerberos srvtab remote earth chet/chet-2500.cisco.com-new-srvtab
Translating "earth"...domain server (192.168.0.0) [OK]
Loading chet/chet-2500.cisco.com-new-srvtab from 172.68.1.123 (via Ethernet0): !
[OK - 66/1000 bytes]
chet-2500(config)# aaa authentication login default krb5-telnet krb5
chet-2500(config)#
chet-2500#
%SYS-5-CONFIG_I: Configured from console by console
chet-2500# write term
Building configuration...
Current configuration:
!
! Last configuration change at 14:08:32 PDT Mon May 13 1996
!
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname chet-2500
!
clock timezone PST -8
clock summer-time PDT recurring
aaa new-model
aaa authentication login default krb5-telnet krb5
aaa authentication login console none
aaa authentication ppp local local
```

```
enable password sMudgKin
!
username chet-2500 password 7 sMudgkin
username chet-3000 password 7 sMudgkin
username chetin password 7 sMudgkin
kerberos local-realm CISCO.COM
kerberos srvtab entry host/chet-2500.cisco.com@CISCO.COM 0 832015393 1 1 8 7 sMudgkin
kerberos server CISCO.COM 172.71.54.14
kerberos credentials forward
!
interface Ethernet0
 ip address 172.16.0.0 255.255.255.0
!
interface Serial0
 no ip address
 shutdown
 no fair-queue
!
interface Serial1
 no ip address
 shutdown
 no fair-queue
!
interface Async2
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
interface Async3
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic address
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
router eigrp 109
 network 172.17.0.0
 no auto-summary
!
ip default-gateway 172.30.55.64
ip domain-name cisco.com
ip name-server 192.168.0.0
ip classless
!
!
line con 0
 exec-timeout 0 0
 login authentication console
line 1 16
 transport input all
line aux 0
 transport input all
line vty 0 4
 password sMudgKin
!
ntp clock-period 17179703
ntp peer 172.19.10.0
ntp peer 172.19.0.0
end
chet-2500#
```

With this configuration, the user can Telnet in to the router using Kerberos credentials, as illustrated in the next example:

```
chet-ss20% bin/telnet -a -F chet-2500
Trying 172.16.0.0...
Connected to chet-2500.cisco.com.
Escape character is '^]'.
[ Kerberos V5 accepts you as "chet@CISCO.COM" ]
User Access Verification
chet-2500>[ Kerberos V5 accepted forwarded credentials ]
chet-2500> show kerberos creds
Default Principal:  chet@CISCO.COM
Valid Starting          Expires                 Service Principal
13-May-1996 15:06:25    14-May-1996 00:08:29    krbtgt/CISCO.COM@CISCO.COM
chet-2500>q
Connection closed by foreign host.
chet-ss20%
```

The following example shows how to map Kerberos instances to Cisco's privilege levels. To map Kerberos instances to privilege levels, you would perform the following tasks:

- Entering configuration mode
- Mapping the Kerberos instance admin to privilege level 15
- Mapping the Kerberos instance restricted to privilege level 3
- Specifying that the instance defined by the **kerberos instance map** command be used for AAA Authorization
- Writing the configuration to the terminal

```
chet-2500# configure term
Enter configuration commands, one per line.  End with CNTL/Z.
chet-2500(config)# kerberos instance map admin 15
chet-2500(config)# kerberos instance map restricted 3
chet-2500(config)# aaa authorization exec default krb5-instance
chet-2500(config)#
chet-2500#
%SYS-5-CONFIG_I: Configured from console by console
chet-2500# write term
Building configuration...
Current configuration:
!
! Last configuration change at 14:59:05 PDT Mon May 13 1996
!
version 11.2
service udp-small-servers
service tcp-small-servers
!
hostname chet-2500
!
aaa new-model
aaa authentication login default krb5-telnet krb5
aaa authentication login console none
aaa authentication ppp default krb5 local
aaa authorization exec default krb5-instance
enable password sMudgKin
!
username chet-2500 password 7 sMudgkin
username chet-3000 password 7 sMudgkin
username chetin password 7 sMudgkin
ip domain-name cisco.com
ip name-server 192.168.0.0
kerberos local-realm CISCO.COM
kerberos srvtab entry host/chet-2500.cisco.com@CISCO.COM 0 832015393 1 1 8 7 sMudgkin
kerberos server CISCO.COM 172.71.54.14
kerberos instance map admin 15
kerberos instance map restricted 3
kerberos credentials forward
clock timezone PST -8
clock summer-time PDT recurring
```

```
!
interface Ethernet0
 ip address 172.16.0.0 255.255.255.0
!
interface Serial0
 no ip address
 shutdown
 no fair-queue
!
interface Serial1
 no ip address
 shutdown
 no fair-queue
!
interface Async2
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
interface Async3
 ip unnumbered Ethernet0
 encapsulation ppp
 shutdown
 async dynamic address
 async dynamic routing
 async mode dedicated
 no cdp enable
 ppp authentication pap local
 no tarp propagate
!
router eigrp 109
 network 172.17.0.0
no auto-summary
!
ip default-gateway 172.30.55.64
ip classless
!
!
line con 0
 exec-timeout 0 0
 login authentication console
line 1 16
 transport input all
line aux 0
 transport input all
line vty 0 4
 password sMudgKin
!
ntp clock-period 17179703
ntp peer 172.19.10.0
ntp peer 172.19.0.0
end
chet-2500#
```

The following example shows output from the three types of sessions now possible for user chet with Kerberos instances turned on:

```
chet-ss20% telnet chet-2500
Trying 172.16.0.0 ...
Connected to chet-2500.cisco.com.
Escape character is '^]'.
User Access Verification
Username: chet
Password:
chet-2500> show kerberos creds
Default Principal:  chet@CISCO.COM
Valid Starting          Expires                 Service Principal
13-May-1996 14:58:28    13-May-1996 22:59:29    krbtgt/CISCO.COM@CISCO.COM
```

```
chet-2500> show privilege
Current privilege level is 1
chet-2500> q
Connection closed by foreign host.
chet-ss20% telnet chet-2500
Trying 172.16.0.0 ...
Connected to chet-2500.cisco.com.
Escape character is '^]'.
User Access Verification
Username: chet/admin
Password:
chet-2500# show kerberos creds
Default Principal:  chet/admin@CISCO.COM
Valid Starting          Expires                 Service Principal
13-May-1996 14:59:44    13-May-1996 23:00:45    krbtgt/CISCO.COM@CISCO.COM
chet-2500# show privilege
Current privilege level is 15
chet-2500# q
Connection closed by foreign host.
chet-ss20% telnet chet-2500
Trying 172.16.0.0 ...
Connected to chet-2500.cisco.com.
Escape character is '^]'.
User Access Verification
Username: chet/restricted
Password:
chet-2500# show kerberos creds
Default Principal:  chet/restricted@CISCO.COM
Valid Starting          Expires                 Service Principal
13-May-1996 15:00:32    13-May-1996 23:01:33    krbtgt/CISCO.COM@CISCO.COM
chet-2500# show privilege
Current privilege level is 3
chet-2500# q
Connection closed by foreign host.
chet-ss20%
```

Encrypting a Telnet Session Example

The following example shows how to establish an encrypted Telnet session from a router to a remote host named “host1”:

```
Router>
 telnet host1 /encrypt kerberos
```

Additional References

Related Documents

Related Topic	Document Title
User Authentication	*Cisco IOS Security Guide: Securing User Services*

RFCs

RFC	Title
RFC 2942	Telnet Authentication: Kerberos Version 5

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Configuring Kerberos

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 9 Feature Information for Configuring Kerberos

Feature Name	Releases	Feature Information
Configuring Kerberos	11.1	Kerberos is a secret-key network authentication protocol, developed at the Massachusetts Institute of Technology (MIT), that uses the Data Encryption Standard (DES) cryptographic algorithm for encryption and authentication. Kerberos was designed to authenticate requests for network resources. Kerberos, like other secret-key systems, is based on the concept of a trusted third party that performs secure verification of users and services. In the Kerberos protocol, this trusted third party is called the key distribution center (KDC). In Cisco IOS Release 11.1, this feature was introduced.

Lawful Intercept Architecture

The Lawful Intercept (LI) feature supports service providers in meeting the requirements of law enforcement agencies to provide the ability to intercept Voice-over-Internet protocol (VoIP) or data traffic going through the edge routers (or other network locations). This document explains LI architecture, including Cisco Service Independent Intercept architecture and PacketCable Lawful Intercept architecture. It also describes the components of the LI feature and provides instructions on how to configure the LI feature in your system.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Prerequisites for Lawful Intercept

Access to the Cisco LI MIB view should be restricted to the mediation device and to system administrators who need to be aware of lawful intercepts on the router. To access the MIB, users must have level-15 access rights on the router.

Communication with Mediation Device

For the router to communicate with the mediation device to execute a lawful intercept, the following configuration requirements must be met:

- The mediation device must have an administrative function (AF) and an administrative function provisioning interface (AFPI).
- You must add the mediation device to the Simple Network Management Protocol (SNMP) user group that has access to the CISCO-TAP2-MIB view.

Use the **snmp-server user** command, specifying the mediation device username and password, to add the mediation device to an SNMP user group, then use the **snmp-server group** command to associate the group with a view that includes the CISCO-TAP2-MIB and one or more optional MIBS, such as CISCO-IP-TAP-MIB.

When you add the mediation device as a CISCO-TAP2-MIB user, you can include the mediation device authorization password if you want. The password must be at least eight characters in length.

- The time of day on both the router and the mediation device must be set to the same value.

To synchronize the time settings, ensure that Network Time Protocol (NTP) is running on both the router and mediation device.

- The security level on both the router and the mediation device must be set to identical values. The minimum security level required for the LI feature is “auth”.

If encryption of SMNP messages is required (optional), set the security level to “priv”.

Restrictions for Lawful Intercept

General Restrictions

- To maintain router performance, LI is limited to no more than .25% of traffic. For example, if the router is handling 10 Gbps, then the average tap rate is 25 Mbps. If the average packet size is 200 b, then the packet-per-second rate would be 16 kpps.
- There is no command-line interface (CLI) available to configure LI on the router. All error messages are sent to the mediation device as SNMP notifications. All intercepts are provisioned using SNMPv3 only.

Cisco ASR 1000 Series Routers

- Cisco ASR 1000 series routers do not support the interception of IP packets from Asynchronous Transfer Mode (ATM) Permanent Virtual Circuits (PVCs).

Information About Lawful Intercept

Introduction to Lawful Intercept

LI is the process by which law enforcement agencies (LEAs) conduct electronic surveillance as authorized by judicial or administrative order. Increasingly, legislation is being adopted and regulations are being enforced that require service providers (SPs) and ISPs to implement their networks to explicitly support authorized electronic surveillance. The types of SPs or ISPs that are subject to LI mandates vary greatly from country to country. LI compliance in the United States is specified by the Communications Assistance for Law Enforcement Act (CALEA), and accredited by the Commission on Accreditation for Law Enforcement Agencies.

Cisco supports two architectures for LI: PacketCable and Service Independent Intercept. The LI components by themselves do not ensure customer compliance with applicable regulations but rather provide tools that can be used by SPs and ISPs to construct an LI-compliant network.

Cisco Service Independent Intercept Architecture

The *Cisco Service Independent Intercept Architecture Version 3.0* document describes implementation of LI for VoIP networks using the Cisco Broadband Telephony Softswitch (BTS) 10200 Softswitch call agent, version 5.0, in a non-PacketCable network. Packet Cable Event Message specification version 1.5-I01 is used to deliver the call identifying information along with version 2.0 of the Cisco Tap MIB for call content.

The *Cisco Service Independent Intercept Architecture Version 2.0* document describes implementation of LI for VoIP networks using the Cisco BTS 10200 Softswitch call agent, versions 4.4 and 4.5, in a non-PacketCable network. Although not a PacketCable network, PacketCable Event Messages Specification version I08 is still used to deliver call identifying information, along with version 1.0 or version 2.0 of the Cisco Tap MIB for call content. The *Cisco Service Independent Intercept Architecture Version 2.0* document adds additional functionality for doing data intercepts by both IP address and session ID, which are both supported in version 2.0 of the Cisco Tap MIB (CISCO-TAP2-MIB).

The *Cisco Service Independent Intercept Architecture Version 1.0* document describes implementation of LI for VoIP networks that are using the Cisco BTS 10200 Softswitch call agent, versions 3.5 and 4.1, in a non-PacketCable network. Although not a PacketCable network, PacketCable Event Message Specification version I03 is still used to deliver call identifying information, along with version 1.0 of the Cisco Tap MIB (CISCO-TAP-MIB) for call content. Simple data intercepts by IP address are also discussed.

PacketCable Lawful Intercept Architecture

The P*acketCable Lawful Intercept Architecture for BTS Version 5.0* document describes the implementation of LI for VoIP using Cisco BTS 10200 Softswitch call agent, version 5.0, in a PacketCable network that conforms to PacketCable Event Messages Specification version 1.5-I01.

The *PacketCable Lawful Intercept Architecture for BTS Versions 4.4 and 4.5* document describes the implementation of LI for VoIP using Cisco BTS 10200 Softswitch call agent, versions 4.4 and 4.5, in a PacketCable network that conforms to PacketCable Event Messages Specification version I08.

The *PacketCable Lawful Intercept Architecture for BTS Versions 3.5 and 4.1* document describes the implementation of LI for VoIP using Cisco BTS 10200 Softswitch call agent, versions 3.5 and 4.1, in a PacketCable network that conforms to PacketCable Event Message Specification version I03.

The *PacketCable Control Point Discovery Interface Specification* document defines an IP-based protocol that can be used to discover a control point for a given IP address. The control point is the place where Quality of Service (QoS) operations, LI content tapping operations, or other operations may be performed.

CISCO ASR 1000 Series Routers

The Cisco ASR 1000 series routers support two types of LI: regular and broadband (per-subscriber). Broadband wiretaps are executed on access subinterfaces. Regular wiretaps are executed on access subinterfaces and physical interfaces. Wiretaps are not required, and are not executed, on internal interfaces. The router determines which type of wiretap to execute based on the interface that the target's traffic is using.

LI on the Cisco ASR 1000 series routers can intercept traffic based on a combination of one or more of the following fields:

- Destination IP address and mask (IPv4 or IPv6 address)
- Destination port or destination port range
- Source IP address and mask (IPv4 or IPv6 address)
- Source port or source port range
- Protocol ID
- Type of Service (TOS)
- Virtual routing and forwarding (VRF) name, which is translated to a *vrf-tableid* value within the router.
- Subscriber (user) connection ID

The LI implementation on the Cisco ASR 1000 series routers is provisioned using SNMP3 and supports the following functionality:

- Interception of communication content. The router duplicates each intercepted packet and then places the copy of the packet within a UDP-header encapsulated packet (with a configured CCCid). The router sends the encapsulated packet to the LI mediation device. Even if multiple lawful intercepts are configured on the same data flow, only one copy of the packet is sent to the mediation device. If necessary, the mediation device can duplicate the packet for each LEA.
- Interception of IPv4 and IPv6 flows.
- Interception of IPv4 and IPv6 multicast flows, where the target is the source of the multicast traffic.

VRF Aware LI

VRF Aware LI is the ability to provision a LI wiretap on IPv4 data in a particular Virtual Private Network (VPN). This feature allows a LEA to lawfully intercept targeted data within that VPN. Only IPv4 data within that VPN is subject to the VRF-based LI tap.

VRF Aware LI is available for the following types of traffic:

- ip2ip
- ip2tag (IP to MPLS)
- tag2ip (MPLS to IP)

To provision a VPN-based IPv4 tap, the LI administrative function (running on the mediation device) uses the CISCO-IP-TAP-MIB to identify the name of the VRF table that the targeted VPN uses. The VRF name is used to select the VPN interfaces on which to enable LI in order to execute the tap.

The router determines which traffic to intercept and which mediation device to send the intercepted packets based on the VRF name (along with the source and destination address, source and destination port, and protocol).

Note When using the Cisco-IP-TAP-MIB, if the VRF name is not specified in the stream entry, the global IP routing table is used by default.

LI of IP Packets on ATM Interfaces

The Lawful Intercept feature enables you to configure the system so that IP packets that are sent and received on ATM interfaces are intercepted based on the PVC information, such as the Virtual Path Identifier (VPI) or Virtual Channel Identifier (VCI). If you specify an interface when configuring the system, then all IP traffic on the given interface corresponding to the VPI or VCI on the ATM PVC is intercepted. If you do not specify an interface when configuring the system, then IP traffic corresponding to the ATM PVC on all interfaces is intercepted.

LI of IP traffic on ATM interfaces is available for the following interfaces and encapsulation types:

- ATM interface
- ATM multipoint interface
- ATM subinterface point-to-point
- PPP over ATM (PPPoA) encapsulation
- PPP over Ethernet over ATM (PPPoEoA) encapsulation

To provision an IP traffic tap on an ATM interface, the LI administrative function (running on the mediation device) uses the CISCO-IP-TAP-MIB to specify the VPI and VCI information for ATM PVCs. This information is used to select the interfaces on which to enable LI in order to execute the tap.

The router determines which traffic to intercept and to which mediation device to send the intercepted packets based on the VPI and VCI information.

When an ATM interface tap is provisioned, the system creates an IP_STREAM entry type, that stores all tap information (such as the PVC information and interface). The LI feature intercepts packets at the IP layer. If the interface is an ATM interface, LI extracts the PVC information from the packet and matches it against the provisioned streams. If an interface is specified when configuring the system, LI also matches the packet information against the interface. For each matching stream, the LI module sends a copy of the packet to the corresponding mediation device.

IPv6 Based Lawful Intercepts

To configure IPv6 based lawful intercepts, the system identifies either the source or destination address as the target address and then determines if a less specific route to the target address exists. If a less specific route to the target address exists, the system identifies the list of interfaces that can used to reach the target address and applies the intercepts to those interfaces only.

The system automatically detects route changes and reapplies intercepts on any changed routes.

The system uses the IPv6 stream details specified by the **snmp set** command to identify the target address, using the following criteria:

- If the source address prefix length is 0, the destination address is chosen as the target address. Likewise, if the destination address prefix length is 0, the source address is chosen as the target address.
- If neither the source address nor destination address prefix length is 0, the address with the longer prefix length is chosen as the target address.
- If the prefix lengths of the source address and destination address are equal, then the system determines which network is close to the Content IAP (CIAP) by doing a longest match lookup on the

prefix in the IPv6 routing table. The system chooses the location (source or destination) with the longer prefix as the target.

Lawful Intercept MIBs

Due to its sensitive nature, the Cisco LI MIBs are only available in software images that support the LI feature. These MIBs are not accessible through the Network Management Software MIBs Support page (http://www.cisco.com/public/sw-center/netmgmt/cmtk/mibs.shtml).

- Restricting Access to the Lawful Intercept MIBs, page 124

Restricting Access to the Lawful Intercept MIBs

Only the mediation device and users who need to know about lawful intercepts should be allowed to access the LI MIBs. To restrict access to these MIBs, you must:

1. Create a view that includes the Cisco LI MIBs.
2. Create an SNMP user group that has read-and-write access to the view. Only users assigned to this user group can access information in the MIBs.
3. Add users to the Cisco LI user groups to define who can access the MIBs and any information related to lawful intercepts. Be sure to add the mediation device as a user in this group; otherwise, the router cannot perform lawful intercepts.

For more information, see the Creating a Restricted SNMP View of Lawful Intercept MIBs module.

Note Access to the Cisco LI MIB view should be restricted to the mediation device and to system administrators who need to be aware of lawful intercepts on the router. To access the MIB, users must have level-15 access rights on the router.

How to Configure Lawful Intercept

Although there are no direct user commands to provision lawful intercept on the router, you do need to perform some configuration tasks, such as providing access to LI MIBs, setting up SNMP notifications, and enabling the LI RADIUS session feature. This section describes how to perform the following tasks:

- Creating a Restricted SNMP View of Lawful Intercept MIBs, page 124
- Enabling SNMP Notifications for Lawful Intercept, page 127
- Disabling SNMP Notifications, page 128
- Enabling RADIUS Session Intercepts, page 129

Creating a Restricted SNMP View of Lawful Intercept MIBs

To create and assign users to an SNMP view that includes the Cisco lawful intercept MIBs, perform the steps in this section.

- You must issue the commands in global configuration mode with level-15 access rights.
- SNMPv3 must be configured on the router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server view** *view-name MIB-name* **included**
4. **snmp-server view** *view-name MIB-name* **included**
5. **snmp-server view** *view-name MIB-name* **included**
6. **snmp-server view** *view-name MIB-name* **included**
7. **snmp-server view** *view-name MIB-name* **included**
8. **snmp-server group** *group-name* **v3 auth read** *view-name* **write** *view-name*
9. **snmp-server user** *user-name group-name* **v3 auth md5** *auth-password*
10. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server view** *view-name MIB-name* **included** **Example:** `Router(config)# snmp-server view exampleView ciscoTap2MIB included`	Creates an SNMP view that includes the CISCO-TAP2-MIB (where *exampleView*is the name of the view to create for the MIB). • This MIB is required for both regular and broadband lawful intercept.
Step 4	**snmp-server view** *view-name MIB-name* **included** **Example:** `Router(config)# snmp-server view exampleView ciscoIpTapMIB included`	Adds the CISCO-IP-TAP-MIB to the SNMP view.

	Command or Action	Purpose
Step 5	**snmp-server view** *view-name MIB-name* **included** **Example:** `Router(config)# snmp-server view exampleView cisco802TapMIB included`	Adds the CISCO-802-TAP-MIB to the SNMP view.
Step 6	**snmp-server view** *view-name MIB-name* **included** **Example:** `Router(config)# snmp-server view exampleView ciscoUserConnectionTapMIB included`	Adds the CISCO-USER-CONNECTION-TAP-MIB to the SNMP view.
Step 7	**snmp-server view** *view-name MIB-name* **included** **Example:** `Router(config)# snmp-server view exampleView ciscoMobilityTapMIB included`	Adds the CISCO-MOBILITY-TAP-MIB to the SNMP view.
Step 8	**snmp-server group** *group-name* **v3 auth read** *view-name* **write** *view-name* **Example:** `Router(config)# snmp-server group exampleGroup v3 auth read exampleView write exampleView`	Creates an SNMP user group that has access to the LI MIB view and defines the group's access rights to the view.
Step 9	**snmp-server user** *user-name group-name* **v3 auth md5** *auth-password* **Example:** `Router(config)# snmp-server user exampleUser exampleGroup v3 auth md5 examplePassword`	Adds users to the specified user group.
Step 10	**end** **Example:** `Router(config)# end`	Exits the current configuration mode and returns to privileged EXEC mode.

- Where to Go Next, page 126

Where to Go Next

The mediation device can now access the lawful intercept MIBs and issue SNMP **set** and **get** requests to configure and run lawful intercepts on the router. To configure the router to send SNMP notification to the mediation device, see the Enabling SNMP Notifications for Lawful Intercept.

Enabling SNMP Notifications for Lawful Intercept

SNMP automatically generates notifications for lawful intercept events. To configure the router to send lawful intercept notifications to the mediation device, perform the steps in this section.

- You must issue the commands in global configuration mode with level-15 access rights.
- SNMPv3 must be configured on the router.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **snmp-server host** *ip-address* **community-string udp-port** *port notification-type*
4. **snmp-server enable traps snmp authentication linkup linkdown coldstart warmstart**
5. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**snmp-server host** *ip-address* **community-string udp-port** *port notification-type* **Example:** `Router(config)# snmp-server host 10.2.2.1 community-string udp-port 161 udp`	Specifies the IP address of the mediation device and the password-like community-string that is sent with a notification request. • For lawful intercept, the **udp-port** must be 161 and not 162 (the SNMP default).

	Command or Action	Purpose
Step 4	**snmp-server enable traps snmp authentication linkup linkdown coldstart warmstart** **Example:** `Router(config)# snmp-server enable traps snmp authentication linkup linkdown coldstart warmstart`	Configures the router to send RFC 1157 notifications to the mediation device. • These notifications indicate authentication failures, link status (up or down), and router restarts.
Step 5	**end** **Example:** `Router(config)# end`	Exits the current configuration mode and returns to privileged EXEC mode.

Disabling SNMP Notifications

To disable SNMP notifications on the router, perform the steps in this section.

Note To disable lawful intercept notifications, use SNMPv3 to set the CISCO-TAP2-MIB object cTap2MediationNotificationEnable to false(2). To reenable lawful intercept notifications through SNMPv3, reset the object to true(1).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **no snmp-server enable traps**
4. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.

	Command or Action	Purpose
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**no snmp-server enable traps** **Example:** `Router(config)# no snmp-server enable traps`	Disables all SNMP notification types that are available on your system.
Step 4	**end** **Example:** `Router(config)# end`	Exits the current configuration mode and returns to privileged EXEC mode.

Enabling RADIUS Session Intercepts

There are no user CLI commands available to provision the mediation device or taps. However, to enable the intercepts through the CISCO-TAP-MIB you must configure the system to make the account-session-id value available to the mediation device. To enable RADIUS session intercepts on the router, perform the steps in this section.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **aaa intercept**
4. **aaa authentication ppp default group radius**
5. **aaa accounting delay-start all**
6. **aaa accounting send stop-record authentication failure**
7. **aaa accounting network default start-stop group radius**
8. **radius-server attribute 44 include-in-access-req**
9. **radius-server host** *host-name*
10. **aaa server radius dynamic-author**
11. **client** *ip-address*
12. **domain** {**delimiter** *character*| **stripping [right-to-left]**}
13. **server-key** *word*
14. **port** *port-number*
15. **exit**
16. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**aaa intercept** **Example:** `Router(config)# aaa intercept`	Enables lawful intercept on the router. • Associate this command with a high administrative security to ensure that unauthorized users cannot stop intercepts if this command is removed.
Step 4	**aaa authentication ppp default group radius** **Example:** `Router(config)# aaa authentication ppp default group radius`	Specifies the authentication method to use on the serial interfaces that are running Point-to-Point protocol (PPP). **Note** This command is required because tap information resides only on the RADIUS server. You can authenticate with locally configured information, but you cannot specify a tap with locally configured information.
Step 5	**aaa accounting delay-start all** **Example:** `Router(config)# aaa accounting delay-start all`	Delays the generation of accounting start records until the user IP address is established. Specifying the **all** keyword ensures that the delay applies to all VRF and non-VRF users. **Note** This command is required so that the mediation device can see the IP address assigned to the target.
Step 6	**aaa accounting send stop-record authentication failure** **Example:** `Router(config)# aaa accounting send stop-record authentication failure`	(Optional) Generates accounting stop records for users who fail to authenticate while logging into or during session negotiation. **Note** If a lawful intercept action of 1 does not start the tap, the stop record contains Acct-Termination-Cause, attribute 49, set to 15 (Service Unavailable).

	Command or Action	Purpose
Step 7	**aaa accounting network default start-stop group radius** **Example:** `Router(config)# aaa accounting network default start-stop group radius`	(Optional) Enables accounting for all network-related service requests. **Note** This command is required only to determine the reason why a tap did not start.
Step 8	**radius-server attribute 44 include-in-access-req** **Example:** `Router(config)# radius-server attribute 44 include-in-access-req`	(Optional) Sends RADIUS attribute 44 (Accounting Session ID) in access request packets before user authentication (including requests for preauthentication). **Note** Enter this command to obtain attribute 44 from the Access-Request packet. Otherwise you will have to wait for the accounting packets to be received before you can determine the value of attribute 44.
Step 9	**radius-server host** *host-name* **Example:** `Router(config)# radius-server host host1`	(Optional) Specifies the RADIUS server host.
Step 10	**aaa server radius dynamic-author** **Example:** `Router(config)# aaa server radius dynamic-author`	Configures a device as an Authentication, Authorization, and Accounting (AAA) server to facilitate interaction with an external policy server and enters dynamic authorization local server configuration mode. **Note** This is an optional command if taps are always started with a session starts. The command is required if CoA-Requests are used to start and stop taps in existing sessions.
Step 11	**client** *ip-address* **Example:** `Router(config-locsvr-da-radius)# client 10.0.0.2`	(Optional) Specifies a RADIUS client from which the device will accept CoA-Request packets.

	Command or Action	Purpose

Step 12	**domain** {**delimiter** *character*| **stripping [right-to-left]**}
	
	Example:
	`Router(config-locsvr-da-radius)# domain stripping right-to-left`
	
	Example:
	`Router(config-locsvr-da-radius)# domain delimiter @`
		(Optional) Configures username domain options for the RADIUS application.
		• The **delimiter** keyword specifies the domain delimiter. One of the following options can be specified for the *character* argument: **@**, /, **$**, **%**, \, **#** or **-**
		• The **stripping** keyword compares the incoming username with the names oriented to the left of the **@** domain delimiter.
		• The **right-to-left** keyword terminates the string at the first delimiter going from right to left.

Step 13	**server-key** *word* **Example:** `Router(config-locsvr-da-radius)# server-key samplekey`	(Optional) Configures the RADIUS key to be shared between a device and RADIUS clients.
Step 14	**port** *port-number* **Example:** `Router(config-locsvr-da-radius)# port 1600`	(Optional) Specifies a RADIUS client from which the device will accept CoA-Request packets.
Step 15	**exit** **Example:** `Router(config-locsvr-da-radius)# exit`	Exits dynamic authorization local server configuration mode and returns to global configuration mode.
Step 16	**end** **Example:** `Router(config)# end`	Exits the current configuration mode and returns to privileged EXEC mode.

Configuration Examples for Lawful Intercept

Example Enabling Mediation Device Access Lawful Intercept MIBs

The following example shows how to enable the mediation device to access the lawful intercept MIBs. It creates an SNMP view (tapV) that includes three LI MIBs (CISCO-TAP2-MIB, CISCO-IP-TAP-MIB, CISCO-802-TAP-MIB). It also creates a user group that has read, write, and notify access to MIBs in the tapV view.

```
snmp-server view tapV ciscoTap2MIB included
snmp-server view tapV ciscoIpTapMIB included
snmp-server view tapV cisco802TapMIB included
snmp-server group tapGrp v3 auth read tapV write tapV notify tapV
snmp-server user MDuser tapGrp v3 auth md5 MDpasswd
snmp-server engineID local 1234
```

Example Enabling RADIUS Session Lawful Intercept

The following example shows the configuration of a RADIUS-Based Lawful Intercept solution on a router acting as a network access server (NAS) device employing a PPPoEoA link:

```
aaa new-model
!
aaa intercept
!
aaa group server radius SG
server 10.0.56.17 auth-port 1645 acct-port 1646
!
aaa authentication login LOGIN group SG
aaa authentication ppp default group SG
aaa authorization network default group SG
aaa accounting send stop-record authentication failure
aaa accounting network default start-stop group SG
!
aaa server radius dynamic-author
client 10.0.56.17 server-key cisco
!
vpdn enable
!
bba-group pppoe PPPoEoA-TERMINATE
virtual-template 1
!
interface Loopback0
ip address 10.1.1.2 255.255.255.0
!
interface GigabitEthernet4/1/0
description To RADIUS server
ip address 10.0.56.20 255.255.255.0
duplex auto
!
interface GigabitEthernet4/1/2
description To network
ip address 10.1.1.1 255.255.255.0
duplex auto
!
interface GigabitEthernet5/0/0
description To subscriber
no ip address
!
interface GigabitEthernet5/0/0.10
encapsulation dot1q 10
protocol pppoe group PPPoEoA-TERMINATE
!
interface Virtual-Template1
ip unnumbered Loopback0
ppp authentication chap
!
radius-server attribute 44 include-in-access-req
```

```
radius-server attribute nas-port format d
radius-server host 10.0.56.17 auth-port 1645 acct-port 1646
radius-server key cisco
```

Additional References

Related Documents

Related Topic	Document Title
Cisco IOS commands	Cisco IOS Master Commands List, All Releases
Configuring SNMP Support	Configuring SNMP Support
Security Commands	*Cisco IOS Security Command Reference*

Standards

Standard	Title
PacketCable™ *Control Point Discovery Interface Specification*	*PacketCable™ Control Point Discovery Interface Specification* (PKT-SP-CPD-I02-061013)

MIBs

MIB	MIBs Link
• CISCO-802-TAP-MIB • CISCO-IP-TAP-MIB • CISCO-MOBILITY-TAP-MIB • CISCO-TAP2-MIB • CISCO-USER-CONNECTION-TAP-MIB	To locate and download MIBs for selected platforms, Cisco software releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
RFC-2865	*Remote Authentication Dial In User Service (RADIUS)*
RFC-3576	*Dynamic Authorization Extensions to Remote Authentication Dial In User Service (RADIUS)*
RFC-3924	*Cisco Architecture for Lawful Intercept in IP Networks*

Technical Assistance

Description	Link
The Cisco Support and Documentation website provides online resources to download documentation, software, and tools. Use these resources to install and configure the software and to troubleshoot and resolve technical issues with Cisco products and technologies. Access to most tools on the Cisco Support and Documentation website requires a Cisco.com user ID and password.	http://www.cisco.com/cisco/web/support/index.html

Feature Information for Lawful Intercept

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 10 Feature Information for Lawful Intercept

Feature Name	Releases	Feature Information
Lawful Intercept	12.0(32)S 12.2(31)SB2 12.2(33)SRB 12.2(33)SXH 12.4(22)T 15.0(1)M	The Lawful Intercept (LI) feature supports service providers in meeting the requirements of law enforcement agencies to provide the ability to intercept VoIP or data traffic going through the edge routers. In 12.0(32)S, this feature was introduced. This feature was integrated into Cisco IOS Release 12.2(31)SB2. This feature was integrated into Cisco IOS Release 12.2(33)SRB. This feature was integrated into Cisco IOS Release 12.2(33)SXH. This feature was integrated into Cisco IOS Release 12.4(22)T. In Cisco IOS Release 15.0(1)M, support was added for intercepting IP packets on ATM interfaces and for IPv6 based Lawful Intercepts. For more information, see

Image Verification

The Image Verification feature allows users to automatically verify the integrity of Cisco IOS images. Thus, users can be sure that the image is protected from accidental corruption, which can occur at any time during transit, starting from the moment the files are generated by Cisco until they reach the user. The efficiency of Cisco IOS routers is also improved because the routers can now automatically detect when the integrity of an image is accidentally corrupted as a result of transmission errors or disk corruption.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for Image Verification

Cisco IOS Release 12.2(18)S and 12.0(26)S Only

Image Verification is applied to and attempted on any file; however, if the file is not an image file, image verification will not occur and you will see the following error, “SIGNATURE-NOT-FOUND.”

Cisco IOS Release 12.3(4)T Only

Image Verification is applied only to image files. If any other file type is copied or verified, you will not receive a warning that image verification did occur, and the command (copy or verify) will silently succeed.

Note The Image Verification feature can only be used to check the integrity of a Cisco IOS software image that is stored on a Cisco IOS device. It cannot be used to check the integrity of an image on a remote file system or an image running in memory.

Information About Image Verification

How Image Verification Works

Because a production image undergoes a sequence of transfers before it is copied into the memory of a router, the integrity of the image is at risk of accidental corruption every time a transfer occurs. When downloading an image from Cisco.com, a user can run a message-digest5 (MD5) hash on the downloaded image and verify that the MD5 digest posted on Cisco.com is the same as the MD5 digest that is computed on the user's server. However, many users choose not to run an MD5 digest because it is 128-bits long and the verification is manual. Image verification allows the user to automatically validate the integrity of all downloaded images, thereby, significantly reducing user interaction.

How to Use Image Verification

Globally Verifying the Integrity of an Image

The **file verify auto** command enables image verification globally; that is, all images that are to be copied (via the **copy** command) or reloaded (via the **reload** command) are automatically verified. Although both the **copy** and **reload** commands have a **/verify** keyword that enables image verification, you must issue the keyword each time you want to copy or reload an image. The **file verify auto** command enables image verification by default, so you no longer have to specify image verification multiple times.

If you have enabled image verification by default but prefer to disable verification for a specific image copy or reload, the **/noverify** keyword, along with either the **copy** or the **reload** command, will override the **file verify auto** command.

Use this task to enable automatic image verification.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **file verify auto**
4. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**file verify auto** **Example:** `Router(config)# file verify auto`	Enables automatic image verification.
Step 4	**exit** **Example:** `Router(config)# exit`	Exits global configuration mode. You must exit global configuration mode if you are going to copy or reload an image.

• What to Do Next, page 139

What to Do Next

After issuing the **file verify auto** command, you do not have to issue the **/verify** keyword with the **copy** or the **reload** command because each image that is copied or reloaded will be automatically verified.

Verifying the Integrity of an Image That Is About to Be Copied

When issuing the **copy** command, you can verify the integrity of the copied file by entering the **/verify** keyword. If the integrity check fails, the copied file will be deleted. If the file that is about to be copied does not have an embedded hash (an old image), you will be prompted whether or not to continue with the copying process. If you choose to continue, the file will be successfully copied; if you choose not to continue, the copied file will be deleted.

Without the **/verify** keyword, the **copy** command could copy a file that is not valid. Thus, after the **copy** command has been successfully executed, you can issue the **verify** command at any time to check the integrity of the files that are in the storage of the router.

Use this task to verify the integrity of an image before it is copied onto a router.

SUMMARY STEPS

1. **enable**
2. **copy** [**/erase**] [**/verify**| **/noverify**] *source-url destination-url*
3. **verify** [**/md5** [*md5-value*]] *filesystem: file-url*]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**copy** [**/erase**] [**/verify**| **/noverify**] *source-url destination-url* **Example:** `Router# copy /verify tftp://10.1.1.1/ jdoe/c7200-js-mz disk0:`	Copies any file from a source to a destination. • **/verify** --Verifies the signature of the destination file. If verification fails, the file will be deleted. • **/noverify** --Does not verify the signature of the destination file before the image is copied. **Note** **/noverify** is often issued if the **file verify auto** command is enabled, which automatically verifies the signature of all images that are copied.
Step 3	**verify** [**/md5** [*md5-value*]] *filesystem: file-url*] **Example:** `Router# verify bootflash://c7200-kboot-mz.121-8a.E`	(Optional) Verifies the integrity of the images in the router's storage.

Verifying the Integrity of an Image That Is About to Be Reloaded

By issuing the **reload** command with the /**verify** keyword, the image that is about to be loaded onto your system will be checked for integrity. If the /**verify** keyword is specified, image verification will occur before the system initiates the reboot. Thus, if verification fails, the image will not be loaded.

Note Because different platforms obtain the file that is to be loaded in various ways, the file specified in BOOTVAR will be verified. If a file is not specified, the first file on each subsystem will be verified. On certain platforms, because of variables such as the configuration register, the file that is verified may not be the file that is loaded.

Use this task to verify the integrity of an image before it is reloaded onto a router.

SUMMARY STEPS

1. **enable**
2. **reload** [[**warm**] [**/verify**| **/noverify**] *text* | [**warm**] [**/verify**| **/noverify**] **in** [*hh* **:** *mm* [*text*] | [**warm**] [**/verify**| **/noverify**] **at** *hh* **:** *mm* [*month day* | *day month*] [*text*] | [**warm**] [**/verify**| **/noverify**] **cancel**]

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**reload** [[**warm**] [**/verify**| **/noverify**] *text*	[**warm**] [**/verify**| **/noverify**] **in** [*hh* **:** *mm* [*text*]	[**warm**] [**/verify**| **/noverify**] **at** *hh* **:** *mm* [*month day*	*day month*] [*text*]	[**warm**] [**/verify**| **/noverify**] **cancel**] **Example:** `Router# reload /verify`	Reloads the operating system. • /**verify**--Verifies the signature of the destination file. If verification fails, the file will be deleted. • **/noverify** --Does not verify the signature of the destination file before the image is reloaded. **Note** **/noverify** is often issued if the **file verify auto** command is enabled, which automatically verifies the signature of all images that are copied.

Configuration Examples for Image Verification

Global Image Verification Example

The following example shows how to enable automatic image verification. After enabling this command, image verification will automatically occur for all images that are either copied (via the **copy** command) or reloaded (via the **reload** command).

```
Router(config)# file verify auto
```

Image Verification via the copy Command Example

The following example shows how to specify image verification before copying an image:

```
Router# copy /verify tftp://10.1.1.1/jdoe/c7200-js-mz disk0:
Destination filename [c7200-js-mz]?
Accessing tftp://10.1.1.1/jdoe/c7200-js-mz...
```

```
Loading jdoe/c7200-js-mz from 10.1.1.1 (via FastEthernet0/0):!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 19879944 bytes]
19879944 bytes copied in 108.632 secs (183003 bytes/sec)
Verifying file integrity of disk0:/c7200-js-
mz  ..................................................................................
.....................................................................................
.....................................................................................
.........................Done!
Embedded Hash         MD5 :CFA258948C4ECE52085DCF428A426DCD
Computed Hash               MD5 :CFA258948C4ECE52085DCF428A426DCD
CCO Hash                       MD5 :44A7B9BDDD9638128C35528466318183
Signature Verified
```

Image Verification via the reload Command Example

The following example shows how to specify image verification before reloading an image onto the router:

```
Router# reload /verify
Verifying file integrity of bootflash:c7200-kboot-mz.121-8a.E
%ERROR:Signature not found in file bootflash:c7200-kboot-mz.121-8a.E.
Signature not present. Proceed with verify? [confirm]
Verifying file disk0:c7200-js-
mz ..............................................................................
.....................................................................Done!
Embedded Hash           MD5 :CFA258948C4ECE52085DCF428A426DCD
Computed Hash               MD5 :CFA258948C4ECE52085DCF428A426DCD
CCO Hash                MD5 :44A7B9BDDD9638128C35528466318183
Signature Verified
Proceed with reload? [confirm]n
```

Verify Command Sample Output Example

The following example shows how to specify image verification via the **verify** command:

```
Router# verify disk0:c7200-js-mz
%Filesystem does not support verify operations
Verifying file integrity of disk0:c7200-js-mz.....................................
.....................................................................................Done!
Embedded Hash           MD5 :CFA258948C4ECE52085DCF428A426DCD
Computed Hash               MD5 :CFA258948C4ECE52085DCF428A426DCD
CCO Hash                MD5 :44A7B9BDDD9638128C35528466318183
```

Signature Verified

Additional References

Related Documents

Related Topic	Document Title
Configuration tasks and information for loading, maintaining, and rebooting system images	Using the Cisco IOS Integrated File System feature module in the *Cisco IOS Configuration Fundamentals and Network Management Configuration Guide* , Release 12.4T.

Related Topic	Document Title
Additional commands for loading, maintaining, and rebooting system images	*Cisco IOS Configuration Fundamentals Command Reference* , Release 12.4T

Standards

Standard	Title
None	--

MIBs

MIB	MIBs Link
• None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFC	Title
None	--

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for Image Verification

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 11 Feature Information for Image Verification

Feature Name	Releases	Feature Information
Image Verification	12.2(25)S 12.0(26)S 12.3(4)T Cisco IOS XE Release 2.1	The Image Verification feature allows users to automatically verify the integrity of Cisco IOS images. The following commands were introduced or modified: **copy**, **file verify auto**, **reload**, **verify**.

IP Source Tracker

The IP Source Tracker feature tracks information in the following ways:

- Gathers information about the traffic that is flowing to a host that is suspected of being under attack.
- Generates all the necessary information in an easy-to-use format to track the network entry point of a DoS attack.
- Tracks Multiple IPs at the same time.
- Tracks DoS attacks across the entire network.

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for IP Source Tracker

Packets Can Be Dropped for Routers

IP source tracking is designed to track attacks against hosts. Packets can be dropped if the line card or port adapter CPU is overwhelmed. Therefore, when used to track an attack against a router, IP source tracking can drop control packets, such as Border Gateway Protocol (BGP) updates.

Engine 0 and 1 Performances Affected on Cisco 12000 Series

There is no performance impact for packets destined to nontracked IP addresses on Engine 2 and Engine 4 line cards because the IP source tracker affects only tracked destinations. Engine 0 and Engine 1 performances are affected because on these engines all packets are switched by the CPU.

Note On Cisco 7500 series routers, there is no performance impact on destinations that are not tracked.

Information About IP Source Tracker

Identifying and Tracking Denial of Service Attacks

One of the many challenges faced by customers today is the tracking and blocking denial-of-service (DoS) attacks. Counteracting a DoS attack involves intrusion detection, source tracking, and blocking. This functionality addresses the need for source tracking.

To trace attacks, NetFlow and access control lists (ACLs) have been used. To block attacks, committed access rate (CAR) and ACLs have been used. Support for these features on the Cisco 12000 series Internet router has depended on the type of line card used. Support for these features on the Cisco 7500 series routers depends upon the type of port adapter used. There is, therefore, a need to develop a way to receive information that both traces the source of an attack and is supported on all line cards and port adapters.

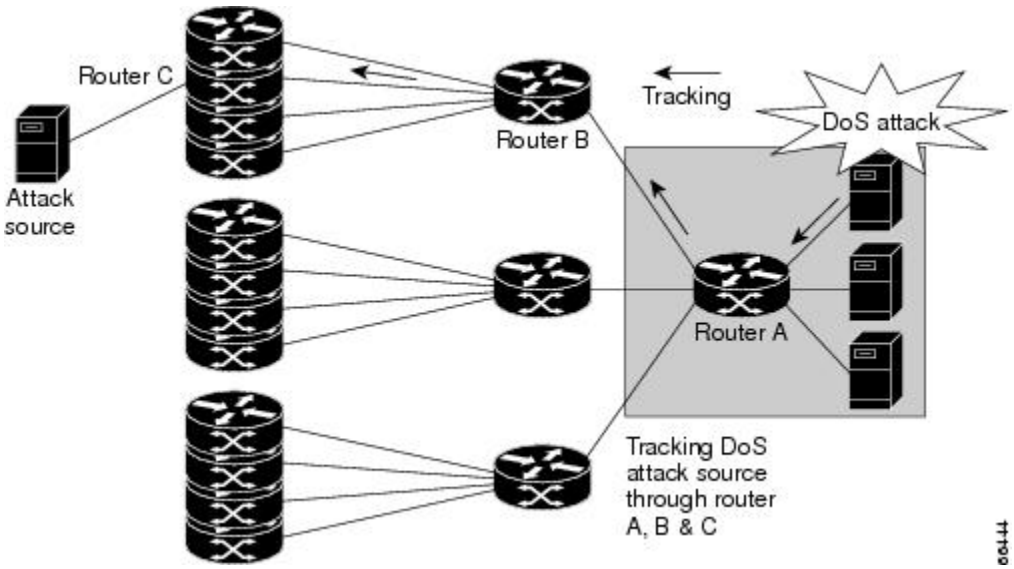
Normally, when you identify the host that is subject to a DoS attack, you must determine the network ingress point to effectively block the attack. This process starts at the router closest to the host.

For example, in the figure below, you would start at Router A and try to determine the next upstream router to examine. Traditionally, you would apply an output ACL to the interface connecting to the host to log packets that match the ACL. The logging information is dumped to the router console or system log. You then have to analyze this information, and possibly go through several ACLs in succession to identify the input interface for the attack. In this case the information points back to Router B.

You then repeat this process on Router B, which leads back to Router C, an ingress point into the network. At this point you can use ACLs or CAR to block the attack. This procedure can require applying several

ACLs that generate an excessive amount of output to analyze, making this procedure cumbersome and error prone.

Figure 1 Source Tracking in a DoS Attack



Using IP Source Tracker

IP source tracker provides an easier, more scalable alternative to output ACLs for tracking DoS attacks, and it works as follows:

- After you identify the destination being attacked, enable tracking for the destination address on the whole router by entering the **ip source-track** command.
- Each line card creates a special Cisco Express Forwarding (CEF) entry for the destination address being tracked. For line cards or port adapters that use specialized Application-Specific Integrated Circuit (ASICs) for packet switching, the CEF entry is used to punt packets to the line card's or port adapter's CPU.
- Each line card CPU collects information about the traffic flow to the tracked destination.
- The data generated is periodically exported to the router. To display a summary of the flow information, enter the **show ip source-track summary** command. To display more detailed information for each input interface, enter the **show ip source-track** command.
- Statistics provide a breakdown of the traffic to each tracked IP address. This breakdown allows you to determine which upstream router to analyze next. You can shut down the IP source tracker on the current router by entering the **no ip source-track** command, and reopen it on the upstream router.
- Repeat Step 1 to Step 5 until you identify the source of the attack.
- Apply CAR or ACLs to limit or stop the attack.

- IP Source Tracker Hardware Support, page 147

IP Source Tracker Hardware Support

IP source tracking is supported on all Engine 0, 1, 2, and 4 line cards in the Cisco 12000 series Internet router. It is also supported on all port adapters and RSPs that have CEF switching enabled on Cisco 7500 series routers.

How to Configure IP Source Tracker

Configuring IP Source Tracking

To configure IP source tracking for a host under attack, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip source-track** *ip-address*
4. **ip source-track address-limit** *number*
5. **ip source-track syslog-interval** *number*
6. **ip source-track export-interval** *number*

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip source-track** *ip-address* **Example:** `Router(config)# ip source-track 100.10.0.1`	Enables IP source tracking for a specified host.

	Command or Action	Purpose
Step 4	**ip source-track address-limit** *number* **Example:** `Router(config)# ip source-track address-limit 10`	(Optional) Limits the number of hosts that can be simultaneously tracked at any given time. **Note** If this command is not enabled, there is no limit to the number of hosts that be can tracked.
Step 5	**ip source-track syslog-interval** *number* **Example:** `Router(config)# ip source-track syslog-interval 2`	(Optional) Sets the time interval, in minutes, used to generate syslog messages that indicate IP source tracking is enabled. **Note** If this command is not enabled, system log messages are not generated.
Step 6	**ip source-track export-interval** *number* **Example:** `Router(config)# ip source-track export-interval 30`	(Optional) Sets the time interval, in seconds, used to export IP tracking statistics that are collected in the line cards to the gigabit route processor (GRP) and the port adapters to the route switch processor (RSP). **Note** If this command is not enabled, traffic flow information is exported to the GRP and RSP every 30 seconds.

- What to Do Next, page 149

What to Do Next

After you have configured source tracking on your network device, you can verify your configuration and source tracking statistics, such as traffic flow. To complete this task, see the following section "Verifying IP Source Tracking, page 149."

Verifying IP Source Tracking

To verify the status of source tracking, such as packet processing and traffic flow information, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **show ip source-track** [*ip-address*] [**summary** | **cache**
3. **show ip source-track export flows**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**show ip source-track** [*ip-address*] [**summary** | **cache** **Example:** `Router# show ip source-track summary`	Displays traffic flow statistics for tracked IP host addresses
Step 3	**show ip source-track export flows** **Example:** `Router# show ip source-track export flows`	Displays the last 10 packet flows that were exported from the line card to the route processor. **Note** This command can be issued only on distributed platforms, such as the GRP and the RSP.

Example

The following example, which is sample output from the **show ip source-track summary** command, shows how to verify that IP source tracking is enabled for one or more hosts:

```
Router# show ip source-track summary
Address          Bytes    Pkts    Bytes/s   Pkts/s
10.0.0.1          119G   1194M    443535      4432
192.168.1.1       119G   1194M    443535      4432
192.168.42.42     119G   1194M    443535      4432
```

The following example, which is sample output from the **show ip source-track summary** command, shows how to verify that no traffic has yet to be received for the destination hosts that are being tracked:

```
Router# show ip source-track summary
Address        Bytes   Pkts   Bytes/s   Pkts/s
10.0.0.1           0      0         0        0
192.168.1.1        0      0         0        0
192.168.42.42      0      0         0        0
```

The following example, which is sample output from the **show ip source-track**command, shows how to verify that IP source tracking is processing packets to the hosts and exporting statistics from the line card or port adapter to the GRP and RSP:

```
Router# show ip source-track
Address         SrcIF    Bytes   Pkts   Bytes/s   Pkts/s
10.0.0.1        PO0/0    119G   1194M    513009     5127
192.168.1.1     PO0/0    119G   1194M    513009     5127
```

192.168.42.42 PO0/0 119G 1194M 513009 5127

Configuration Examples for IP Source Tracker

Configuring IP Source Tracking Example

The following example shows how to configure IP source tracking on all line cards and port adapters in the router. In this example, each line card or port adapter collects traffic flow data to host address 100.10.0.1 for 2 minutes before creating an internal system log entry; packet and flow information recorded in the system log is exported for viewing to the route processor or switch processor every 60 seconds.

```
Router# configure interface
Router(config)# ip source-track 100.10.0.1
Router(config)# ip source-track syslog-interval 2
Router(config)# ip source-track export-interval 60
```

Verifying Source Interface Statistics for All Tracked IP Addresses Example

The following example displays a summary of the traffic flow statistics that are collected on each source interface for tracked host addresses.

```
Router# show ip source-track
Address         SrcIF     Bytes    Pkts     Bytes/s     Pkts/s
10.0.0.1        PO2/0         0       0           0          0
192.168.9.9     PO1/2      131M    511M        1538          6
192.168.9.9     PO2/0      144G   3134M     6619923     143909
```

Verifying a Flow Statistic Summary for All Tracked IP Addresses Example

The following example displays a summary of traffic flow statistics for all hosts that are being tracked; it shows that no traffic has yet been received.

```
Router# show ip source-track summary
Address              Bytes    Pkts     Bytes/s     Pkts/s
10.0.0.1                 0       0           0          0
100.10.1.1           131M    511M        1538          6
192.168.9.9          146G   3178M     6711866     145908
```

Verifying Detailed Flow Statistics Collected by a Line Card Example

The following example displays traffic flow information that is collected on line card 0 for all tracked hosts.

```
Router# exec slot 0 show ip source-track cache
========= Line Card (Slot 0) =======
IP packet size distribution (7169M total packets):
   1-32   64   96  128  160  192  224  256  288  320  352  384  416  448  480
   .000 .000 .000 0.00 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
    512  544  576 1024 1536 2048 2560 3072 3584 4096 4608
   .000 .000 .000 .000 .000 .000 .000 .000 .000 .000 .000
```

```
IP Flow Switching Cache, 278544 bytes
  1 active, 4095 inactive, 13291 added
  198735 ager polls, 0 flow alloc failures
  Active flows timeout in 0 minutes
  Inactive flows timeout in 15 seconds
  last clearing of statistics never
Protocol         Total    Flows   Packets Bytes  Packets Active(Sec) Idle(Sec)
--------         Flows     /Sec     /Flow  /Pkt     /Sec     /Flow     /Flow
SrcIf          SrcIPaddress    DstIf          DstIPaddress    Pr TOS Flgs  Pkts
Port Msk AS                    Port Msk AS    NextHop              B/Pk  Active
PO0/0          101.1.1.0       Null           100.1.1.1       06 00  00      55K
0000 /0  0                     0000 /0  0     0.0.0.0                100    10.1
```

Verifying Flow Statistics Exported from Line Cards and Port Adapters Example

The following example displays packet flow information that is exported from line cards and port adapters to the GRP and the RSP:

```
Router# show ip source-track export flows
SrcIf         SrcIPaddress    DstIf         DstIPaddress    Pr SrcP DstP  Pkts
PO0/0         101.1.1.0       Null          100.1.1.1       06 0000 0000    88K
PO0/0         101.1.1.0       Null          100.1.1.3       06 0000 0000    88K
PO0/0         101.1.1.0       Null          100.1.1.2       06 0000 0000    88K
```

Additional References

The following sections provide references related to IP Source Tracker.

Related Documents

Related Topic	Document Title
ACLs	*Cisco IOS Security Configuration Guide: Securing the Data Plane* , Release 12.4T
Dynamic ACLs	Configuring Lock-and-Key Security (Dynamic Access Lists)
DoS prevention	Configuring TCP Intercept (Preventing Denial-of-Service Attacks)

Standards

Standards	Title
None	--

MIBs

MIBs	MIBs Link
None	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

RFCs	Title
None	--

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for IP Source Tracker

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 12 Feature Information for IP Source Tracker

Feature Name	Releases	Feature Information
IP Source Tracker	12.0(21)S 12.0(22)S 12.0(26)S 12.3(7)T 12.2(25)S	The IP Source Tracker feature allows information to be gathered about the traffic that is flowing to a host that is suspected of being under attack. This feature was introduced in Release 12.0(21)S on the Cisco 12000 series. This feature was implemented in Release 12.0(22)S on the Cisco 7500 series. This feature was implemented in Release 12.0(26)S on the Cisco 12000 series IP Service Engine (ISE) line cards. This feature was integrated into Cisco IOS Release 12.3(7)T. This feature was integrated into Cisco IOS Release 12.2(25)S. The following commands were introduced or modified: **ip source-track, ip source-track address-limit, ip source-track export-interval, ip source-track syslog-interval, show ip source-track, show ip source-track export flows.**

Cisco IOS Resilient Configuration

The Cisco IOS Resilient Configuration feature enables a router to secure and maintain a working copy of the running image and configuration so that those files can withstand malicious attempts to erase the contents of persistent storage (NVRAM and flash).

Finding Feature Information

Your software release may not support all the features documented in this module. For the latest feature information and caveats, see the release notes for your platform and software release. To find information about the features documented in this module, and to see a list of the releases in which each feature is supported, see the Feature Information Table at the end of this document.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Restrictions for Cisco IOS Resilient Configuration

- This feature is available only on platforms that support a Personal Computer Memory Card International Association (PCMCIA) Advanced Technology Attachment (ATA) disk. There must be enough space on the storage device to accommodate at least one Cisco IOS image (two for upgrades) and a copy of the running configuration. IOS Files System (IFS) support for secure file systems is also needed by the software.
- It may be possible to force removal of secured files using an older version of Cisco IOS software that does not contain file system support for hidden files.
- This feature can be disabled only by using a console connection to the router. With the exception of the upgrade scenario, feature activation does not require console access.
- You cannot secure a bootset with an image loaded from the network. The running image must be loaded from persistent storage to be secured as primary.
- Secured files will not appear on the output of a **dir** command issued from an executive shell because the IFS prevents secure files in a directory from being listed. ROM monitor (ROMMON) mode does not have any such restriction and can be used to list and boot secured files. The running image and

running configuration archives will not be visible in the Cisco IOS **dir** command output. Instead, use the **show secure bootset** command to verify archive existence.

Information About Cisco IOS Resilient Configuration

Feature Design of Cisco IOS Resilient Configuration

A great challenge of network operators is the total downtime experienced after a router has been compromised and its operating software and configuration data erased from its persistent storage. The operator must retrieve an archived copy (if any) of the configuration and a working image to restore the router. Recovery must then be performed for each affected router, adding to the total network downtime.

The Cisco IOS Resilient Configuration feature is intended to speed up the recovery process. The feature maintains a secure working copy of the router image and the startup configuration at all times. These secure files cannot be removed by the user. This set of image and router running configuration is referred to as the primary bootset.

The following factors were considered in the design of Cisco IOS Resilient Configuration:

- The configuration file in the primary bootset is a copy of the running configuration that was in the router when the feature was first enabled.
- The feature secures the smallest working set of files to preserve persistent storage space. No extra space is required to secure the primary Cisco IOS image file.
- The feature automatically detects image or configuration version mismatch.
- Only local storage is used for securing files, eliminating scalability maintenance challenges from storing multiple images and configurations on TFTP servers.
- The feature can be disabled only through a console session.

How to Use Cisco IOS Resilient Configuration

Archiving a Router Configuration

This task describes how to save a primary bootset to a secure archive in persistent storage.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **secure boot-image**
4. **secure boot-config**
5. **end**
6. **show secure bootset**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**secure boot-image** **Example:** `Router(config)# secure boot-image`	Enables Cisco IOS image resilience.
Step 4	**secure boot-config** **Example:** `Router(config)# secure boot-config`	Stores a secure copy of the primary bootset in persistent storage.
Step 5	**end** **Example:** `Router(config)# end`	Exits to privileged EXEC mode.
Step 6	**show secure bootset** **Example:** `Router# show secure bootset`	(Optional) Displays the status of configuration resilience and the primary bootset filename.

Example

The following example displays sample output from the **show secure bootset** command:

```
Router# show secure bootset
IOS resilience router id JMX0704L5GH
IOS image resilience version 12.3 activated at 08:16:51 UTC Sun Jun 16 2002
Secure archive slot0:c3745-js2-mz type is image (elf) []
  file size is 25469248 bytes, run size is 25634900 bytes
  Runnable image, entry point 0x80008000, run from ram
IOS configuration resilience version 12.3 activated at 08:17:02 UTC Sun Jun 16 2002
```

```
Secure archive slot0:.runcfg-20020616-081702.ar type is config
configuration archive size 1059 bytes
```

Restoring an Archived Router Configuration

This task describes how to restore a primary bootset from a secure archive after the router has been tampered with (by an NVRAM erase or a disk format).

Note To restore an archived primary bootset, Cisco IOS image resilience must have been enabled and a primary bootset previously archived in persistent storage.

SUMMARY STEPS

1. **reload**
2. **dir** [*filesystem* **:**]
3. **boot** [*partition-number* **:**][*filename*]
4. **no**
5. **enable**
6. **configure terminal**
7. **secure boot-config** [**restore** *filename*
8. **end**
9. **copy** *filename* **running-config**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**reload** **Example:** `Router# reload`	(Optional) Enters ROM monitor mode, if necessary.
Step 2	**dir** [*filesystem* **:**] **Example:** `rommon 1 > dir slot0:`	Lists the contents of the device that contains the secure bootset file. • The device name can be found in the output of the **show secure bootset** command.
Step 3	**boot** [*partition-number* **:**][*filename*] **Example:** `rommon 2 > boot slot0:c3745-js2-mz`	Boots up the router using the secure bootset image.

	Command or Action	Purpose

Step 4	**no**
	
	Example:
	`--- System Configuration Dialog ---`
	
	Example:
	`Would you like to enter the initial configuration dialog? [yes/no]: no`
		(Optional) Declines to enter an interactive configuration session in setup mode.
		• If the NVRAM was erased, the router enters setup mode and prompts the user to initiate an interactive configuration session.

Step 5	**enable** **Example:** `Router> enable`	Enables privileged EXEC mode. • Enter your password if prompted.
Step 6	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 7	**secure boot-config** [**restore** *filename* **Example:** `Router(config)# secure boot-config restore slot0:rescue-cfg`	Restores the secure configuration to the supplied filename.
Step 8	**end** **Example:** `Router(config)# end`	Exits to privileged EXEC mode.
Step 9	**copy** *filename* **running-config** **Example:** `Router# copy slot0:rescue-cfg running-config`	Copies the restored configuration to the running configuration.

Additional References

The following sections provide references related to Cisco IOS Resilient Configuration.

Related Documents

Related Topic	Document Title
Additional commands: complete command syntax, command mode, defaults, usage guidelines, and examples	*The Cisco IOS Configuration Fundamentals and Network Management Command Reference , Release 12.4T*

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
No new or modified MIBs are supported by this feature, and support for existing MIBs has not been modified by this feature.	To locate and download MIBs for selected platforms, Cisco IOS releases, and feature sets, use Cisco MIB Locator found at the following URL: http://www.cisco.com/go/mibs

RFCs

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

Technical Assistance

Description	Link
The Cisco Support website provides extensive online resources, including documentation and tools for troubleshooting and resolving technical issues with Cisco products and technologies. To receive security and technical information about your products, you can subscribe to various services, such as the Product Alert Tool (accessed from Field Notices), the Cisco Technical Services Newsletter, and Really Simple Syndication (RSS) Feeds. Access to most tools on the Cisco Support website requires a Cisco.com user ID and password.	http://www.cisco.com/techsupport

Feature Information for Cisco IOS Resilient Configuration

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 13 Feature Information for Cisco IOS Resilient Configuration

Feature Name	Releases	Feature Information
Cisco IOS Resilient Configuration	12.3(8)T	The Cisco IOS Resilient Configuration feature enables a router to secure and maintain a working copy of the running image and configuration so that those files can withstand malicious attempts to erase the contents of persistent storage (NVRAM and flash). In 12.3(8)T this feature was introduced. The following commands were introduced or modified: **secure boot-config, secure boot-image, show secure bootset.**